

PROJECT MANUAL

Fayetteville Regional Airport

A.I.P No. 3-37-0021-046-2019

AIRLINE TERMINAL IMPROVEMENTS – Part 2

Owner:

THE CITY OF FAYETTEVILLE

Architect of Record:

***GORDON JOHNSON ARCHITECTURE
FAYETTEVILLE, NC***

Civil Engineer:

***CRAWFORD DESIGN COMPANY
FAYETTEVILLE, NC***

Structural Engineer:

***FLEMING & ASSOCIATES
FAYETTEVILLE, NC***

Mechanical / Electrical / Fire Protection Engineer:

***RMF ENGINEERING
CHARLOTTE, NC***

Volume Three of Three

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- F – Required Forms (Post Award)
- G – CSPP
- * – Subsurface & Environmental Reports are referenced in Project Special Provisions

END OF DOCUMENT

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SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
 - 3. Sleeves and sleeve seals for cables.

1.3 DEFINITIONS

- A. NRTL: Nationally Recognized Testing Laboratory.
- B. VFC: Variable-frequency controller.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.6 COORDINATION

- A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

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PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. 600-Volt Building Wire Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. General Cable Corporation.
 - 2. Southwire Company.
 - 3. Encore.
 - 4. Okanite
 - 5. Tyco
- B. Special Systems Wire Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Belden Cable
 - 2. Tyco Thermal Controls (fire alarm cable)
- C. Copper Conductors: Comply with NEMA WC 70.
- D. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN
- E. Conductor sizes: Minimum conductor size shall be #12 for feeder and branch circuits. Maximum conductor size shall be 500 kcmil. per 2008 SCO Electrical Guidelines and Policies.

2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Hubbell Power Systems, Inc.
 - 3. O-Z/Gedney; EGS Electrical Group LLC.
 - 4. 3M; Electrical Products Division.
 - 5. Tyco Electronics Corp.
 - 6. Ilsco
 - 7. Thomas-Betts
 - 8. Ideal
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 CONDUCTOR AND CABLE LUBRICANT

- A. Manufacturers:

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1. American Polywater Corporation
2. Ideal Industries
3. 3M Company

- B. The cable pulling lubricant GEL shall be compatible with all cable jackets. The lubricant GEL shall be UL or CSA listed and water soluble, non-toxic and environmentally safe.

2.4 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems, Inc.
 2. Calpico, Inc.
 3. Metraflex Co.
 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 2. Pressure Plates: Stainless steel. Include two for each sealing element.
 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND WIRING METHODS

- A. Service Entrance: Type THWN-2, 90°C Wet rating single conductors in raceway.
- B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway.

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- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- E. Feeders Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway.
- F. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway.
- G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- I. Branch Circuits Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway.
- J. Cord Drops and Portable Appliance Connections: Type SOJ, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- K. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- L. Class 2 Control Circuits: Type THHN-THWN, in raceway.
- M. Fire Alarm Signaling and Notification Circuits: Refer to specifications for fire alarm system.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Unless specifically noted on the drawings, all wiring shall be installed in a raceway.
- B. Surface mount devices only where specifically shown on the plans. Obtain written permission from the Engineer for all other surface mounting locations that are not specifically shown on the plans.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Identify and color-code conductors according to Division 26 Section "Identification for Electrical Systems."

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- G. Where the conductor length from the panel to the first outlet on a 277 volt circuit exceeds 125 feet, the branch circuit conductors from the panel to the first outlet shall not be smaller than #10 AWG.
- H. Where the conductor length from the panel to the first outlet on a 120 volt circuit exceeds 50 feet, the branch circuit conductors from the panel to the first outlet shall not be smaller than #10 AWG.
- I. Install no more than 3 phase wires in any feeder or branch circuit conduit.
- J. Install a dedicated neutral conductor for each single phase 277-volt or 120-volt circuit.

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.
- D. Joints in solid conductors shall be spliced using Ideal “wirenuts”, 3M Company “Scotchlock” in junction boxes, outlet boxes and lighting fixtures.
 - 1. “Sta-kon” or other permanent type crimp connectors shall not be used for branch circuit connections.
- E. Joints in stranded conductors shall be spliced by approved mechanical connectors and electrical vinyl tape.
 - 1. Solderless mechanical connectors for splices and taps, provided with U/L-approved insulating covers, may be used instead of mechanical connectors plus tape.
- F. Conductors, in all cases, shall be continuous from outlet to outlet and no splicing shall be made except within outlet or junction boxes, troughs and gutters.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

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- D. Rectangular Sleeve Minimum Metal Thickness:
 - 1. For sleeve rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
 - 2. For sleeve rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both wall surfaces.
- G. Extend sleeves installed in floors 2 inches above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and cable unless sleeve seal is to be installed unless seismic criteria require different clearance.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and conduit, using joint sealant appropriate for size, depth, and location of joint.
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop.
- L. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.
- M. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch annular clear space between conduit and sleeve for installing mechanical sleeve seals.
- N. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between conduit and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground exterior-wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

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3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. Prior to energizing feeders, sub-feeders and service conductor, cables shall be tested for electrical continuity and short circuits. A copy of these tests shall be sent to the engineer of record and the owner.
 - 3. All current carrying phase conductors and neutrals shall be tested as installed, and before connections are made, for insulation resistance and accidental grounds. This shall be done with a DC megger. The procedures listed below shall be followed:
 - a. Three-phase conductor installations:
 - 1) For each phase conductor, ground all other conductors, shields and metal conduit as applicable.
 - 2) Apply test voltage between tested conductor and ground for sixty seconds. Repeat this procedure for other phase conductors.
 - 3) Minimum readings shall be one million (1,000,000) or more ohms for #6 AWG wire and smaller, 250,000 ohms or more for #4 AWG wire or larger, between conductors and between conductor and ground.
 - b. Single-phase conductor installations:
 - 1) Ground the neutral conductor, neutral shield and metal conduit as applicable.
 - 2) Apply test voltage between phase conductor and ground for sixty seconds.
 - 3) Minimum readings shall be one million (1,000,000) or more ohms for #6 AWG wire and smaller, 250,000 ohms or more for #4 AWG wire or larger, between the phase conductor and ground.
 - c. After all fixtures, devices and equipment are installed and all connections completed to each panel, the contractor shall disconnect the neutral feeder conductor from the neutral bar and take a megger reading between the neutral bar and the grounded enclosure.
 - 1) Whenever this reading is less than 250,000 ohms, the contractor shall disconnect the branch circuit neutral wires from this neutral bar. The contractor shall then test each one separately to the panel and until the low readings are found.

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- 2) The contractor shall correct troubles, reconnect and retest until at least 250,000 ohms from the neutral bar to the grounded panel can be achieved with only the neutral feeder disconnected.
 - d. At final inspection, the contractor shall furnish a megger and show the engineers that the panels comply with the above requirements.
 - 1) The contractor shall also furnish a hook-on type ammeter and voltmeter to take current and voltage readings as directed by the representatives.
 4. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Test Reports: Prepare a written report to record the following and complete the form at the end of this section:
 1. Test procedures used.
 2. Test results that comply with requirements.
 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D. Remove and replace malfunctioning units and retest as specified above.

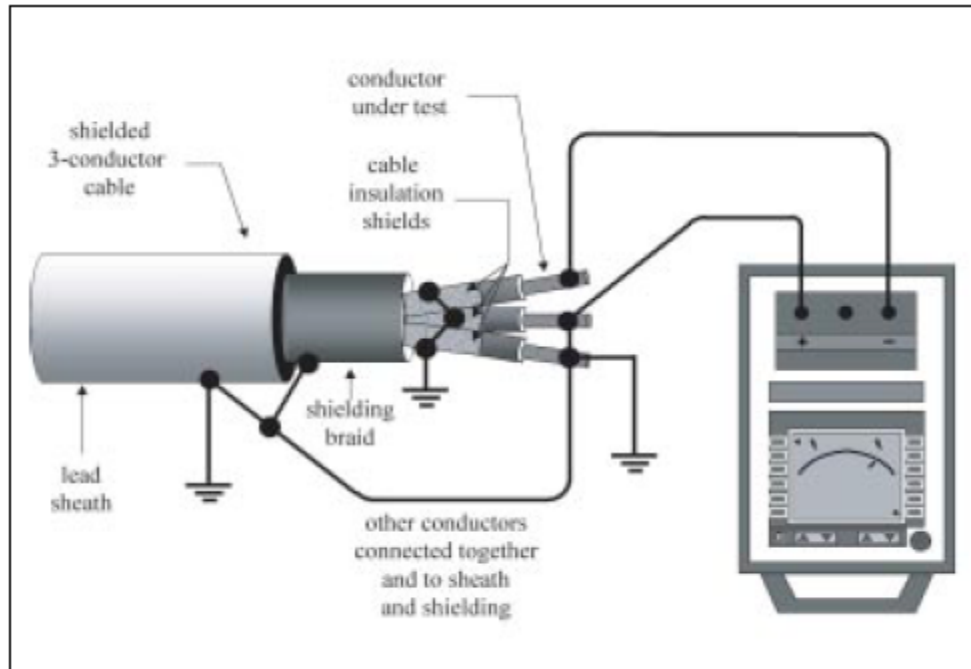
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Figure1: Example conductor-megger setup.



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REPORT OF CABLE MEGGER TESTING

TESTING COMPANY: _____

DATE OF TEST: _____

CLIENT/LOCATION: _____

MANUFACTURER AND TYPE OF CABLE: _____

VOLTAGE RATING OF CABLES: _____

TEST EQUIPMENT MFG./MODEL: _____

TEST VOLTAGE (IN VDC): _____

TEST RESULTS (IN MEGA-OHMS):

PANEL/CABLES TESTED	CABLES A-G	CABLES B-G	CABLES C-G	PANEL NEUTRAL TO ENCLOSURE

WEATHER CONDITIONS:

COMMENTS:

TESTER'S SIGNATURE: _____

CONTRACTOR'S LICENSE #: _____

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END OF SECTION 260519

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SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes methods and materials for grounding systems.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
 - 1. Test wells.
 - 2. Ground rods.
 - 3. Grounding arrangements and connections for separately derived systems.
 - 4. Grounding points for chilled water piping, domestic water piping, fire protection piping and natural gas piping.
- C. Qualification Data: For Exothermic-welding personnel.
- D. Field quality-control test reports. Submit written test reports to include the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- E. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:
 - 1. Instructions for periodic testing and inspection of grounding features at test wells based on NETA MTS.
 - a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
 - b. Include recommended testing intervals.

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1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467 for grounding and bonding materials and equipment.
- C. Personnel performing Exothermic-welding must be certified by the manufacturer whose equipment will be utilized on this project and must provide a certificate indicating the manufacturer who provided the training and the date of the training.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Grounding Conductors, Cables, Connectors, and Rods:
 - a. Apache Grounding/Erico Inc.
 - b. Boggs, Inc.
 - c. Chance/Hubbell.
 - d. Copperweld Corp.
 - e. Dossert Corp.
 - f. Encore
 - g. Erico Inc.; Electrical Products Group.
 - h. Framatome Connectors/Burndy Electrical.
 - i. Galvan Industries, Inc.
 - j. Harger Lightning Protection, Inc.
 - k. Hastings Fiber Glass Products, Inc.
 - l. Heary Brothers Lightning Protection Co.
 - m. Ideal Industries, Inc.
 - n. ILSCO.
 - o. Kearney/Cooper Power Systems.
 - p. Korns: C. C. Korns Co.; Division of Robroy Industries.
 - q. Lightning Master Corp.
 - r. Lyncole XIT Grounding.
 - s. O-Z/Gedney Co.; a business of the EGS Electrical Group.
 - t. Raco, Inc.; Division of Hubbell.
 - u. Robbins Lightning, Inc.
 - v. Salisbury: W. H. Salisbury & Co.
 - w. Southwire Company
 - x. Superior Grounding Systems, Inc.
 - y. Thomas & Betts, Electrical.

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2.2 CONDUCTORS

A. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

B. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 8 inches 24-inches length, unless otherwise indicated; with insulators.

2.3 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

1. Provide correct mold for type and size of conductor and termination type.

2.4 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad, 3/4 inch in diameter and 10-feet long and shall be copper-clad steel construction.

1. Inspection Wells: Provide inspection well for each grounding electrode installed as detailed on the drawings.

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PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install a continuous bare copper conductor, No. 2/0 AWG minimum unless show otherwise on the drawings.
 - 1. Bury at least 24 inches below grade.
 - 2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- C. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus on insulated spacers 1 inch, minimum, from wall 6 inches above finished floor, unless otherwise indicated.
 - 2. Provide a main ground bus for the service as shown on the drawings: 3/4-inch minimum thick x 24-inch minimum length. Increase size if necessary to accommodate the required exothermic terminations.
 - 3. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.
- D. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Exothermic-welded connectors except and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Exothermic weld.
 - 4. Connections to Structural Steel: Exothermic-welded connectors.
 - 5. Connections to ground bus: Exothermic-welded

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

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- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install four ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation. Refer to details on the drawings.

3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits raceways and cables.
- B. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system ground bus to each service location, terminal cabinet, wiring closet, and central equipment location.
 - 1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
 - 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- C. **Metal Poles Supporting Outdoor Lighting Fixtures:** Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.4 INSTALLATION

- A. Grounding electrode conductors #4 AWG and larger shall be installed in a raceway system.
- B. Wherever grounding electrode conductors are connected/bonded to wall mounted grounding busses, all conductors shall be identified with black phenolic identification labels having 1/4" high white letters indicating the equipment where the grounding electrode conductor originates from. Labels shall be wire-tied to the grounding electrode conductors at the point where the conductor is connected/bonded to the bus. The following areas apply:
 - 1. Main Electric room grounding bus.
 - 2. Satellite electric rooms grounding busses.
 - 3. Emergency electric rooms grounding busses.
 - 4. Telecommunications rooms grounding busses.

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- C. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- D. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
 - 2. Provide test/inspection wells for each ground rod installed. Refer to drawings for details.
 - 3. For each electrical service on the project install at three rods spaced at least 20-ft. from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor and to the main ground bar. Refer to drawings for details.
 - 4. Use exothermic welded connections for conductor connections to ground rods except at Test Wells where bolted connection shall be utilized.
- E. Test Wells: Ground rod driven through drilled hole in bottom of Test/Inspection well as indicated on the drawings and shall be at least 12 inches deep, with cover.
 - 1. Test Wells: Install test wells as indicated. Set top of test well flush with finished grade, surface or floor.
- F. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
 - 4. Bond cable trays and/or cable ladder sections at all section joints, tees, radius, waterfalls and 4-way intersections.
- G. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Connect within 5'-0" of where pipe enters building. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

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3. Chilled Water, Hot Water and Steam Piping: Where chilled water piping and/or hot water piping and/or steam piping enter the building install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to metal pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Connect within 5'-0" of where pipe enters building. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 4. Gas Piping: Where gas is utilized for connected electrical equipment within the building having the potential of energizing the gas piping due to a failure of insulation of the connected electrical equipment the gas piping shall be bonded to the grounding system. The bonding shall occur between the gas shutoff valve and where the gas piping enters the building or in the case of underground piping entering the building below grade the gas piping shall be bonded within 5-ft of where it enters the building.
- H. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

3.5 "UFER" GROUNDING SYSTEM

- A. Provide one 20-ft. long, 2/0 AWG size copper grounding conductor and exothermically connect to the steel column nearest the main electrical room and exothermically connect to the horizontal foundation re-bar located nearest the bottom of the foundation footing as detailed on the drawings. The grounding conductor shall be bonded as shown on the drawing details ("Supplemental Ground Electrode Detail").
- B. Each perimeter steel column shall be exothermically welded to the horizontal re-bar located nearest the bottom of the foundation footing.

3.6 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
 2. Make connections with clean, bare metal at points of contact.
 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

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- B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- D. Non-contact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- E. Connections at Test Wells: Use bolted connections between conductors and ground rods.
- F. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.
- G. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- H. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.7 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 - 3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and

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their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

- B. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
 2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
 5. Substations and Pad-Mounted Equipment: 5 ohms.
 6. Manhole Grounds: 10 ohms.
- C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

3.8 GRADING AND PLANTING

- A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION 260526

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SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.
- B. Related Sections include the following:
 - 1. Division 26 Section "Vibration and Seismic Controls For Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

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- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
 - 2. Nonmetallic slotted support systems.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze hangers. Include Product Data for components.
 - 2. Steel slotted channel systems. Include Product Data for components.
 - 3. Nonmetallic slotted channel systems. Include Product Data for components.
 - 4. Equipment supports.
- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.
- C. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.
- D. Coordinate electrical service connections to components furnished by utility companies.
 - 1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
 - 2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.

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- E. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces.
- F. Coordinate installation locations of electrical switchboards, panelboards, disconnect switches, circuit breaker enclosures, control enclosures, motor control centers, raceways, lighting fixtures, junction and pull boxes with all mechanical, plumbing and fire protection trades prior to installation of equipment and systems.
 - 1. Provide dimensioned layout drawing(s) of the proposed locations of all switchboards, panelboards, disconnect switches, circuit breaker enclosures, control enclosures, motor control centers, raceways, lighting fixtures, junction/pull boxes larger than 6" x 6" x 4" and conduit routing of all conduits over 2" diameter. The scaled drawing(s) shall indicate actual dimensions of proposed equipment, front elevations, and access door swings. Minimum scale factor shall be 1/8" = 1'-0".
 - 2. Coordinate the installation drawings with all other trades to assure proper and conflict free installation of electrical systems and components.
 - 3. Submit drawings to the Engineer for review prior to commencing the installation of any electrical equipment.
 - 4. Provide code required access and clearances to all equipment and sufficient access for maintenance.
- G. Provide dimensioned layout drawing(s) of main electrical room, generator room, and electrical closet prior to commencing work in that room. The scaled drawing(s) shall indicate actual dimensions of proposed equipment, front elevations, and access door swings. Minimum scale factor shall be 1/4" = 1'-0".
 - 1. Coordinate the installation drawings with all other trades to assure proper and conflict free installation of electrical systems and components.
 - 2. Submit drawings to the Engineer for review prior to commencing the installation of any electrical equipment.
- H. All individual motor starters for mechanical equipment (fans, pumps, etc.) shall be furnished and installed under Division 23 unless indicated as part of a motor control center.
- I. Under Division 26, power wiring shall be provided up to a termination point consisting of a junction box, trough, starter or disconnect switch. Under Division 26 line side terminations shall be provided. Wiring from the termination point to the mechanical equipment, including final connections, shall be provided under Division 22 or 23.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

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1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 4. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened Portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

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2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 1. Secure raceways to these supports with two-bolt conduit clamps.

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3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 - 6. To Light Steel: Sheet metal screws.
 - 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
 - 8. Conduits installed in the interior or exterior building walls shall be spaced off the wall surface a minimum of ¼-inch using “clamp-backs” or strut.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

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- B. Use **3000-psi**, 28-day compressive-strength concrete.
- C. Anchor equipment to concrete base.
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

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SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
 - 1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. FMC: Flexible metal conduit.
- D. IMC: Intermediate metal conduit.
- E. LFMC: Liquidtight flexible metal conduit.
- F. LFNC: Liquidtight flexible nonmetallic conduit.
- G. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Custom enclosures and cabinets.

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2. For handholes and boxes for underground wiring, including the following:
 - a. Duct entry provisions, including locations and duct sizes.
 - b. Frame and cover design.
 - c. Grounding details.
 - d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
 - e. Joint details.

- C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members in the paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

- D. Manufacturer Seismic Qualification Certification: Submit certification that enclosures and cabinets and their mounting provisions, including those for internal components, will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the cabinet or enclosure will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will retain its enclosure characteristics, including its interior accessibility, after the seismic event."
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- E. Qualification Data: For professional engineer and testing agency.

- F. Source quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

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PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - 3. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 4. Electri-Flex Co.
 - 5. Manhattan/CDT/Cole-Flex.
 - 6. Maverick Tube Corporation.
 - 7. O-Z Gedney; a unit of General Signal.
 - 8. Wheatland Tube Company.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. EMT: ANSI C80.3.
- D. FMC: Zinc-coated steel.
- E. LFMC: Flexible steel conduit with PVC jacket.
- F. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 - 2. Fittings for EMT: Steel compression type.
- G. Joint Compound for Rigid Steel Conduit: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 3. Aruco Corporation.
 - 4. CANTEX Inc.
 - 5. CertainTeed Corp.; Pipe & Plastics Group.
 - 6. Condux International, Inc.
 - 7. ElecSYS, Inc.

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8. Electri-Flex Co.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT/Cole-Flex.
11. RACO; a Hubbell Company.
12. Thomas & Betts Corporation.

- B. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.
- C. Fittings for RNC: NEMA TC 3; match to conduit type and material.

2.3 OPTICAL FIBER/COMMUNICATIONS CABLE RACEWAY AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Arcco Corporation.
 2. Endot Industries Inc.
 3. IPEX Inc.
 4. Lamson & Sessions; Carlon Electrical Products.
- B. Description: Comply with UL 2024; flexible type, approved for plenum installation.

2.4 METAL WIREWAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper B-Line, Inc.
 2. Hoffman.
 3. Square D; Schneider Electric.
- B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1 for indoor applications or 3R for outdoor applications, unless otherwise indicated.
- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Screw-cover type.
- E. Finish: Manufacturer's standard enamel finish.

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2.5 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application..
- B. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MonoSystems
 - b. Hubbell Incorporated; Wiring Device-Kellems Division
 - c. Wiremold Company (The); Electrical Sales Division
- C. Tele-Power Poles:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MonoSystems, Inc.
 - b. Panduit Corp.
 - c. Wiremold / Legrand.
 - 2. Material: Galvanized steel with baked-enamel finish.
 - 3. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 - 2. EGS/Appleton Electric.
 - 3. Erickson Electrical Equipment Company.
 - 4. Hoffman.
 - 5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
 - 6. O-Z/Gedney; a unit of General Signal.
 - 7. RACO; a Hubbell Company.
 - 8. Scott Fetzer Co.; Adalet Division.
 - 9. Spring City Electrical Manufacturing Company.
 - 10. Thomas & Betts Corporation.
 - 11. Walker Systems, Inc.; Wiremold Company (The).
 - 12. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
 - 13. Highline Products.

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14. FSR for Audio/Visual system applications.
- B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy or aluminum, Type FD, with gasketed cover.
- D. Wall outlet boxes.
 1. For surface or recessed mounted receptacle, data and/or telephone boxes provide 4" square by 2 1/8" deep box unless noted otherwise on the plans.
 - a. Surface mounted cast boxes for mechanical and electrical rooms.
 - b. Recessed boxes in finished spaces.
- E. Floor Boxes: Floor boxes for slab on grade:
 1. Power and Telecommunications Floor Boxes: PVC, round:
 - a. Minimum height with adjustable base screws set in lowest position shall be 2.6-inches.
 - b. Floor opening shall be 4.19 inches diameter.
 - c. Provide one (1) duplex, 125V, 15-ampere receptacle.
 - d. Flush covers, UL listed for intended installation.
 - e. Solid brass carpet flanges.
 - f. Brass device cover and flaps.
 - g. Note: Where quadplex outlets (comprised of 2-duplex receptacles) are shown on the plans then two complete floor box assemblies will be required per outlet shown.
- F. Floor Boxes: Floor boxes for elevated floors above grade where the fire rating of the floor can be maintained with the floor box installed:
 1. Power Floor Boxes: Cast iron metal, fully adjustable, round:
 - a. Minimum height with adjustable base screws set in lowest position shall be 2.6-inches.
 - b. Floor opening shall be 4.19 inches diameter.
 - c. Provide one (1) duplex, 125V, 15-ampere receptacle.
 - d. Flush covers, UL listed for intended installation.
 - e. Solid brass carpet flanges.
 - f. Brass device cover and flaps.
 - g. Note: Where quadplex outlets (comprised of 2-duplex receptacles) are shown on the plans then two complete floor box assemblies will be required per outlet shown.
 2. Telecommunications Floor Boxes: Cast iron metal, fully adjustable, round:
 - a. Minimum height with adjustable base screws set in lowest position shall be 2.6-inches.

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- b. Floor opening shall be 4.19 inches diameter.
 - c. Provide 2-port duplex frame suitable for keystone type modular jacks utilizing category 5e or category 6 wiring configuration.
 - d. Flush covers, UL listed for intended installation.
 - e. Solid brass carpet flanges.
 - f. Brass device cover and flaps.
 - g. Note: Where outlets shown on the drawings require 3 or more data cables per floor box outlet then two complete floor box assemblies shall be required per outlet shown.
- G. Floor boxes for elevated floors above grade where the fire rating of the floor cannot be maintained using traditional in-slab installed boxes:
 - 1. Power and/or Telecommunications Floor Fire-rated poke-through (1-4 hours) to match the fire rating of the floor.
 - a. Three-inch diameter cored hole requirement.
 - b. Provide two (2) duplex, 125V, 15-ampere receptacles.
 - c. Provide 4-ports suitable for keystone type modular jacks utilizing category 5e or category 6 wiring configuration.
 - d. Flush covers, UL listed.
- H. Audio/Visual floor boxes:
 - 1. Refer to power, special systems, and AV drawings for information regarding AV floor boxes.
 - 2. Coordinate with Architect/Owner for exact location of boxes prior to rough in. Coordinate location with furniture when applicable.
- I. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- J. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1 cast aluminum with gasketed cover.
- K. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Plastic.
- L. Cabinets:
 - 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.

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2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. Description: Comply with SCTE 77.
 - 1. Color of Frame and Cover: Green.
 - 2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
 - 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
 - 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - 5. Cover Legend: Molded lettering, "ELECTRIC." or "TELEPHONE."
 - 6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 - 7. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. CDR Systems Corporation.
 - d. NewBasis.

2.8 SLEEVES FOR RACEWAYS

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.
- C. Coordinate sleeve selection and application with selection and application of firestopping.

2.9 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex Co.
 - 4. Pipeline Seal and Insulator, Inc.

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- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 2. Pressure Plates: Stainless steel. Include two for each sealing element.
 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.10 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
1. Tests of materials shall be performed by a independent testing agency.
 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
1. Exposed Conduit: Rigid steel conduit.
 2. Concealed Conduit, Aboveground: Rigid steel conduit or IMC.
 3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
 6. Application of Handholes and Boxes for Underground Wiring:
 - a. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
 - b. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer-concrete units SCTE 77, Tier 8 structural load rating.
 - c. Handholes and Pull Boxes Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf vertical loading.
- B. Comply with the following indoor applications, unless otherwise indicated:

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1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:
 - a. Loading dock areas from the floor to a distance of 10-ft above the floor.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units from the floor to a distance of 10-ft. above the floor.
 - c. Mechanical and electrical rooms from the floor to a distance of 10-ft. above the floor.
 3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 5. Damp or Wet Locations: Rigid steel conduit or IMC.
 6. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: EMT.
 7. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: EMT.
 8. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: EMT.
 9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid Steel Conduit:
 - a. Use threaded rigid steel conduit fittings, unless otherwise indicated.
 2. EMT terminations and couplings:
 - a. Steel-plated hexagonal compression connectors.
 - b. Pot metal, setscrew or indented type fittings are prohibited.

3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

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- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- H. Install raceways above ceilings tight to the floor structure above.
 - 1. Group feeder and branch circuit raceways together using common trapeze supports wherever feasible.
- I. Embedded raceways within concrete slabs shall not be permitted due to the potential practice of 'blind' drilling floor and elevated slabs for the purpose of installing fastening devices.
 - 1. Raceways shall be routed under slab on grade or suspended to the bottom of the elevated slab supporting structure.
- J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- K. Raceway Terminations at all conduit ends entering junction boxes, panel enclosures, switchboards and control enclosures:
 - 1. Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- L. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
- M. Raceways for Optical Fiber and Communications Cable: Install metallic, rigid and flexible raceways as follows:
 - 1. 3/4-Inch Trade Size and Smaller: Install raceways in maximum lengths of 50 feet.
 - 2. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.
 - 3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements.
 - a. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- N. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

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1. Seal raceways where they pass from warm to cold locations to prevent condensation from forming on the inside or exterior surfaces of the raceways:
 - a. Boundaries of refrigerated spaces.
 - b. From exterior non-conditioned spaces to conditioned spaces.
 2. Where otherwise required by NFPA 70.
- O. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet.
1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
 2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change.
 3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.
- P. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semi-recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
 2. Use LFMC in damp or wet locations not subject to severe physical damage.
- Q. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
- R. Junction and pull box minimum size:
1. Recessed locations.
 - a. 4" square x 2 1/8" deep.
 - b. Single gang plaster/mud ring.
 2. Accessible locations.
 - a. 4" square x 2 1/8" deep.

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- b. For pull boxes, larger sizes may be required to meet the NEC requirements for number of conduits and orientation of conduits to the pull box.
- S. Device box minimum size:
 - 1. Single receptacle or single wall switch.
 - a. 4" square x 2 1/8" deep with single gang plaster/mud ring.
 - 2. Multiple receptacles or wall switches (two devices or switches).
 - a. 4" square x 2 1/8" deep with double device plaster/mud ring.
 - 3. Multiple receptacles or wall switches (more than two devices or switches).
 - a. Gangable boxes x 2 1/8" deep with appropriately sized plaster/mud ring.
- T. Set metal floor boxes level and flush with finished floor surface.
- U. For floor boxes installed in slab-on grade concrete provide concrete 'pour-pans' made specifically for the floor boxes being installed.
 - 1. Install under the floor box.
- V. For floor boxes installed in fire rated elevated concrete slabs provide UL fire rated assembly and/or product to the bottom of the floor box where the floor penetration occurs to maintain the fire rating of the floor per the structural design.
- W. All enclosures containing electrical devices shall be UL or third party labeled as an assembly and shall display the appropriate label on the enclosure. This shall include HVAC control enclosures whether manufactured for a specific purpose or fabricated in the field from UL or third party listed materials and/or electrical devices. The electrical devices shall include, but are not be limited to, the following:
 - 1. Control relays
 - 2. Control transformers
 - 3. Fuses
 - 4. Disconnect switches
 - 5. Motor starting equipment
 - 6. Contactors
 - 7. Terminal/barrier strips

3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
 - 1. Excavate trench bottom to provide firm and uniform support for conduit.
 - 2. Install backfill.

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3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction.
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
 - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes and boxes with bottom below the frost line, below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

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- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
 - 1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
 - 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both surfaces of walls.
- G. Extend sleeves installed in floors 2 inches above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed or unless seismic criteria require different clearance.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint.
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials.
- L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
- M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground, exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

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3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.8 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

END OF SECTION 260533

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SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 260533 - Raceways and Boxes for Electrical Systems.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks.
 - 2. Handholes and boxes.
 - 3. Manholes.

1.3 DEFINITION

- A. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Duct-bank materials, including separators and miscellaneous components.
 - 2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
 - 3. Accessories for manholes, handholes, boxes, and other utility structures.
 - 4. Warning tape.
- B. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:
 - 1. Duct entry provisions, including locations and duct sizes.
 - 2. Reinforcement details.
 - 3. Frame and cover design and manhole frame support rings.
 - 4. Ladder details.
 - 5. Grounding details.
 - 6. Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.

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7. Joint details.

- C. Shop Drawings for Factory-Fabricated Handholes and Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:
 - 1. Duct entry provisions, including locations and duct sizes.
 - 2. Cover design.
 - 3. Grounding details.
 - 4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
- D. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.
 - 1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
 - 2. Drawings shall be signed and sealed by a qualified professional engineer.
- E. Product Certificates: For concrete and steel used in precast concrete manholes and handholes, as required by ASTM C 858.
- F. Qualification Data: For professional engineer and testing agency.
- G. Source quality-control test reports.
- H. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Comply with ANSI C2.
- C. Electrical Components, Devices, and Accessories (Including Ducts for Communications and Telephone Service): Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.
- B. Store precast concrete and other factory-fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.
- C. Lift and support precast concrete units only at designated lifting or supporting points.

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1.7 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Architect no fewer than two days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Architect's written permission.

1.8 COORDINATION

- A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.
- B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Furnish cable-support stanchions, arms, insulators, and associated fasteners in quantities equal to 5 percent of quantity of each item installed.

PART 2 - PRODUCTS

2.1 CONDUIT

- A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.
- B. RNC: Schedule 40 PVC. Comply with NEMA TC 2, NEMA TC-18 and UL 651.

2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ARNCO Corp.

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2. Beck Manufacturing.
3. Cantex, Inc.
4. CertainTeed Corp.; Pipe & Plastics Group.
5. Condux International, Inc.
6. ElecSys, Inc.
7. Electri-Flex Company.
8. IPEX Inc.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT; a division of Cable Design Technologies.
11. Spiraduct/AFC Cable Systems, Inc.
12. Southern Pipe, Inc.
13. Queen City Plastics, Inc.

B. Underground Plastic Utilities Duct: NEMA TC 2, NEMA TC-18, NEMA Type EPC-40-PVC (Schedule 40 PVC), UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

C. Duct Accessories:

1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
2. Warning Tape: Underground-line warning tape specified in Division 26 Section "Identification for Electrical Systems."
3. Duct Sealing Compound: Nonhardening, safe for human skin contact, not deleterious to cable insulation, workable at temperatures as low as 34 deg F, withstands temperature of 300 deg F without slump, and adheres to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and the common metals.

2.3 PRECAST CONCRETE HANDHOLES AND BOXES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carder Concrete Products.
2. Christy Concrete Products.
3. Elmhurst-Chicago Stone Co.
4. Oldcastle Precast Group.
5. Riverton Concrete Products; a division of Cretex Companies, Inc.
6. Utility Concrete Products, LLC.
7. Utility Vault Co.
8. Wausau Tile, Inc.
9. Stay-Right
10. Hanson Pipe and Precast

B. Comply with ASTM C 858 for design and manufacturing processes.

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- C. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.
1. Frame and Cover: Weatherproof steel frame, with steel cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
 2. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 3. Cover Legend: Molded lettering, "ELECTRIC", "TELEPHONE" or as indicated on the drawings.
 4. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
 5. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.
 - a. Extension shall provide increased depth of 12 inches.
 - b. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.
 6. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.
 - a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
 - b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
 - c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.
 7. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
 - a. Type and size shall match fittings to duct or conduit to be terminated.
 - b. Fittings shall align with elevations of approaching ducts and be located near interior corners of handholes to facilitate racking of cable.
 8. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.4 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

- A. Description: Comply with SCTE 77.
1. Color: Manufacturer's standard.
 2. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.

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4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 5. Cover Legend: Molded lettering, "ELECTRIC", "TELEPHONE" or as indicated on the drawings.
 6. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 7. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.
- B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. CDR Systems Corporation.
 - d. NewBasis.
- C. Fiberglass Handholes and Boxes with Polymer Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. Christy Concrete Products.
 - d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.
- D. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers of polymer concrete.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carson Industries LLC.
 - b. Christy Concrete Products.
 - c. Nordic Fiberglass, Inc.

2.5 PRECAST MANHOLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carder Concrete Products.
 2. Christy Concrete Products.

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3. Elmhurst-Chicago Stone Co.
4. Oldcastle Precast Group.
5. Riverton Concrete Products; a division of Cretex Companies, Inc.
6. Utility Concrete Products, LLC.
7. Utility Vault Co.
8. Wausau Tile, Inc.
9. Stay-Right
10. Hanson pipe and Precast

- B. Comply with ASTM C 858, with structural design loading as specified in Part 3, Article "Underground Enclosure Application" and with interlocking mating sections, complete with accessories, hardware, and features.

1. Design structure according to details on Drawings.
2. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.
 - a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.
 - b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
 - c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.
3. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
 - a. Type and size shall match fittings to duct or conduit to be terminated.
 - b. Fittings shall align with elevations of approaching ducts and be located near interior corners of manholes to facilitate racking of cable.

- C. Concrete Knockout Panels: 1-1/2 to 2 inches thick, for future conduit entrance and sleeve for ground rod.

- D. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

- E. Source Quality Control: Inspect structures according to ASTM C 1037.

2.6 CAST-IN-PLACE MANHOLES

- A. Description: Underground utility structures, constructed in place, complete with accessories, hardware, and features. Include concrete knockout panels for conduit entrance and sleeve for ground rod.

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- B. Materials: Comply with ASTM C 858 and with Division 03 Section "Cast-in-Place Concrete."
- C. Structural Design Loading: As specified in Part 3 "Underground Enclosure Application" Article.
- D. Comply with AASHTO loading specified for manhole.

2.7 UTILITY STRUCTURE ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Bilco Company (The).
 - 2. Campbell Foundry Company.
 - 3. Carder Concrete Products.
 - 4. Christy Concrete Products.
 - 5. East Jordan Iron Works, Inc.
 - 6. Elmhurst-Chicago Stone Co.
 - 7. McKinley Iron Works, Inc.
 - 8. Neenah Foundry Company.
 - 9. NewBasis.
 - 10. Oldcastle Precast Group.
 - 11. Osburn Associates, Inc.
 - 12. Pennsylvania Insert Corporation.
 - 13. Riverton Concrete Products; a division of Cretex Companies, Inc..
 - 14. Strongwell Corporation; Lenoir City Division.
 - 15. Underground Devices, Inc.
 - 16. Utility Concrete Products, LLC.
 - 17. Utility Vault Co.
 - 18. Wausau Tile, Inc.
- B. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.
 - 1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A 48/A 48M, Class 30B with milled cover-to-frame bearing surfaces; diameter, 29 inches.
 - a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.
 - 2. Cover Legend: Cast in. Selected to suit system.
 - a. Legend: "ELECTRIC-LV" for duct systems with power wires and cables for systems operating at 600 V and less.
 - b. Legend: "ELECTRIC-HV" for duct systems with medium-voltage cables.
 - c. Legend: "SIGNAL" for communications, data, and telephone duct systems.

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3. Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.
 - a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. where packaged mix complying with ASTM C 387, Type M, may be used.
- C. Manhole Sump Frame and Grate: ASTM A 48/A 48M, Class 30B, gray cast iron.
- D. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch- diameter eye, and 1-by-4-inch bolt.
 1. Working Load Embedded in 6-Inch, 4000-psi Concrete: 13,000-lbf minimum tension.
- E. Pulling Eyes in Nonconcrete Walls: Eyebolt with reinforced fastening, 1-1/4-inch- diameter eye, rated 2500-lbf minimum tension.
- F. Pulling-In and Lifting Irons in Concrete Floors: 7/8-inch- diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.
 1. Ultimate Yield Strength: 40,000-lbf shear and 60,000-lbf tension.
- G. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch ID by 2-3/4 inches deep, flared to 1-1/4 inches minimum at base.
 1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.
- H. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch bolt, 5300-lbf rated pullout strength, and minimum 6800-lbf rated shear strength.
- I. Cable Rack Assembly: Steel, hot-dip galvanized, except insulators.
 1. Stanchions: T-section or channel; 2-1/4-inch nominal size; punched with 14 holes on 1-1/2-inch centers for cable-arm attachment.
 2. Arms: 1-1/2 inches wide, lengths ranging from 3 inches with 450-lb minimum capacity to 18 inches with 250-lb minimum capacity. Arms shall have slots along full length for cable ties and be arranged for secure mounting in horizontal position at any vertical location on stanchions.
 3. Insulators: High-glaze, wet-process porcelain arranged for mounting on cable arms.
- J. Cable Rack Assembly: Nonmetallic. Components fabricated from nonconductive, fiberglass-reinforced polymer.
 1. Stanchions: Nominal 36 inches high by 4 inches wide, with minimum of 9 holes for arm attachment.

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2. Arms: Arranged for secure, drop-in attachment in horizontal position at any location on cable stanchions, and capable of being locked in position. Arms shall be available in lengths ranging from 3 inches with 450-lb minimum capacity to 20 inches with 250-lb minimum capacity. Top of arm shall be nominally 4 inches wide, and arm shall have slots along full length for cable ties.

- K. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F. Capable of withstanding temperature of 300 deg F without slump and adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.
- L. Fixed Manhole Ladders: Arranged for attachment to roof or wall of manhole. Ladder and mounting brackets and braces shall be fabricated from hot-dip galvanized steel.

2.8 SOURCE QUALITY CONTROL

- A. Test and inspect precast concrete utility structures according to ASTM C 1037.
- B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 1. Tests of materials shall be performed by a independent testing agency.
 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or the manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

2.9 CONSTRUCTION MATERIALS

- A. Mortar: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. where packaged mix complying with ASTM C 387, Type M, may be used.
- B. Brick for Manhole Chimney: Sewer and manhole brick, ASTM C 32, Grade MS.
- C. Concrete: Use 3000-psi- minimum, 28-day compressive strength and 3/8-inch maximum aggregate size. Concrete and reinforcement are specified in Division 03 Section "Cast-in-Place Concrete."

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PART 3 - EXECUTION

3.1 UNDERGROUND DUCT APPLICATION

- A. Ducts for Electrical Cables Over 600 V: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.
- B. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.
- C. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.
- D. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.

3.2 UNDERGROUND ENCLOSURE APPLICATION

- A. Handholes and Boxes for 600 V and Less, Including Telephone, Communications, and Data Wiring:
 - 1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.
 - 2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20 structural load rating.
 - 3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer concrete units, SCTE 77, Tier 8 structural load rating.
 - 4. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf vertical loading.
- B. Manholes: Precast or cast-in-place concrete.
 - 1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.
 - 2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

3.3 EARTHWORK

- A. Excavation and Backfill: Do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

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- C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching.

3.4 DUCT INSTALLATION

- A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.
- B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations, unless otherwise indicated.
- C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.
- D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.
 - 1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line.
 - 2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
 - 3. Grout end bells into structure walls from both sides to provide watertight entrances.
- E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Division 26 Section "Common Work Results for Electrical".
- F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- G. Pulling Cord: Install 100-lbf- test nylon cord in ducts, including spares.
- H. Concrete-Encased Ducts: Support ducts on duct separators.
 - 1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.

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2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
 - a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
 - b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope.
3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
6. Minimum Space between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts.
7. Depth: Install top of duct bank at least 24 inches below finished grade in areas not subject to deliberate traffic, and at least 30 inches below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated.
8. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
 - b. Stub-Ups to Equipment: For equipment mounted on indoor or on outdoor concrete bases, extend rigid steel conduit vertically into the equipment. Install insulated grounding bushings on terminations at equipment.
9. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of the centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

3.5 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Cast-in-Place Manhole Installation:

1. Finish interior surfaces with a smooth-troweled finish.
2. Windows for Future Duct Connections: Form and pour concrete knockout panels 1-1/2 to 2 inches thick, arranged as indicated.

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3. Cast-in-place concrete, formwork, and reinforcement are specified in Division 03 Section "Cast-in-Place Concrete."
- B. Precast Concrete Handhole and Manhole Installation:
 1. Comply with ASTM C 891, unless otherwise indicated.
 2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
 3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevations:
 1. Manhole Roof: Install with rooftop at least 15 inches below finished grade.
 2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch above finished grade.
 3. Install handholes with bottom below the frost line, below grade.
 4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch above finished grade.
 5. Where indicated, cast handhole cover frame integrally with handhole structure.
- D. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.
- E. Manhole Access: Circular opening in manhole roof; sized to match cover size.
 1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
 2. Install chimney, constructed of precast concrete collars and rings to support frame and cover and to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.
- F. Waterproofing: Apply waterproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. Waterproofing materials and installation are specified in Division 07 Section ". After ducts have been connected and grouted, and before backfilling, waterproof joints and connections and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.
- G. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.
- H. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.
- I. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches for manholes and 2 inches for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

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- J. Warning Sign: Install "Confined Space Hazard" warning sign on the inside surface of each manhole cover.

3.6 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas and trafficways, set so cover surface will be flush with finished grade. Set covers of other handholes 1 inch above finished grade.
- D. Install handholes and boxes with bottom below the frost line, below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.
- F. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
- G. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.
 - 1. Concrete: 3000 psi, 28-day strength, complying with Division 03 Section "Cast-in-Place Concrete," with a troweled finish.
 - 2. Dimensions: 10 inches wide by 12 inches deep.

3.7 GROUNDING

- A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:

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1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.9 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of handholes, including sump. Remove foreign material.

END OF SECTION 260543

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SECTION 260548 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Isolation pads.
2. Spring isolators.
3. Restrained spring isolators.
4. Channel support systems.
5. Restraint cables.
6. Hanger rod stiffeners.
7. Anchorage bushings and washers.

- B. Related Sections include the following:

1. Division 26 Section "Hangers and Supports For Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 DEFINITIONS

- A. The IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: **C.**
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: **II.**
 - a. Component Importance Factor: **[1.0] [1.5]**
 - b. Component Response Modification Factor: **[1.5] [2.5] [3.5] [5.0]**
 - c. Component Amplification Factor: **[1.0] [2.5]**

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3. Design Spectral Response Acceleration at Short Periods (0.2 Second):
4. Design Spectral Response Acceleration at 1.0-Second Period:

1.5 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.
 - a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other Division 26 Sections for equipment mounted outdoors.
2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
3. Field-fabricated supports.
4. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

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- C. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.
- D. Welding certificates.
- E. Qualification Data: For professional engineer and testing agency.
- F. Field quality-control test reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage pre-approval by ICC-ES, or pre-approval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If pre-approved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- E. Comply with NFPA 70.
- F. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing seismic engineering services, including the design of seismic restraints, that are similar to those indicated for this Project.

1.7 PROJECT CONDITIONS

- A. Project Seismic Design Category as Defined in NCSBC.
 - 1. Seismic design category shall be determined from information. Contained in the bid documents.
 - 2. Seismic Design Category: C
 - 3. Seismic Use Group: II

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1.8 COORDINATION

- A. Coordinate layout and installation of seismic bracing with building structural system and Engineerural features, and with mechanical, fire-protection, electrical, and other building features in the vicinity.
- B. Coordinate concrete bases with building structural system.

PART 2 - PRODUCTS

2.1 SEISMIC-RESTRAINT DEVICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Amber/Booth Company, Inc.
 - 2. California Dynamics Corporation.
 - 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 4. Hilti Inc.
 - 5. Loos & Co.; Seismic Earthquake Division.
 - 6. Mason Industries.
 - 7. TOLCO Incorporated; a brand of NIBCO INC.
 - 8. Unistrut; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an evaluation service member of ICC-ES.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- D. Restraint Cables: ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Do not weld stiffeners to rods.
- F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.

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- G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.
- H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- I. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- J. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.2 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 - 3. Baked enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.

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- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment and Hanger Restraints:
 - 1. Install restrained isolators on electrical equipment.
 - 2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.
- B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- D. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different

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structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

- A. Inspection Agency: Engage a qualified testing agency to perform inspections and prepare final report.
- B. Perform inspections.
- C. Inspections:
 - 1. Schedule inspection with Owner, through Engineer, with at least seven days' advance notice.
 - 2. Inspect all seismic restraints for electrical equipment
- D. Prepare inspection reports.
 - 1. The final written, signed and sealed report shall be prepared by a professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing seismic engineering services, including the design of seismic restraints, that are similar to those indicated for this Project. The engineer shall visit the site and inspect all seismic restraints as described within the section of the specifications prior to issuing the report.

3.6 ELECTRICAL SEISMIC-RESTRAINT DEVICE SCHEDULE

- A. Life safety systems:
 - 1. Fire alarm system.
 - 2. Emergency egress lighting system.

END OF SECTION 260548

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SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Identification for raceway.
 - 2. Identification for conductors and communication and control cable.
 - 3. Underground-line warning tape.
 - 4. Warning labels and signs.
 - 5. Instruction signs.
 - 6. Equipment identification labels.
 - 7. Miscellaneous identification products.
 - 8. Labeling for Fault Current Levels.

1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.
- C. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and ANSI C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.145.

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1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Color for Printed Legend:
 - 1. See Section 2.6 of this specification for color codes for use on this project.
- C. Phenolic Tags: Color coded phenolic tags with wire attachment to conduit or outlet.

2.2 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.3 UNDERGROUND-LINE WARNING TAPE

- A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.
 - 1. Not less than 6 inches wide by 4 mils thick.
 - 2. Compounded for permanent direct-burial service.
 - 3. Embedded continuous metallic strip or core installed to allow detection from above grade without disturbing surface.
 - 4. Printed legend shall indicate type of underground line.

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2.4 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70, 70E and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
 - 1. Custom warning labels indicating the available Fault Current level shall meet National Electrical Code (NFPA 70) 110.24, NFPA 70E and applicable OSHA requirements.
- C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. Screw mount with four (4) self-tapping stainless steel screws. Nominal size, 7 by 10 inches.
- D. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.5 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
 - 1. Engraved legend with black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
 - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.6 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting using a minimum of two (2) self-tapping stainless steel screws. Minimum letter height shall be 1/2 inch.
- B. Nameplate material colors shall be:
 - 1. Blue surface with white core for 120/208 volt equipment.
 - 2. Black surface with white core for 277/480 volt equipment.
 - 3. Bright red surface with white core for all equipment related to fire alarm system.
 - 4. Dark red (burgundy) surface with white core for all equipment related to security.
 - 5. Green surface with white core for all equipment related to "emergency" systems.
 - 6. Orange surface with white core for all equipment related to telephone systems.
 - 7. Brown surface with white core for all equipment related to data systems.

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8. White surface with black core for all equipment related to paging systems.
9. Purple surface with white core for all equipment related to TV systems.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
 1. Minimum Width: 3/16 inch.
 2. Tensile Strength: 50 lb, minimum.
 3. Temperature Range: Minus 40 to plus 185 deg F.
 4. Color: Black, except where used for color-coding.
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws; provide measures to prevent hazard from sharp end of screws.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Accessible Raceways, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A and all empty (spare) conduit runs and conduits with conductors or cables for future use shall be identified and shall indicate where they terminate: Identify with color coded (see Section 2.6) snap-around label.
- B. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, snap-around, color-coding bands:
 1. See Section 2.6 for color codes.
- C. Power-Circuit Conductor Identification: For primary and secondary conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.
- D. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape. Identify each ungrounded conductor according to source and circuit number.
- E. Cable Labels: Each branch circuit and each feeder shall be tagged in each panelboard gutter and in all pull or junction boxes, wire trough, etc. Tags in panelboard gutters shall indicate circuit. Tags in junction boxes and pull boxes shall indicate the circuit or feeder numbers and its point of origin. Tags for branch circuits shall be printed cloth or vinyl plastic with self-stick pressure adhesive.
- F. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source and circuit number.

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- G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.
1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.
- H. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Limit use of underground-line warning tape to direct-buried cables.
- I. Available Fault Current Warning labels:
1. Where shown on this project, whether new or existing equipment, the following equipment shall be provided with warning labels indicating the available fault current level:
 - a. Switchboards
 - b. Pad mounted transformers
 - c. Dry type transformers
 - d. Distribution panels
 - e. Panelboards
 2. Available Fault Current level warning labels shall be:
 - a. Provided by the contractor and shall include the information as shown on the drawings. The contractor shall install the labels.
- J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply baked-enamel warning signs. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
 2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
- K. Instruction Signs:
1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction

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- signs with approved legend where instructions are needed for system or equipment operation.
2. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 1/2-inch- high letters for emergency instructions at equipment used for power transfer.
- L. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
 - a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where 2 lines of text are required, use labels 2 inches high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor or finished surface level.
 2. Equipment to Be Labeled (All may not apply to this project):
 - a. Panelboards, electrical cabinets, and enclosures.
 - b. Access doors and panels for concealed electrical items.
 - c. Electrical switchboards.
 - d. Transformers.
 - e. Emergency system boxes and enclosures.
 - f. Disconnect switches.
 - g. Enclosed circuit breakers.
 - h. Motor starters.
 - i. Push-button stations.
 - j. Power transfer equipment.
 - k. Contactors.
 - l. Remote-controlled switches, dimmer modules, and control devices.
 - m. Battery inverter units.
 - n. Battery racks.
 - o. Power-generating units.
 - p. Voice and data cable terminal equipment.
 - q. Master clock and program equipment.
 - r. Intercommunication and call system master and staff stations.
 - s. Television/audio components, racks, and controls.
 - t. Fire-alarm control panel and annunciators.
 - u. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
 - v. Monitoring and control equipment.
 - w. Uninterruptible power supply equipment.

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- x. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.
- y. Dimmers.
- z. Inverters.
- aa. Frequency converters.

3.2 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- G. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - 1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - d. Neutral: White
 - e. Ground: Green
 - 3. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - d. Neutral: Neutral Gray
 - e. Ground: Green

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4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.
- J. Raceway Boxes: All outlet boxes, junction boxes and pull boxes shall have their covers and exterior visible surfaces painted with colors to match the surface color scheme outlined in section 2.6. This includes covers on boxes above lift-out and other type accessible ceilings. For emergency circuits, paint one half of box green and other half blue or black depending on voltage.
 1. The Contractor shall blank-off the center portion of the cover plate with 2” wide tape prior to painting. After painting with the tape removed, the circuit labeling shall be indicated on the non-painted surface of the cover plate using permanent black marker.
- K. Empty Conduit: All empty conduit runs and conduit with conductors for future use shall be identified for use and shall indicate where they terminate. Identification shall be by tags with string or wire attached to conduit or outlet.

END OF SECTION 260553

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SECTION 260573 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes computer-based, fault-current, overcurrent protective device coordination and Arc-Flash hazard studies.
 - 1. Protective devices shall be set based on results of the protective device coordination study and shall be coordinated with the electrical distribution equipment (circuit breakers, panel boards, switchboards, switchgear) prior to the contractor ordering the equipment.
 - 2. The electrical equipment overcurrent protections devices shall be revised in order to provide a completely coordinated system as recommended by the coordination study. The coordination study shall be revised to reflect the changes required to coordinate the system overcurrent protection devices.

1.3 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals shall be in digital form.
 - 1. Coordination-study input data, including completed computer program input data sheets.
 - 2. Study and Equipment Evaluation Reports.
 - 3. Coordination-Study Report; signed, dated, and sealed by a qualified professional engineer.
 - a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selectin of devices and associated characteristics is satisfactory.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For coordination-study specialist.

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- B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.

1.5 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.
- B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 - 1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study and shall seal and sign the study, associated supporting documents and drawings. All elements of the study shall be performed under the direct supervision and control of this engineer.
- C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.
- D. Comply with IEEE 399 for general study procedures.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Computer Software Developers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CGI CYME.
 - 2. EDSA Micro Corporation.
 - 3. ESA Inc.
 - 4. Operation Technology, Inc.
 - 5. SKM Systems Analysis, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

- A. Comply with IEEE 242 and IEEE 399.
- B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device

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settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

1. Features:
 - a. Arcing faults.
 - b. Simultaneous faults.
 - c. Explicit negative sequence.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.
 1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

- A. Gather and tabulate the following input data to support coordination study:
 1. Product Data for overcurrent protective devices specified in other electrical Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 2. Impedance of utility service entrance.
 3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
 - a. Circuit-breaker and fuse-current ratings and types.
 - b. Relays and associated power and current transformer ratings and ratios.
 - c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
 - d. Generator kilovolt amperes, size, voltage, and source impedance.
 - e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
 - f. Busway ampacity and impedance.
 - g. Motor horsepower and code letter designation according to NEMA MG 1.
 4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:

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- a. Special load considerations, including starting inrush currents and frequent starting and stopping.
- b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
- c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
- d. Generator thermal-damage curve.
- e. Ratings, types, and settings of utility company's overcurrent protective devices.
- f. Special overcurrent protective device settings or types stipulated by utility company.
- g. Time-current-characteristic curves of devices indicated to be coordinated.
- h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
- i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
- j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.3 FAULT-CURRENT STUDY

- A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
 1. Switchboard bus.
 2. Transformers.
 3. Distribution panelboard.
 4. Branch circuit panelboard.
- B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.
- D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 241 and IEEE 242.
 1. Transformers:
 - a. IEEE C57.96.
 2. Low-Voltage Circuit Breakers: IEEE 1015.
- E. Study Report:

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1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
2. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium-voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.

F. Equipment Evaluation Report:

1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.4 COORDINATION STUDY

- A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
 2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
 3. Calculate the maximum and minimum ground-fault currents.
- B. Comply with IEEE 241, IEEE 242 recommendations for fault currents and time intervals.
- C. Transformer Primary Overcurrent Protective Devices:
1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
 - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
 2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.
- D. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

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- E. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
 - a. Device tag.
 - b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
 - c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
 - d. Fuse-current rating and type.
 - e. Ground-fault relay-pickup and time-delay settings.
 2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
 - a. Device tag.
 - b. Voltage and current ratio for curves.
 - c. Three-phase and single-phase damage points for each transformer.
 - d. No damage, melting, and clearing curves for fuses.
 - e. Cable damage curves.
 - f. Transformer inrush points.
 - g. Maximum fault-current cutoff point.
- F. Completed data sheets for setting of overcurrent protective devices.

3.5 ARC FLASH HAZZARD STUDY

- A. The analysis will identify the system operating modes including all possible 600-volt tie-breaker positions, utility source contributions, and in-plant motor and generator contributions.
- B. The analysis will determine the time required to clear the arcing fault current using the protective device settings and associated trip curves.
- C. Working distances will be selected based on system voltage and equipment class.
- D. Wherever feasible, recommendations for reducing arc flash energy levels at high risk locations will be included.
- E. The arc flash hazard analysis will be performed according to the IEEE 1584 equations that are presented in NFPA70E-2015, Annex D.
 1. Calculations for the incident energy at each fault location will be included.
 2. Calculations for the flash protection boundary at each fault location will be included.

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- F. The flash protection boundary and the incident energy will be calculated at all significant locations in the electrical distribution system that will be required to be adjusted or maintained.
 - 1. Switchboards, panelboards and circuit breakers within.
 - 2. Transformer primary and secondary terminals.
- G. Safe working distances will be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm².
- H. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model and used in the arc flash analysis.
- I. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations
- J. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios will be compared and the greatest incident energy must be uniquely reported for each equipment location.
 - 1. The calculations will be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions.
 - 2. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off).
 - 3. Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating.
 - 4. The calculations will take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.
- K. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators will be decremented as follows:
 - 1. Fault contribution from induction motors will not be considered beyond 3-5 cycles.
 - 2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).
- L. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary will include both the line and load side of the main breaker.
 - 1. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions will be included in the fault calculation.

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- M. Coordination will be checked between all devices within the branch containing the immediate protective device upstream of the calculation location. The calculation will utilize the fastest device to compute the incident energy for the corresponding location.
- N. Arc Flash calculations will be based on actual overcurrent protective device clearing time.
 - 1. Maximum clearing time will be capped at 2 seconds based on IEEE 1584 section.
- O. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location will be utilized.

END OF SECTION 260573

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SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following lighting control devices:
 - 1. Time switches.
 - 2. Outdoor photoelectric switches and indoor photoelectric sensors.
 - 3. Indoor photoelectric sensors.
 - 4. Lighting contactors.
- B. Related Sections include the following:
 - 1. Division 26 Section "Wiring Devices" for wall-box dimmers and manual light switches.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
 - 1. Provide scaled plan layouts of all occupancy sensor locations based upon the manufacturer's suggested layout for their equipment in full compliance with these specifications.
 - a. Show sensor type being supplied for each sensor location and the area of coverage for each sensor.
 - 2. Interconnection diagrams showing field-installed wiring.

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- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Intermatic, Inc.
 - 2. Leviton Mfg. Company Inc.
 - 3. Lithonia Lighting; Acuity Lighting Group, Inc.
 - 4. Paragon Electric Co.; Invensys Climate Controls.
 - 5. Square D; Schneider Electric.
 - 6. TORK.
 - 7. Touch-Plate, Inc.
 - 8. Watt Stopper (The).
 - 9. Bodine
 - 10. Sensor Switch
 - 11. Crestron
- B. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.
 - 1. Contact Configuration: SPST.
 - 2. Contact Rating: 20-A ballast load, 120/240-V ac.
 - 3. Program: 2 on-off set points on a 24-hour schedule, allowing different set points for each day of the week and an annual holiday schedule that overrides the weekly operation on holidays.
 - 4. Battery Backup: For schedules and time clock.

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2.2 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Intermatic, Inc.
 2. Lithonia Lighting; Acuity Lighting Group, Inc.
 3. Paragon Electric Co.; Invensys Climate Controls.
 4. Square D; Schneider Electric.
 5. TORK.
 6. Touch-Plate, Inc.
 7. Watt Stopper (The).
 8. Sensor Switch.
 9. Crestron.
- B. Description: Solid state, with DPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.
1. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
 2. Time Delay: 15-second minimum, to prevent false operation.
 3. Surge Protection: Metal-oxide varistor, complying with IEEE C62.41.1, IEEE C62.41.2, and IEEE 62.45 for Category A1 locations.
 4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.
 5. Contact voltage rating: Suitable for the circuit being controlled.

2.3 INDOOR PHOTOELECTRIC SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Intermatic, Inc.
 2. Lithonia Lighting; Acuity Lighting Group, Inc.
 3. Lutron Electronics Co., Inc.
 4. Paragon Electric Co.; Invensys Climate Controls.
 5. Square D; Schneider Electric.
 6. TORK.
 7. Touch-Plate, Inc.
 8. Watt Stopper (The).
 9. Sensor Switch.
 10. Crestron.
- B. Ceiling-Mounted Photoelectric Sensor: Solid-state, light-level sensor unit, with communications with dimmers or lighting drivers, to detect changes in lighting levels that are

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perceived by the eye and adjust lighting fixture dimming level to maintain a target (setpoint) lighting level. Arrange photoelectric sensors to provide closed-loop or semi-open-loop daylighting control of lighting fixture rows near exterior windows.

2.4 INDOOR OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hubbell Lighting.
 - 2. Leviton Mfg. Company Inc.
 - 3. Lithonia Lighting; Acuity Lighting Group, Inc.
 - 4. TORK.
 - 5. Watt Stopper (The).
 - 6. Sensor Switch.
 - 7. Crestron.
- B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.
 - 1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - 2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
 - 3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
 - 4. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 - 5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
 - 6. Bypass Switch: Override the on function in case of sensor failure.
 - 7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keep lighting off when selected lighting level is present.
- C. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.
 - 1. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in..
 - 2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.

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3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot- high ceiling.
- D. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.
 1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch- high ceiling.
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
 4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch- high ceiling.
 5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot- high ceiling in a corridor not wider than 14 feet.
- E. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.
 1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.

2.5 WALL OCCUPANCY SENSORS

A. Wall-Switch Sensors:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 6111 for 120 V, 6117 for 277 V.
 - b. Hubbell; WS1277.
 - c. Leviton; ODS 10-ID.
 - d. Pass & Seymour; WS3000.
 - e. Watt Stopper (The); WS-200.
 - f. Lutron;
 - g. Lithonia;
2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft..

B. Wall-Switch Sensors:

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1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; AT120 for 120 V, AT277 for 277 V.
 - b. Leviton; ODS 15-ID.
 - c. Lutron;
 - d. Lithonia;
2. Description: Adaptive-technology type, 120/277 V, adjustable time delay up to 20 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft..

C. Long-Range Wall-Switch Sensors:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATP1600WRP.
 - b. Leviton; ODWWV-IRW.
 - c. Pass & Seymour; WA1001.
 - d. Watt Stopper (The); CX-100.
 - e. Lutron;
 - f. Lithonia;
2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, with a minimum coverage area of 1200 sq. ft..

D. Long-Range Wall-Switch Sensors:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATD1600WRP.
 - b. Leviton; ODW12-MRW.
 - c. Watt Stopper (The); DT-200.
 - d. Lutron;
 - e. Lithonia;
2. Description: Dual technology, with both passive-infrared- and ultrasonic-type sensing, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, and a minimum coverage area of 1200 sq. ft..

E. Wide-Range Wall-Switch Sensors:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATP120HBRP.
 - b. Leviton; ODWHB-IRW.
 - c. Pass & Seymour; HS1001.
 - d. Watt Stopper (The); CX-100-3.
 - e. Lutron;
 - f. Lithonia;

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2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 150-degree field of view, with a minimum coverage area of 1200 sq. ft..

2.6 LIGHTING CONTACTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. ASCO Power Technologies, LP; a division of Emerson Electric Co.
 2. Eaton Electrical Inc.; Cutler-Hammer Products.
 3. GE Industrial Systems; Total Lighting Control.
 4. Hubbell Lighting.
 5. Lithonia Lighting; Acuity Lighting Group, Inc.
 6. Square D; Schneider Electric.
- B. Description: Electrically operated and electrically held, combination type with fusible switch, complying with NEMA ICS 2 and UL 508.
 1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
 3. Enclosure: Comply with NEMA 250.
 4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

2.7 EMERGENCY INVERTER FOR LIGHTING

2.8 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

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PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

- A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.
- F. Complete wiring systems shall be color coded according to the manufacturer's recommendations and conductors must be tagged or identified at terminals.

3.4 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

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3.5 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 - 2. Operational Test: Verify operation of each lighting control device, and adjust time delays.
- B. Lighting control devices that fail tests and inspections are defective work.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance or replaced or additional work with specified requirements.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 90 days of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 260923

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SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
 - 1. Distribution transformers.

1.3 SUBMITTALS

- A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

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- D. Qualification Data: For testing agency.
- E. Source quality-control test reports.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."
- D. Energy-Efficient Transformers Rated 15 kVA and Larger: Certified as meeting NEMA TP 1, Class 1 efficiency levels when tested according to NEMA TP2.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Challenger Electrical Equipment Corp.; a division of Eaton Corp.
 - 2. Eaton Electrical Inc.; Cutler-Hammer Products.
 - 3. Federal Pacific Transformer Company; Division of Electro-Mechanical Corp.
 - 4. General Electric Company.
 - 5. Siemens Energy & Automation, Inc.
 - 6. Sola/Hevi-Duty.
 - 7. Square D; Schneider Electric.

2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Cores: Grain-oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices except for taps.
 - 1. Internal Coil Connections: Brazed or pressure type.
 - 2. Coil Material: Copper.

2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- B. Comply with NEMA TP-1 Energy Efficient @ 35% average loading.
- C. Provide transformers that are constructed to withstand seismic forces specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- D. Cores: One leg per phase.
- E. Enclosure: Ventilated, NEMA 250, Type 2.
 - 1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- F. Transformer Enclosure Finish: Comply with NEMA 250.
 - 1. Finish Color: ANSI 61 gray.

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- G. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.
- H. Insulation Class: Installation shall conform with NEMA ST 20 standards for 220 degree C UL system. Transformers shall be rated for 115 degree C temperature rise over 40 degree C ambient, provided case temperature rise shall not exceed 45 degree C over 40 degree C ambient. Transformer overload capability shall be in accordance with IEEE C57. 96 for standard transformers.
- I. Energy Efficiency for Transformers Rated 15 kVA and Larger:
 - 1. Complying with NEMA TP 1, Class 1 efficiency levels.
 - 2. Tested according to NEMA TP 2.
- J. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.
 - 1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
 - 2. Indicate value of K-factor on transformer nameplate.
- K. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.
 - 1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
 - 2. Include special terminal for grounding the shield.
 - 3. Shield Effectiveness:
 - a. Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.
 - b. Common-Mode Noise Attenuation: Minimum of minus 120 dBA at 0.5 to 1.5 kHz; minimum of minus 65 dBA at 1.5 to 100 kHz.
 - c. Normal-Mode Noise Attenuation: Minimum of minus 52 dBA at 1.5 to 10 kHz.
- L. Wall Brackets: Manufacturer's standard brackets.
- M. Fungus Proofing: Permanent fungicidal treatment for coil and core.
- N. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

2.4 IDENTIFICATION DEVICES

- A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

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2.5 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.91.
- B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
 - 1. Brace wall-mounting transformers as specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Construct concrete bases not less than 4 inches larger in both directions than supported unit and 4 inches high. Paint bases OSHA approved yellow.

3.3 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

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1. Transformer secondary is the source for a separately derived system as defined in the NEC. As such, secondary neutral shall be bonded to the main service ground bus or electrode in accordance with NEC requirements.
 2. Where transformer is located at a remote location from the main service ground bus or electrode, grounding conductor shall be run in feeder raceway back to primary source enclosure ground.
 3. All transformers shall be provided with a secondary local grounding electrode as required by the NEC; this may consist of a UL listed grounding clamp on a local 3/4" (minimum) copper cold water pipe or grounded structural steel member.
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 CONDUIT CONNECTIONS

- A. No non-flexible conduits shall be attached directly to transformer housing.
- B. Where construction permits, stub conduits up into transformer housing from beneath. Stub-ups shall be fitted with fiber-throated grounding bushing with suitable lug. Stub-ups shall be bonded together and to transformer case with ground wire of size required by N.E.C.
- C. Where connection must be made to housing, provide vibration dampening assembly consisting of:
1. Female hub-type liquid-tight connector.
 2. Male hub-type liquid-tight connector.
 3. Short length (approximately 6") liquid-tight flexible conduit.
 4. Bonding jumper of NEC size on inside of assembly. Bond from lug to grounded transformer case.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Remove and replace units that do not pass tests or inspections and retest as specified above.
- D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each transformer's primary and secondary terminations. Remove all access panels so terminations and connections are visible to portable scanner.

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1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each transformer 11 months after date of Substantial Completion.
2. A thermographic imaging survey shall be required for the following equipment installations:
 - a. Concrete Pad Mount Transformer connections (primary and secondary).
3. Thermographic imaging survey shall be performed by a thermographic imaging contractor who is a Level III Certified Thermographer and who has received accreditation through a NETA accredited thermography training program.
4. Imaging contractor shall utilize equipment that has been calibrated with the previous six months of test; calibration shall be part of an ongoing calibration program that is traceable to the National Institute of Standards and Technology (NIST).
5. Imaging equipment shall include a Forward Looking Infrared Camera able to detect emitted thermal infrared radiation and convert the detected emissions into a visual image.
6. Electrical contractor shall correct deficiencies and retesting shall be repeated until no deficiencies are detected.
7. The Imaging contractor shall provide a certified test report to the engineer and the owner; report shall include efficiencies detected, corrective measures taken and resulting final outcome of analysis.

- E. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.6 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.7 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262200

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SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

- A. NRTL: Nationally Recognized Testing Laboratory.
- B. SVR: Suppressed voltage rating.
- C. TVSS: Transient voltage surge suppressor.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.

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1. Scaled layout of equipment within the project electric room.
 2. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 3. Detail enclosure types and details for types other than NEMA 250, Type 1.
 4. Detail bus configuration, current, and voltage ratings.
 5. Short-circuit current rating of panelboards and overcurrent protective devices.
 6. Include evidence of NRTL listing for series rating of installed devices.
 7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 8. Include wiring diagrams for power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.
 9. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device.
- C. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Field Quality-Control Reports:
1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- E. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

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1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace devices that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 18-months from date of Final Acceptance of the Work.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
 - b. Altitude: Not exceeding 6600 feet.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

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1. Ambient temperatures within limits specified.
 2. Altitude not exceeding 6600 feet.
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
1. Notify Construction Manager and Owner no fewer than seven days in advance of proposed interruption of electric service.
 2. Do not proceed with interruption of electric service without Owner's written permission.
 3. Comply with NFPA 70E.

1.10 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
1. Warranty Period: 18-months from date of Substantial Completion.

1.12 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Keys: Two spares for each type of panelboard cabinet lock.
 2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Two spares for each panelboard.

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PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Enclosures: Flush- and surface-mounted cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Kitchen or Wash-Down Areas: NEMA 250, Type 4X stainless steel.
 - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
 - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 - 4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
 - 5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 - 6. Finishes:
 - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel.
 - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.
 - 7. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
- C. Incoming Mains Location: Top and bottom.
- D. Phase, Neutral, and Ground Buses:
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box 100% rated.
 - 3. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
 - 4. Split Bus: Vertical buses divided into individual vertical sections.

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- E. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Main and Neutral Lugs: Mechanical type.
 - 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 - 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 - 5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 - 6. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 - 7. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
- F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- G. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Series rated panelboard are not acceptable.
- H. Service entrance equipment must be third party SE rated.

2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 - 1. For doors more than 36 inches high, provide two latches, keyed alike.
- D. Mains: Circuit breaker or lugs only.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers or plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

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- G. System Coordination: Overcurrent protection devices provided by the manufacturer on this project shall provide adequate time separation between devices installed in series so that the closest device upstream of a fault condition will open and clear the fault prior to any other upstream overcurrent protection device operating.
1. This includes but is not limited to providing overcurrent protection devices with the same trip rating as shown on the drawings and equipped adjustable time current curve characteristics, shown or not shown on the drawings, that coordinate with other overcurrent protection devices that are in the same series circuit.
 2. When installed all series connect overcurrent protection devices shall be coordinated in this manner.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. System Coordination: Overcurrent protection devices provided by the manufacturer on this project shall provide adequate time separation between devices installed in series so that the closest device upstream of a fault condition will open and clear the fault prior to any other upstream overcurrent protection device operating.
1. This includes but is not limited to providing overcurrent protection devices with the same trip rating as shown on the drawings and equipped adjustable time current curve characteristics, shown or not shown on the drawings, that coordinate with other overcurrent protection devices that are in the same series circuit.
 - a. When installed all series connect overcurrent protection devices shall be coordinated in this manner. Exceptions: Selective coordination is not required between protective devices with the same trip rating or protective devices in series where the operation of either device would affect the same load.
 2. Whenever trip ratings are required to be increased or decreased in order to coordinate with overcurrent devices that are in the same series circuit the cost of the adjusted trip rating/circuit breaker shall be included in the bid. This shall be brought to the attention of the Engineer prior to ordering the equipment.

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- a. The engineer shall issue any required changes to feeder conductors due to trip rating adjustments for coordination purposes.

- F. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- G. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents. Series ratings are not acceptable.
 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replaceable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
 3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 4. GFCI Circuit Breakers: Where shown on the drawings for receptacle circuits, provide Class A ground-fault protection (6-mA trip).
 5. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Where shown on the drawings for mechanical equipment provide Class B ground-fault protection (30-mA trip).
 6. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

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- d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 - f. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
 - g. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
 - h. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.
7. System Coordination: Overcurrent protection devices provided by the manufacturer on this project shall provide adequate time separation between devices installed in series so that the closest device upstream of a fault condition will open and clear the fault prior to any other upstream overcurrent protection device operating.
- a. This includes but is not limited to providing overcurrent protection devices with the same trip rating as shown on the drawings and equipped adjustable time current curve characteristics, shown or not shown on the drawings, that coordinate with other overcurrent protection devices that are in the same series circuit.
 - b. When installed all series connect overcurrent protection devices shall be coordinated in this manner.

2.5 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Equipment Mounting: Install panelboards on concrete bases, 4-inch nominal thickness.
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
 - 2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to panelboards.
 - 5. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- D. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- E. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- F. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- G. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- H. Install filler plates in unused spaces.
- I. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Provide pull wire and cap each spare conduit.
- J. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- K. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

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- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- D. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. For services 1000 amperes or larger, the following tests shall be performed on the service circuit breakers and the distribution circuit breakers. Testing shall be performed by a qualified factory technician at the job site. Prior to testing the contractor shall verify the circuit breaker settings with the Engineer of record. All readings shall be tabulated:
 - a. Phase tripping tolerance (within 20% of UL requirements).
 - b. Trip time (per phase) in seconds.
 - c. Instantaneous trip (amps) per phase.
 - d. Insulation resistance (in megaohms) at 100 volts (phase to phase, and line to load).
 - 4. The ground fault protection on the new circuit breakers (if provided) shall be performance tested in the field and properly calibrated and set in accordance with the Overcurrent Protective Device Coordination Study.
 - 5. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard's terminations. Remove all access panels so terminations and connections are visible to portable scanner.
 - 6. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.

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7. A thermographic imaging survey shall be required for the following equipment installations:
 - a. Distribution panelboard conductor terminations.
8. Thermographic imaging survey shall be performed by a thermographic imaging contractor who is a Level III Certified Thermographer and who has received accreditation through a NETA accredited thermography training program.
9. Imaging contractor shall utilized equipment that has been calibrated within the previous six months of test; calibration shall be part of an ongoing calibration program that is traceable to the National Institute of Standards and Technology (NIST).
10. Imaging equipment shall include a Forward Looking Infrared Camera able to detect emitted thermal infrared radiation and convert the detected emissions into a visual image.
11. Electrical contractor shall correct deficiencies and retesting shall be repeated until no deficiencies are detectable.
12. The Imaging contractor shall provide a certified test report to the engineer and the owner; report shall include deficiencies detected, corrective measures taken and resulting final outcome of analysis.

- E. Panelboards will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study."
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
 1. Measure as directed during period of normal system loading.
 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

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3.6 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

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SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Twist-locking receptacles.
 - 3. Snap switches and wall-box dimmers.
 - 4. Communications outlets.
 - 5. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.
- B. Related Sections include the following:
 - 1. Division 27 Section "Communications Horizontal Cabling" for workstation outlets.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.

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- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described in subparagraphs below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Service/Power Poles: One for every 10, but no fewer than one.
 - 2. Floor Service Outlet Assemblies: One for every 10, but no fewer than one.
 - 3. Poke-Through, Fire-Rated Closure Plugs: One for every five floor service outlets installed, but no fewer than two.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
 - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 - 3. Leviton Mfg. Company Inc. (Leviton).
 - 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

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2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, Heavy-Duty, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 5351 (single), 5352 (duplex).
 - b. Hubbell; HBL5351 (single), CR5352 (duplex).
 - c. Leviton; 5891 (single), 5352 (duplex).
 - d. Pass & Seymour; 5381 (single), 5352 (duplex).
 - 2. Receptacles shall have side wired terminals with brass screws and hex ground screw.
- B. Tamper-Resistant Convenience Receptacles, Heavy-Duty, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; TR8300.
 - b. Hubbell; HBL8300SG.
 - c. Leviton; 8300-SGG.
 - d. Pass & Seymour; 63H.

2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, non-feed through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, Heavy-Duty, 125 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; GF20.
 - b. Pass & Seymour; 2084.
 - c. Leviton; W7899
 - d. Hubbell; GFR5362

2.4 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

- A. Wiring Devices for Hazardous (Classified) Locations: Comply with NEMA FB 11 and UL 1010.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper Crouse-Hinds.
 - b. EGS/Appleton Electric.

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- c. Killark; a division of Hubbell Inc.

2.5 TWIST-LOCKING RECEPTACLES

- A. Single Convenience Receptacles, Heavy-Duty, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; L520R.
 - b. Hubbell; HBL2310.
 - c. Leviton; 2310.
 - d. Pass & Seymour; L520-R.

2.6 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. All switches shall have quiet operating mechanisms without the use of mercury switches. All switches shall be listed by an “approved” third-party agency, approved for the voltage and amperage indicated. Self ground type is not acceptable. Switches shall have side wired terminals with brass screws and hex ground screw.
- C. Switches, Heavy-Duty, 120/277 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
 - b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
 - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
 - d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).
- D. Pilot Light Switches, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221PL for 120 V and 277 V.
 - b. Hubbell; HPL1221PL for 120 V and 277 V.
 - c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
 - d. Pass & Seymour; PS20AC1-PLR for 120 V.
 - 2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."
- E. Key-Operated Switches, Heavy-Duty, 120/277 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:

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- a. Cooper; 2221L.
- b. Hubbell; HBL1221L.
- c. Leviton; 1221-2L.
- d. Pass & Seymour; PS20AC1-L.

2. Description: Single pole, with factory-supplied key in lieu of switch handle.

F. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Cooper; 1995.
- b. Hubbell; HBL1557.
- c. Leviton; 1257.
- d. Pass & Seymour; 1251.

2.7 WALL-BOX DIMMERS

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
- B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.
- C. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.8 COMMUNICATIONS OUTLETS

A. Data/Communications Outlet:

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Cooper; 3560-6.
- b. Leviton; 40649.

2. Description: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e. Comply with UL 1863.

B. Combination TV and Data Outlet:

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Cooper; 3562.
- b. Leviton; 40595.

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2. Description: Single RJ-45 jack for 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e; and one Type F coaxial cable connector.

2.9 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
 3. Material for Unfinished Spaces: Smooth, high-impact thermoplastic.
 4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in "wet locations."
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum or thermoplastic with lockable cover.

2.10 FLOOR SERVICE FITTINGS

- A. Type: Modular, flush-type, dual-service units suitable for wiring method used.
- B. Compartments: Barrier separates power from voice and data communication cabling.
- C. Service Plate: Round, die-cast aluminum with satin finish.
- D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.
- E. Voice and Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 Category 5e jacks for UTP cable.

2.11 FLOOR SERVICE FITTINGS (SLAB ON GRADE)

- A. Type I: Round PVC Multi-Service power and low voltage floor box with two (2) 1 ½" hubs for low voltage and two (2) 1" hubs for power.
 1. Minimum depth of concrete pour 3.00".
 2. 5.75" external diameter X 6" height.
 3. Accepts ¾", 1", 1 ¼", 1 ½" schedule 40 or 80 PVC conduit and ENT tubing.
 4. Products as manufactured by Hubbell: S1PFB
 5. Equal products by: Wiremold

2.12 POKE-THROUGH ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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1. Hubbell Incorporated; Wiring Device-Kellems.
2. MonoSystems.
3. Thomas & Betts Corporation.
4. Wiremold Company (The).

- B. Description: Factory-fabricated and -wired assembly of below-floor junction box with multi-channeled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.

1. Service Outlet Assembly: Flush type with four simplex receptacles and space for four RJ-45 jacks.
2. Size: Selected to fit cored holes in floor and matched to floor thickness.
3. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
4. Closure Plug: Arranged to close unused cored openings and reestablish fire rating of floor.
5. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of four, 4-pair, Category 5e voice and data communication cables.

2.13 MULTIOUTLET ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hubbell Incorporated; Wiring Device-Kellems.
 2. Wiremold Company (The).
- B. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- C. Raceway Material: Metal, with manufacturer's standard finish.
- D. Wire: No. 12 AWG.

2.14 SERVICE POLES

- A. Description: Factory-assembled and -wired units to extend power and voice and data communication from distribution wiring concealed in ceiling to devices or outlets in adjacent casework.
1. Poles: Sized to accommodate all power wiring and communications cabling required in adjacent casework, with height adequate to extend from floor to at least 6 inches above ceiling, and with separate channels for power wiring and voice and data communication cabling.
 2. Mounting: Ceiling trim flange with concealed bracing arranged for positive connection to ceiling supports; with pole foot and carpet pad attachment.
 3. Finishes: Manufacturer's standard painted finish and trim combination (color selected by architect).

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4. Wiring: Sized for minimum of eleven No. 10 AWG power and ground conductors and a minimum of ten, 4-pair, Category 5 voice and data communication cables.

2.15 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
 1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.
 2. Wiring Devices Connected to Emergency Power System: Red.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtail existing conductors is permitted provided the outlet box is large enough.
- D. Device Installation:

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1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Wall switches and Receptacles: Identify panelboard and circuit number from which served.
 - a. Label all cover plates using adhesive film label with clear protective overlay.

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- 1) Labels shall include the power source panelboard name and circuit number.
Example: “Panel 1NL2-24”
 - 2) Labels shall be placed below the toggle on wall switches and below the lower duplex receptacle on receptacles.
- b. For wall switches and/or receptacles connected to generator circuits provide engraved stainless steel cover plate with the text “EMERGENCY” using ¼” high red filled letters.
- 1) Engraved text shall be located above toggle on wall switches and above the upper receptacle for receptacles.
- c. Durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 262726

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SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed switches, and enclosed controllers.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

- 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 - 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 - 3. Current-limitation curves for fuses with current-limiting characteristics.
 - 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
 - 5. Coordination charts and tables and related data.
 - 6. Fuse sizes for elevator feeders and elevator disconnect switches.

- B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

- 1. Ambient temperature adjustment information.
 - 2. Current-limitation curves for fuses with current-limiting characteristics.

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3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
4. Coordination charts and tables and related data.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.

1.5 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Cooper Bussmann, Inc.
 2. Edison Fuse, Inc.

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3. Ferraz Shawmut, Inc.
4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 600 VOLT AND LESS FUSE APPLICATIONS

- A. Cartridge Fuses:
 1. Motor Branch Circuits: Class RK1, time delay.
 2. Other Branch Circuits: Class RK1, time delay.
 3. Control Circuits: Class CC, fast acting.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

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3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

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SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Molded-case circuit breakers.
 - 4. Molded-case switches.
 - 5. Enclosures.

1.3 DEFINITIONS

- A. GD: General duty.
- B. GFCI: Ground-fault circuit interrupter.
- C. HD: Heavy duty.
- D. RMS: Root mean square.
- E. SPDT: Single pole, double throw.

1.4 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current rating.
 - 4. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

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- B. Shop Drawings: Diagram power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
- C. Manufacturer Seismic Qualification Certification: Submit certification that enclosed switches and circuit breakers, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems" Include the following:
 - 1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Field quality-control test reports including the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- E. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - 2. Time-current curves, including selectable ranges for each type of circuit breaker.
 - 3. Routine maintenance requirements for components.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70. Comply with NEMA AB 1 and NEMA KS 1.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

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1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet.

1.7 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Spares: For the following:
 - a. Potential Transformer Fuses: At least 10% of each size installed for project, but not less than 2 of each size.
 - b. Control-Power Fuses: At least 10% of each size installed for project, but not less than 2 of each size.
 - c. Fuses for Fusible Switches: At least 10% of each size installed for project, but not less than 2 of each size.
 - d. Fuses for Fused Power Circuit Devices: At least 10% of each size installed for project, but not less than 2 of each size.
 - 2. Spare Indicating Lights: Six of each type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

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2.2 FUSIBLE AND NONFUSIBLE SWITCHES

A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Siemens Energy & Automation, Inc.
4. Square D/Group Schneider.

B. Fusible Switch, 600 A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Nonfusible Switch, 600 A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

2.3 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Moeller Electric Corporation.
4. Siemens Energy & Automation, Inc.
5. Square D/Group Schneider.

B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip-Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.

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- c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I²t response.
- 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller and let-through ratings less than NEMA FU 1, RK-5.
- 5. GFCI Circuit Breakers: Single- and two-pole configurations with [5] [30]-mA trip sensitivity.
- C. Molded-Case Circuit-Breaker Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Lugs: Mechanical style suitable for number, size, trip ratings, and conductor material.
 - 3. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 - 4. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - 5. Shunt Trip: 120-V trip coil energized from separate circuit.
 - 6. Auxiliary Switch: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
- D. Molded-Case Switches: Molded-case circuit breaker with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.
- E. Molded-Case Switch Accessories:
 - 1. Lugs: Mechanical style suitable for number, size, trip ratings, and material of conductors.
 - 2. Application Listing: Type HACR for heating, air-conditioning, and refrigerating equipment.
 - 3. Shunt Trip: 120-V trip coil energized from separate circuit. Provide "dummy" trip unit where required for proper operation.
 - 4. Auxiliary Switch: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

2.4 ENCLOSURES

- A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
 - 1. Outdoor Locations: NEMA 250, Type 3R.
 - 2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 - 3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2.5 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested enclosures before shipping

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- B. Mount individual wall-mounted switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounted switches to concrete base.
- C. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Provide 2#12, 1#12 ground, ½" C minimum from elevator disconnect switch auxiliary contact to the elevator controller. Coordinate with elevator installer and terminate the conductors at the disconnect switch on either the Normally Open or Normally Closed contact as instructed by the elevator installer.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."
- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Prepare for acceptance testing as follows:
 - 1. Inspect mechanical and electrical connections.
 - 2. Verify switch and relay type and labeling verification.
 - 3. Verify rating of installed fuses.
 - 4. Inspect proper installation of type, size, quantity, and arrangement of mounting or anchorage devices complying with manufacturer's certification.

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5. Test insulation resistance for each enclosed switch, circuit breaker, component, and control circuit.
6. Test continuity of each line- and load-side circuit

B. Perform the following field tests and inspections and prepare test reports:

1. Test mounting and anchorage devices according to requirements in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.5 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges. Verify settings with Engineer of record.

3.6 CLEANING

- A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.
- B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 262816

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SECTION 26 2923 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes separately enclosed, pre-assembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. CE: Conformance Europeene (European Compliance).
- C. CPT: Control power transformer.
- D. EMI: Electromagnetic interference.
- E. IGBT: Insulated-gate bipolar transistor.
- F. LAN: Local area network.
- G. LED: Light-emitting diode.
- H. MCP: Motor-circuit protector.
- I. NC: Normally closed.
- J. NO: Normally open.
- K. OCPD: Overcurrent protective device.
- L. PCC: Point of common coupling.
- M. PID: Control action, proportional plus integral plus derivative.
- N. PWM: Pulse-width modulated.
- O. RFI: Radio-frequency interference.

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- P. TDD: Total demand (harmonic current) distortion.
- Q. THD(V): Total harmonic distortion (voltage).
- R. VFC: Variable-frequency motor controller.
- S. VFD: Variable-frequency drive. Used interchangeably with VFC.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: VFCs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 ACTION SUBMITTALS

- A. Product Data: For each type and rating of VFC indicated. Include features, performance, electrical ratings, operating characteristics, shipping and operating weights, and furnished specialties and accessories.
- B. Shop Drawings: For each VFC indicated. Include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting arrangements, and details, including required clearances and service space around equipment.
 - 1. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Each installed unit's type and details.
 - b. Factory-installed devices.
 - c. Enclosure types and details.
 - d. Nameplate legends.
 - e. Short-circuit current (withstand) rating of enclosed unit.
 - f. Features, characteristics, ratings, and factory settings of each VFC and installed devices.
 - g. Specified modifications.
 - 2. Schematic and Connection Wiring Diagrams: For power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around VFCs. Show VFC layout and relationships between electrical components and adjacent structural and mechanical elements.

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Show support locations, type of support, and weight on each support. Indicate field measurements.

- B. Seismic Qualification Certificates: For VFCs, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.
- C. Product Certificates: For each VFC, from manufacturer.
- D. Harmonic Analysis Study and Report: Comply with IEEE 399 and NETA Acceptance Testing Specification; identify the effects of nonlinear loads and their associated harmonic contributions on the voltages and currents throughout the electrical system. Analyze possible operating scenarios, including recommendations for VFC input filtering to limit TDD and THD(V) at each VFC to specified levels at the point of common coupling as defined by IEEE-519-1992.
- E. Source quality-control reports.
- F. Field quality-control reports.
- G. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals. Include the following:
 - 1. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and MCP trip settings.
 - 2. Manufacturer's written instructions for setting field-adjustable overload relays.
 - 3. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
 - 4. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

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1. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Indicating Lights: Two of each type and color installed.
4. Auxiliary Contacts: Furnish two spare(s) for each size and type of magnetic controller installed.
5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.9 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. IEEE Compliance: Fabricate and test VFC according to IEEE 344 to withstand seismic forces defined in Section 26 0548 "Vibration and Seismic Controls for Electrical Systems."

1.10 DELIVERY, STORAGE, AND HANDLING

- A. If stored in space that is not permanently enclosed and environmentally controlled, remove loose packing and flammable materials from inside controllers and install temporary electric heating, with at least 250 W per controller.

1.11 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions unless otherwise indicated:
 1. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F
 2. Humidity: Less than 95 percent (noncondensing).
 3. Altitude: Not exceeding 3300 feet.
- B. Interruption of Existing Electrical Systems: Do not interrupt electrical systems in facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 1. Notify Owner no fewer than 14 days in advance of proposed interruption of electrical systems.
 2. Indicate method of providing temporary electrical service.
 3. Do not proceed with interruption of electrical systems without Owner's written permission.
 4. Comply with NFPA 70E.

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- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items.

1.12 COORDINATION

- A. Coordinate features of motors, load characteristics, installed units, and accessory devices to be compatible with the following:
 - 1. Torque, speed, and horsepower requirements of the load.
 - 2. Ratings and characteristics of supply circuit and required control sequence.
 - 3. Ambient and environmental conditions of installation location.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.
- C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.13 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB.
 - 2. Danfoss Inc.; Danfoss Drives Div.
 - 3. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 4. Siemens Energy & Automation, Inc.
 - 5. Square D; a brand of Schneider Electric.
- B. General Requirements for VFCs: Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508C.
- C. Application: Constant torque and/or variable torque units shall be supplied for the specific equipment usage. This may include one or both types of VFCs. The manufacturer shall be

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consulted for each specific VFC application to determine the recommended type of VFC to be used.

- D. VFC Description: Variable-frequency power converter (rectifier, dc bus, and IGBT, PWM inverter) factory packaged in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.
 - 1. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
 - 2. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.
- E. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
 - 1. Variable Frequency Controllers shall be of 6-pulse or 12-pulse design with sufficient harmonic distortion mitigation to limit TDD and THD (V) to 2.5% at the defined PCC or per IEEE 519 if more stringent.
- F. Output Rating: Three-phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range.
- G. Unit Operating Requirements:
 - 1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFC input voltage rating.
 - 2. Input AC Voltage Unbalance: Not exceeding 3 percent.
 - 3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
 - 4. Minimum Efficiency: 96 percent at 60 Hz, full load.
 - 5. Minimum Displacement Primary-Side Power Factor: 96 percent under any load or speed condition.
 - 6. Minimum Short-Circuit Current (Withstand) Rating: 65 kA.
 - 7. Ambient Temperature Rating: Not less than 14 deg F and not exceeding 104 deg F.
 - 8. Ambient Storage Temperature Rating: Not less than minus 4 deg F and not exceeding 140 deg F
 - 9. Humidity Rating: Less than 95 percent (noncondensing).
 - 10. Altitude Rating: Not exceeding 3300 feet.
 - 11. Vibration Withstand: Comply with IEC 60068-2-6.
 - 12. Overload Capability: 1.5 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
 - 13. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
 - 14. Speed Regulation: Plus or minus 5 percent.
 - 15. Output Carrier Frequency: Selectable; 0.5 to 15 kHz.
 - 16. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.
- H. Inverter Logic: Microprocessor based, 32 bit, isolated from all power circuits.

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- I. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.
 - 1. Signal: Electrical.
- J. Internal Adjustability Capabilities:
 - 1. Minimum Speed: 5 to 25 percent of maximum rpm.
 - 2. Maximum Speed: 80 to 100 percent of maximum rpm.
 - 3. Acceleration: 0.1 to 999.9 seconds.
 - 4. Deceleration: 0.1 to 999.9 seconds.
 - 5. Current Limit: 30 to minimum of 150 percent of maximum rating.
- K. Self-Protection and Reliability Features:
 - 1. Input transient protection by means of surge suppressors to provide three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
 - 2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
 - 3. Under- and overvoltage trips.
 - 4. Inverter overcurrent trips.
 - 5. VFC and Motor Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor overload alarm and trip; settings selectable via the keypad; NRTL approved.
 - 6. Critical frequency rejection, with three (minimum) selectable, adjustable deadbands.
 - 7. Instantaneous line-to-line and line-to-ground overcurrent trips.
 - 8. Loss-of-phase protection.
 - 9. Reverse-phase protection.
 - 10. Short-circuit protection.
 - 11. Motor overtemperature fault.
 - 12. Interlocking of motor disconnect switches to prevent VFC damage.
- L. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.
- M. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.
- N. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.
- O. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

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- P. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
- Q. Integral Input Disconnecting Means and OCPD: NEMA AB 1, instantaneous-trip circuit breaker; NEMA AB 1, molded-case switch, with power fuse block and current-limiting fuses; NEMA AB 1, thermal-magnetic circuit breaker; NEMA KS 1, nonfusible switch, with power fuse block and current-limiting fuses; or NEMA KS 1, fusible switch with pad-lockable, door-mounted handle mechanism.
 - 1. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFC input current rating, whichever is larger.
 - 2. Auxiliary Contacts: NO/NC, arranged to activate before switch blades open.
 - 3. Lockable in the OFF position.
 - 4. Auxiliary contacts "a" and "b" arranged to activate with circuit-breaker handle.
 - 5. Form 'C' NC and NO alarm contact that operates only when circuit breaker has tripped.

2.2 CONTROLS AND INDICATION

- A. Status Lights: Door-mounted LED indicators displaying the following conditions:
 - 1. Power on.
 - 2. Run.
 - 3. Overvoltage.
 - 4. Line fault.
 - 5. Overcurrent.
 - 6. External fault.
- B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
 - 1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
 - 2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.
 - a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.
- C. Historical Logging Information and Displays:
 - 1. Real-time clock with current time and date.
 - 2. Running log of total power versus time.
 - 3. Total run time.
 - 4. Fault log, maintaining last four faults with time and date stamp for each.

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- D. Indicating Devices: Digital display and additional readout devices as required, mounted flush in VFC door and connected to display VFC parameters including, but not limited to:
1. Output frequency (Hz).
 2. Motor speed (rpm).
 3. Motor status (running, stop, fault).
 4. Motor current (amperes).
 5. Motor torque (percent).
 6. Fault or alarming status (code).
 7. PID feedback signal (percent).
 8. DC-link voltage (V dc).
 9. Set point frequency (Hz).
 10. Motor output voltage (V ac).
- E. Control Signal Interfaces:
1. Electric Input Signal Interface:
 - a. A minimum of two programmable analog inputs: 0- to 10-V dc and 4- to 20-mA dc.
 - b. A minimum of six multifunction programmable digital inputs.
 2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BAS or other control systems:
 - a. 0- to 10-V dc.
 - b. 4- to 20-mA dc.
 - c. Potentiometer using up/down digital inputs.
 - d. Fixed frequencies using digital inputs.
 3. Output Signal Interface: A minimum of two programmable analog output signal(s) (0- to 10-V dc and 4- to 20-mA dc, which can be configured for any of the following:
 - a. Output frequency (Hz).
 - b. Output current (load).
 - c. DC-link voltage (V dc).
 - d. Motor torque (percent).
 - e. Motor speed (rpm).
 - f. Set point frequency (Hz).
 4. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
 - a. Motor running.
 - b. Set point speed reached.
 - c. Fault and warning indication (overtemperature or overcurrent).
 - d. PID high- or low-speed limits reached.

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- F. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.
 - 1. Number of Loops: Two.
- G. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display VFC status and alarms and energy usage. Data available to the BAS must include all commands (on, off, speed) and status control setpoints, zone process variables and controller alarms. Allows VFC to be used with an external system within a multidrop LAN configuration; settings retained within VFC's nonvolatile memory.
 - 1. Network Communications Ports: Ethernet and RS-422/485.
 - 2. Embedded BAS Protocols for Network Communications: ASHRAE 135 BACnet, Echelon LonWorks, Johnson Metasys N2 and Modbus/Memobus protocols accessible via the communications ports.

2.3 LINE CONDITIONING AND FILTERING

- A. Input Line Conditioning: Based on the harmonic analysis study and report, provide input filtering, as required, to limit TDD and THD(V) to 2.5% at the defined PCC or per IEEE 519 if more stringent.
 - 1. In addition to limits defined above, limit worst case THD(V) on source panelboards feeding multiple VFCs to 5% or per IEEE 519 if more stringent.
- B. EMI/RFI Filtering: CE marked; certify compliance with IEC 61800-3 for Category C2.

2.4 BYPASS SYSTEMS

- A. Bypass Operation: Safely transfers motor between power converter output and bypass circuit, manually, automatically, or both. Selector switches set modes and indicator lights indicate mode selected. Unit is capable of stable operation (starting, stopping, and running) with motor completely disconnected from power converter.
- B. Bypass Mode: Manual operation only; requires local operator selection at VFC. Transfer between power converter and bypass contactor and retransfer shall only be allowed with the motor at zero speed.
- C. Bypass Controller: Three-contactor-style bypass allows motor operation via the power converter or the bypass controller; with input isolating switch and barrier arranged to isolate the power converter input and output and permit safe testing and troubleshooting of the power converter, both energized and de-energized, while motor is operating in bypass mode.
 - 1. Bypass Contactor: Load-break, IEC-rated contactor.
 - 2. Input and Output Isolating Contactors: Non-load-break, IEC-rated contactors.

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3. Isolating Switch: Provide manual bypass consisting of a door interlocked main fused disconnect padlockable in the off position.

D. Bypass Contactor Configuration: Full-voltage (across-the-line) type.

1. Provide four position AUTO/OFF/LINE/TEST selector switch: Which allows normal automatic VFC operation of the motor in “AUTO” position; de-energizing of the motor in “OFF” position; bypass, full-voltage (across-the-line), starting and operation of motor in the “LINE” position; and bypass operation of the motor while allowing testing and adjusting of VFC in the “TEST” position.
2. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.
 - a. Operating Voltage: Depending on contactor IEC size and line-voltage rating, manufacturer's standard matching control power or line voltage.
 - b. Power Contacts: Totally enclosed, double break, and silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
3. Overload Relays: NEMA ICS 2.
 - a. Solid-State Overload Relays:
 - 1) Switch or dial selectable for motor-running overload protection.
 - 2) Sensors in each phase.
 - 3) Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
 - 4) Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
 - 5) Analog communication module.
 - b. Form ‘C’ NC and NO isolated overload alarm contact.
 - c. External overload reset push button.

2.5 OPTIONAL FEATURES

- A. Multiple-Motor Capability: VFC suitable for variable-speed service to multiple motors. Overload protection shuts down VFC and motors served by it, and generates fault indications, when overload protection activates.
 1. Configure to allow two or more motors to operate simultaneously at the same speed; separate overload relay for each controlled motor.
- B. Damper control circuit with end of travel feedback capability.
- C. Motor Preheat Function: Preheats motor when idle to prevent moisture accumulation in the motor.

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- D. Firefighter's Override (Smoke Purge) Input: On a remote contact closure from the firefighter's control station or the smoke-control fan controller, whichever is applicable on this project, this password-protected input:
 - 1. Overrides all other local and external inputs (analog/digital, serial communication, and all keypad commands).
 - 2. Forces VFC to operate motor, without any other run or speed command, at a field-adjustable, preset speed.
 - 3. Forces VFC to transfer to Bypass Mode and operate motor at full speed.
 - 4. Causes display of Override Mode on the VFC display.
 - 5. Reset VFC to normal operation on removal of override signal automatically.
- E. Communication Port: RS-232 port, USB 2.0 port, or equivalent connection capable of connecting a printer and a notebook computer.

2.6 ENCLOSURES

- A. Variable frequency drives shall be located indoors, unless approved by the University.
- B. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.
 - 1. Dry and Clean Indoor Locations: Type 1.
 - 2. Outdoor Locations: Type 4X (only allowed with written approval from University).
 - 3. Kitchen and/or Wash-Down Areas: Type 4X, stainless steel.
 - 4. Other Wet or Damp Indoor Locations: Type 4X.
 - 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.
- C. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFC as "Plenum Rated."

2.7 ACCESSORIES

- A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFC enclosure cover unless otherwise indicated.
 - 1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, oiltight type.
 - a. Push Buttons: Recessed or shielded types.
 - b. Pilot Lights: LED types; push to test.
 - c. Selector Switches: Rotary type.
 - d. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.
- B. Reversible NC/NO bypass contactor auxiliary contact(s).

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- C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.
- D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
 - 1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.
- E. Supplemental Digital Meters:
 - 1. Elapsed-time meter.
 - 2. Kilowatt meter.
 - 3. Kilowatt-hour meter.
- F. Breather and drain assemblies, to maintain interior pressure and release condensation in NEMA Type 4 and 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- G. Space heaters, with NC auxiliary contacts, to mitigate condensation in NEMA Type 4 and 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- H. Cooling Fan and Exhaust System: For NEMA 250, Type 1, 4 and 4X; UL 508 component recognized: Supply fan, with stainless steel intake and exhaust grills and filters; 120-V ac; obtained from integral CPT.
- I. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.
- J. Spare control-wiring terminal blocks; wired.

2.8 MOTORS

- A. Motors to be used with Variable Frequency Controllers shall be inverter duty motors.
- B. Cabling from VFCs to motors shall be enclosed in appropriate raceway system; exposed cabling is unacceptable.
- C. Motors to be used with Variable Frequency Controllers shall be equipped with shaft grounding rings bonded to the building grounding system to dissipate any voltages on shafts and extend the life of the motors.

2.9 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2.

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1. Test each VFC while connected to its specified motor.
 2. Verification of Performance: Rate VFCs according to operation of functions and features specified.
- B. VFCs will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance.
- B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 HARMONIC ANALYSIS STUDY

- A. Prepare a harmonic analysis study and report complying with IEEE 519 and NETA Acceptance Testing Specification.

3.3 INSTALLATION

- A. Coordinate layout and installation of VFCs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Wall-Mounting Controllers: Install VFCs on walls with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished floor unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 26 0529 "Hangers and Supports for Electrical Systems."
- C. Floor-Mounting Controllers: Install VFCs on 4-inch nominal thickness concrete base.
 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.

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2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- D. Roof-Mounting Controllers: Install VFC on roofs with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished roof surface unless otherwise indicated, and by bolting units to curbs or mounting on freestanding, lightweight, structural-steel channels bolted to curbs. Seal roof penetrations after raceways are installed.
1. Structural-steel channels are specified in Section 26 0529 "Hangers and Supports for Electrical Systems."
- E. Seismic Bracing: Comply with requirements specified in Section 26 0548 "Vibration and Seismic Controls for Electrical Systems."
- F. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- G. Install fuses in each fusible-switch VFC.
- H. Install fuses in control circuits if not factory installed.
- I. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- J. Comply with NECA 1.

3.4 IDENTIFICATION

- A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."
1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 2. Label each VFC with engraved nameplate.
 3. Label each enclosure-mounted control and pilot device.
- B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.5 CONTROL WIRING INSTALLATION

- A. Install wiring between VFCs and remote devices and facility's central-control system.

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- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic control devices where applicable.
 - 1. Connect selector switches to bypass only those manual- and automatic control devices that have no safety functions when switches are in manual-control position.
 - 2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.6 FIELD QUALITY CONTROL

- A. Control System Integrator: Engage a control system integrator to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Control System Integrator: Engage a control system integrator to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- D. Tests and Inspections:
 - 1. Inspect VFC, wiring, components, connections, and equipment installation.
 - 2. Test and adjust controllers, components, and equipment.
 - 3. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
 - 4. Test continuity of each circuit.
 - 5. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Construction Manager and the Engineer of Record before starting the motor(s).
 - 6. Test each motor for proper phase rotation.
 - 7. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 8. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- E. VFCs will be considered defective if they do not pass tests and inspections.

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- F. Prepare test and inspection reports, including a certified report that identifies the VFC. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.7 STARTUP SERVICE

- A. Engage a Control Systems Integrator to perform control integration of all data communications to/from the BAS and all other startup services. Control Systems Integrator shall be responsible for proper interfacing of VFCs to the BAS and verification of proper setting of all protective features and elements of the system.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.8 ADJUSTING

- A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.
- B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify the Construction manager and the Engineer of Record before increasing settings.
- D. Set field-adjustable pressure switches.

3.9 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.
- B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFCs.

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END OF SECTION 262923

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SECTION 263213 - ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes packaged engine-generator sets for emergency standby power supply with the following features:
 - 1. Diesel engine.
 - 2. Unit-mounted cooling system.
 - 3. Unit-mounted control and monitoring.
 - 4. Fuel system.
 - 5. Outdoor enclosure.
- B. Related Sections include the following:
 - 1. Division 26 Section "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.3 DEFINITIONS

- A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 SUBMITTALS

- A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:
 - 1. Thermal damage curve for generator.
 - 2. Time-current characteristic curves for generator protective device.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

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1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified. Indicate access requirements affected by height of subbase fuel tank.
 2. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 3. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
 4. Wiring Diagrams: Power, signal, and control wiring.
 5. Maintenance platform detailed construction.
 6. Circuit breakers installed at the generator.
- C. Manufacturer Seismic Qualification Certification: Submit certification that subbase-mounted fuel-tank, engine-generator set, batteries, battery racks, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Qualification Data: For installer and manufacturer.
- E. Source quality-control test reports.
1. Certified summary of prototype-unit test report.
 2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
 3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
 4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
 5. Report of sound generation.
 6. Report of exhaust emissions showing compliance with applicable regulations, including EPA requirements.
 7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.
- F. Field quality-control test reports.

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- G. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
- H. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
 - 1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project site.
 - 2. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints of engine skid mounts, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 200 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.
- C. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with ASME B15.1.
- F. Comply with NFPA 37.
- G. Comply with NFPA 70.
- H. Comply with NFPA 110 requirements for Level 1 emergency power supply system.
- I. Comply with UL 2200.
- J. Engine Exhaust Emissions: Comply with applicable state and local government requirements.
- K. Noise Emission: Comply with a maximum sound pressure of 85 dB at 23 feet from the unit due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation and taking noise reflected from the building into account.

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1.6 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Architect no fewer than fourteen (14) days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Architect's written permission.
- B. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: Minus 15 to plus 40 deg C.
 - 2. Relative Humidity: 0 to 95 percent.
 - 3. Altitude: Sea level to 1000 feet.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of final inspection and acceptance..

1.9 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

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1.10 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: One for every 10 of each type and rating, but no fewer than three of each.
 - 2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
 - 3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Caterpillar; Engine Div.
 - 2. Generac Power Systems, Inc.
 - 3. Kohler Co.; Generator Division.
 - 4. Magnetek, Inc.
 - 5. Onan/Cummins Power Generation; Industrial Business Group.
 - 6. Spectrum Detroit Diesel.

2.2 ENGINE-GENERATOR SET

- A. Factory-assembled and -tested, engine-generator set.
- B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
 - 1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.
- C. Capacities and Characteristics:
 - 1. Power Output Ratings: Nominal ratings as indicated herein , with capacity as required to operate as a unit as evidenced by records of prototype testing.
 - 2. Output Connections: Three-phase, four wire.
 - 3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
- D. Generator-Set Performance:
 - 1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.

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2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
8. Below requires 10-second maximum start time under specific conditions and includes startup only, not load assumption.
9. Start Time: Comply with NFPA 110, Type 10, system requirements.
 - a. This generator will be used to provide emergency standby power for egress lighting. The transfer switch and generator system shall provide rated voltage and frequency to the egress lighting system within 10-seconds from the time the normal power source to the transfer switch has been de-energized.

2.3 ENGINE

- A. Fuel: #2 Diesel.
- B. Rated Engine Speed: 1800 rpm.
- C. Lubrication System: The following items are mounted on engine or skid:
 1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
 2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
 3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- D. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.
- E. Governor: Adjustable isochronous, with speed sensing.

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- F. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
 2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
 4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
 5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
 - a. Rating: **50-psig** maximum working pressure with coolant at **180 deg F**, and noncollapsible under vacuum.
 - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
- G. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
1. Minimum sound attenuation of 25 dB at 500 Hz.
 2. Sound level measured at a distance of **23 feet** from exhaust discharge (and including engine, engine cooling-air intake and discharge, and other components of installation) after installation is complete shall be 85 dBA or less.
- H. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- I. Starting System: 24-V electric, with negative ground.
1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
 2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
 3. Cranking Cycle: As required by NFPA 110 for system level specified.
 4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least three times without recharging.
 5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
 6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.

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7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:
 - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
 - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
 - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
 - d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
 - e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
 - f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.4 FUEL OIL STORAGE

A. Subbase-Mounted Fuel Tank.

1. Tank:
 - a. The diesel fuel storage system shall be in accordance with North Carolina Fire Prevention Code. The unit shall be equipped with a UL labeled subbase-mounted fuel tank that shall have a storage capacity of 2000 gallons (minimum) and shall be supplied with a low fuel level alarm float switch and a lockable, exterior located vandal resistant fill cap.
 - b. Subbase-mounted fuel tank shall be of double wall construction or shall be equipped with a fuel containment basin with a normal capacity of 120% of the tank capacity. Leak detection with alarm function shall be provided within secondary containment.
 - c. Unit shall be provided with all necessary fuel vent lines for proper engine performance as well as a means to readily detect the fuel level in the tank without the use of a measuring stick.

B. Comply with NFPA 30.

C. Maintenance/Repair Platform: Provide elevated maintenance/repair platform around sides and electrical alternator end of generator set; platform shall be equipped with handrails and steps and shall be at a height to allow access to all components that may require maintenance or

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repair and will depend on the height added to the generator set height by the subbase-mounted fuel tank. Platform shall be sized to allow full swing of generator doors and replacement of all internal replaceable components and shall meet all required clearances recommended by the manufacturer, required by applicable codes or required by the Authority Having Jurisdiction.

2.5 CONTROL AND MONITORING

- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.
- B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.
- C. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.
- D. Indicating and Protective Devices and Controls as required by NFPA 110 for Level 1 system, and the following:
 - 1. AC voltmeter.
 - 2. AC ammeter.
 - 3. AC frequency meter.
 - 4. DC voltmeter (alternator battery charging).
 - 5. Engine-coolant temperature gage.
 - 6. Engine lubricating-oil pressure gage.
 - 7. Running-time meter.
 - 8. Ammeter-voltmeter, phase-selector switch(es).
 - 9. Generator-voltage adjusting rheostat.
 - 10. Start-stop switch.
 - 11. Overspeed shutdown device.
 - 12. Coolant high-temperature shutdown device.
 - 13. Coolant low-level shutdown device.
 - 14. Oil low-pressure shutdown device.
 - 15. Fuel tank high-level shutdown of fuel supply alarm.
 - 16. Generator overload.
- E. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

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- F. Connection to Data Link: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals. Data system connections to terminals are covered in Division 26 Section "Electrical Power Monitoring and Control."
- G. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.
 - 1. Overcrank shutdown.
 - 2. Coolant low-temperature alarm.
 - 3. Control switch not in auto position.
 - 4. Battery-charger malfunction alarm.
 - 5. Battery low-voltage alarm.
- H. Remote Alarm Annunciator: An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.
- I. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Circuit Breakers shall be suitable for use as service equipment per the National Electrical Code requirements.
- B. Generator Circuit Breaker: Insulated-case, electronic-trip type; 100 percent rated; complying with UL 489.
 - 1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
 - 2. Trip Settings: Selected to coordinate with generator thermal damage curve.
 - 3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
 - 4. Mounting: Adjacent to or integrated with control and monitoring panel.
- C. LOAD SHED CONTROL: Upon generator overload, generator shall signal the lowest priority automatic transfer switch to switch to the neutral position.
 - 1. Provide the necessary control panel and internal logic circuit boards to monitor the generator load and/or frequency.
 - 2. Provide the necessary connections to the Automatic Transfer Switch(es) to perform the load shed based upon the generator overload condition.
 - 3. Provide all necessary conduit and wiring for this control function.

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2.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H or Class F.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- F. Enclosure: Weatherproof.
- G. Instrument Transformers: Mounted within generator enclosure.
- H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
 - 1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.
- I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.
- J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- K. Subtransient Reactance: 12 percent, maximum.

2.8 LOAD BANK

- A. Resistive Load Elements: Corrosion-resistant chromium alloy with ceramic and steel supports. Elements shall be double insulated and designed for repetitive on-off cycling. Elements shall be mounted in removable aluminized-steel heater cases.
- B. Reactive Load Elements: Epoxy-encapsulated reactor coils.
- C. tumbler locks.
- D. Contactor Enclosures: Heated by thermostatically controlled strip heaters to prevent condensation.
- E. Protective Devices: Power input circuits to load banks shall be fused, and fuses shall be selected to coordinate with generator circuit breaker. Fuse blocks shall be located in contactor enclosure. Cooling airflow and overtemperature sensors shall automatically shut down and lock

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out load bank until manually reset. Safety interlocks on access panels and doors shall disconnect load power, control, and heater circuits. Fan motor shall be separately protected by overload and short-circuit devices. Short-circuit devices shall be noninterchangeable fuses with 200,000-A interrupting capacity.

- F. Remote-Control Panel: Separate from load bank in NEMA 250, Type 1 enclosure with a control power switch and pilot light, and switches controlling groups of load elements.
- G. Control Sequence: Control panel may be preset for adjustable single-step loading of generator during automatic exercising.

2.9 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description: Vandal-resistant, weatherproof steel housing, wind resistant up to 100 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.
- B. Description: Prefabricated or pre-engineered reach-in enclosure with the following features:
 - 1. Construction: Galvanized-steel, metal-clad, integral structural-steel-framed building erected on concrete foundation.
 - 2. Structural Design and Anchorage: Comply with ASCE 7 for wind loads.
 - 3. Space Heater: Thermostatically controlled and sized to prevent condensation.
 - 4. Louvers: Equipped with bird screen and filter arranged to permit air circulation when engine is not running while excluding exterior dust, birds, and rodents.
 - 5. Hinged Doors: With padlocking provisions.
 - 6. Ventilation: Louvers equipped with bird screen and filter arranged to permit air circulation while excluding exterior dust, birds, and rodents.
 - 7. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine-generator-set components.
 - 8. Muffler Location: Within enclosure.
 - 9. Sound attenuated to 85 dBA or less as measured 23-ft. from any exterior wall surface of the generator set enclosure.
- C. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at standby rating with ambient temperature at top of range specified in system service conditions.
 - 1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.
- D. Convenience Outlets: Provide a minimum of 4 factory wired, GFCI receptacles.
- E. Sound attenuation:

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1. The entire enclosure except for the louvered openings shall have sound attenuation material mechanically attached to the interior surfaces of the unit.
2. The sound absorption material shall be held in place by a perforated galvanized metal sheeting to form a removable section easily inspected by maintenance personnel.
3. The sound attenuation material and fastening system shall apply to the enclosure roof as well as the side panels and doors.
4. The enclosure package shall be designed to achieve an 85dBA sound rating when measured at a distance of 23 feet, including sound reflected from the adjacent building.

F. Base and mounting:

1. The generator set and enclosure shall be mounted and shipped to the jobsite on a common structural steel sub-base. Provisions for crane unloading of the complete package shall be designed into the base of the unit.
2. The base and enclosure assembly shall allow room within the package to mount and maintain the specified battery charger, engine starting batteries, racks, and cables, generator mounted mainline circuit breaker(s), an engine/generator control panel, and other items as specified or as shown on the drawings.
3. The entire unit consisting of generator set, base, enclosure, and all other specified items including all liquids (i.e., fuel oil, lube oil and cooling water) shall be calculated by the manufacturer. The base of the unit shall be engineered, designed, and manufactured as a heavy duty, welded steel construction with four (4) point lifting provisions as used on heavy duty construction installations.
4. Details and manufacturer's certification of the base construction shall be included with the drawings submitted for approval.

G. Enclosure flooring:

1. The floor of the enclosure shall be designed and constructed in such a manner as to prevent the entrance of rodents. This may be accomplished with solid metal or expanded metal grating but, in any event, shall be capable of supporting any ancillary equipment specified which may be secured to it (such as batteries, subbase tanks, etc.) plus the anticipated weight of maintenance personnel and their tools.
2. Under no circumstances shall the floor area or any of its parts be considered for cooling air intake or discharge requirements of the generator set or its associated equipment, nor shall its properties as a "heat sink" or heat dissipating medium be utilized in any manner whatsoever in this application.

2.10 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.11 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

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1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
 1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
 2. Full load run.
 3. Maximum power.
 4. Voltage regulation.
 5. Transient and steady-state governing.
 6. Single-step load pickup.
 7. Safety shutdown.
 8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
 9. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.
- B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.
- B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- C. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

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3.3 CONNECTIONS

- A. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.
- B. Connect engine exhaust pipe to engine with flexible connector.
- C. Connect fuel piping to engines with a gate valve and union and flexible connector.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FUEL

- A. Provide the specified fuel for the generator fuel storage tank(s). Fill the fuel storage tank(s) to 100% full prior to testing and demonstration of the generator system to the Owner and Engineer. Refill the fuel storage tank(s) to 100% full after acceptance by the Owner and Engineer.

3.5 IDENTIFICATION

- A. Identify system components according to Division 26 Section "Identification for Electrical Systems."

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 as specified here including, but not limited to:

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- a. 100% load test of the generator. This test is designed to determine that the generator system will deliver full load output as connected at the site. Typically this test is performed prior to the building load testing and before final terminations of the emergency system conductors. The test shall be as follows:
 - 1) Generator load Bank Test:
 - a) The generator shall be subjected to a three-hour test using resistive load bank with a 1.0 power factor. This test shall be performed at the job site in the presence of the Engineer. The contractor shall provide the resistive load bank to test the generator.
 - b) One hour at 50% load.
 - c) One hour at 75% load.
 - d) One hour at 100% load.
 - e) Upon completion of the three-hour load test, the generator shall be shutdown after the cooling period. The generator shall be started and immediately upon reaching rated rpm, 100% load shall be applied to demonstrate one-step full load capability. The capability of the system to pick up full standby service load within 10 seconds of power outage shall be demonstrated.
 - 2) The following shall be recorded every thirty minutes during the load bank testing:
 - a) Engine water temperature.
 - b) Oil pressure.
 - c) Voltage per phase and neutral.
 - d) Amperes per phases and neutral.
 - e) Frequency, KW, KVA, and power factor.
 - f) Room or outdoor ambient temperature.
- b. Building load test. This test typically occurs after the Owner has effectively moved into the building and equipment such as refrigerators, freezers, testing equipment, fume hoods and computer equipment is operational. The test essentially determines that the generator system will automatically detect a power loss, automatically start, automatically switch the designated load to the generator in the specified time frame and power the building load for two hours. The load test utilizing the actual building loads and the observation and recording of load changes and the resultant effect on the voltage and frequency shall be a minimum duration of 2 hours of generator run time. A total time of 3-hours shall be allotted for the testing period. The tests shall be as follows:
 - 1) With the prime mover in a “cold start” condition and the emergency load at standard operating level, a primary power failure shall be initiated by opening the switch or breaker supplying the primary power to the building or facility. The test load shall be the load that the emergency generator serves.
 - 2) Observe and record the following during building load testing of the generator:

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- a) If the facility is equipped with a fire pump, the pump shall be energized and running for the initial 5-minute period of the load test, then the pump can be de-energized while the testing is in progress.
 - b) The time delay starting of the generator.
 - c) The cranking time until the prime mover starts and run.
 - d) The time that the generator reach the operating speed.
 - e) The time that the generator achieved steady-condition after the transfer switches transferred to the emergency position.
 - f) The generator voltage, frequency, amperes, prime mover oil pressure, and water temperature.
 - g) The battery charge rate shall be recorded at 5-minute intervals for the first 15 minutes and at 15-minute intervals thereafter.
 - h) When primary power is returned to the building or facility, the time delay on retransfer to the primary power for the transfer switch with a minimum setting of 5 minutes shall be recorded.
 - i) The time delay on the prime mover cool down period and shutdown shall be recorded.
- c. Phase loss test shall be performed to test the generator start circuit upon loss of any individual primary electrical phase serving the building. This may require a building power outage for the purpose of removing and then replacing individual primary fuses serving the building transformer. 600V main circuit breakers feeding the building loads should be opened for this test to prevent a single phase condition from occurring for the building motor loads. Starting of the generator during this test is optional provided the start circuits from the ATS(s) to the generator have already been previously tested and were found to be acceptable.
- d. Battery Tests: Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions.
- e. Check electrolyte level (if applicable) and specific gravity under both conditions. Test for contact integrity of all connectors.
- f. Verify acceptance of charge for each element of battery after discharge. Verify measurements are within manufacturer's specifications.
- g. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
- h. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks.
- i. A full tank of fuel shall be provided, replacing any fuel used for testing (N/A for natural gas).
- j. Diesel fuel shall be treated with an alcohol-free additive to disperse water and clean injectors.
- k. Copy of the generator's load test report shall be sent to the owner, and any state agency involved.
- l. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations, and compare measured levels with required values.

D. Coordinate tests with tests for transfer switches and run them concurrently.

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- E. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.
- F. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- G. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
- H. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- I. Remove and replace malfunctioning units and retest as specified above.
- J. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
- K. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- L. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each power wiring termination and each bus connection. Remove all access panels so terminations and connections are accessible to portable scanner.
 - 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.
 - 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 3. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 263213

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SECTION 263600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes transfer switches rated 600 V and less, including the following:
 - 1. Automatic transfer switches.
 - 2. Bypass/isolation switches.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
 - 1. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
 - 2. Wiring Diagrams: Detail wiring for transfer switches and differentiate between manufacturer-installed and field-installed wiring. Show both power and control wiring.
- C. Manufacturer Seismic Qualification Certification: Submit certification that transfer switches accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

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3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Qualification Data: For manufacturer.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Features and operating sequences, both automatic and manual.
2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.
- B. Source Limitations: Obtain automatic transfer switches and bypass/isolation through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NEMA ICS 1.
- E. Comply with NFPA 70.
- F. Comply with NFPA 110.
- G. Listed as compliant with UL 1008; comply with UL 1008 requirements unless requirements of these Specifications are stricter.

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:
 1. Notify Architect no fewer than fourteen (14) days in advance of proposed interruption of electrical service.
 2. Do not proceed with interruption of electrical service without Architect's written permission.

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1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Contactor Transfer Switches:
 - a. Caterpillar; Engine Div.
 - b. Emerson; ASCO Power Technologies, LP.
 - c. Generac Power Systems, Inc.
 - d. GE Zenith Controls.
 - e. Kohler Power Systems; Generator Division.
 - f. Onan/Cummins Power Generation; Industrial Business Group.
 - g. Russelectric, Inc.
 - h. Spectrum Detroit Diesel.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

- A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
 - 1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
- C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

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- F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 - 1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
 - 2. Switch Action: Double throw; mechanically held in both directions.
 - 3. Contacts: Silver plated copper. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.
- G. Neutral Switching. Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.
- H. Neutral Terminal: Solid and fully rated, unless otherwise indicated.
- I. Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.
- J. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device or available devices for future capabilities.
- K. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
 - 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
 - 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
- L. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.
- M. All feeders lugs, relays, timers, control wiring and accessories shall be front accessible.
- N. All transfer switch coils, springs, and control elements shall be easily inspectable and conveniently removable from the front of the transfer switch without major disassembly or disconnection of power conductors.
- O. Electrical Operation: Accomplish by a non-fused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.
- P. Multifunction Digital-Metering Monitor: Microprocessor-based unit equal to Square D PM650 suitable for three-or four-wire systems and with the following features:

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1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
 - a. Phase Current: A, B, C, N
 - b. Volts, Line to Line: A-C, C-B, C-A
 - c. Volts, Line to Neutral: A-N, B-N, C-N
 - d. Real Power (kW): A, B, C, Total
 - e. Reactive Power (kVar): A, B, C, Total
 - f. Apparent Power (kVA): A, B, C, Total
 - g. Power Factor (True): A, B, C, Total
 - h. Frequency
 - i. Real Energy (kWh): Three Phase Total
 - j. Reactive Energy (kVARh): Three Phase Total
 - k. Apparent Energy (KVah): Three Phase Total
 - l. Energy Accumulation Modes: Signed, Absolute, Energy In, Energy Out
 - m. KYZ Output
 - n. Communications
 - o. Front Display
 - p. THD, Voltage & Current: A, B, C
 - q. Current Demand: A, B, C, Present & Past
 - r. Power Demand (kWd, kVARd, kVAd): Three Phase Total, Present & Past
 - s. Date/Time Sampling: Peak Demands, Power Up/Restart, Resets
 - t. Predicted Power Demand: kW, kVAR, kVA
 - u. Advance Demand Options: Synch to Communications, Sliding Block Calculation
 - v. Onboard alarms: Over/Under Conditions. Phase Unbalance Conditions
 - w. Min/Max Readings: Frequency, Current, Voltage, Power, Power Factor, THD
 - x. Data and Event Logs
 - y. Downloadable Firmware
 - z. Revenue Accuracy, ANSI: C12.16
 - aa. Accuracy (of reading): Power/Energy – 5%, Current/Voltage – 2.5%
 - bb. Harmonic Response (Based on Sample Rate): 31
 - cc. UL Listed
2. Mounting: Display and control unit flush or semi-flush mounted in instrument compartment door.

2.3 AUTOMATIC TRANSFER SWITCHES

- A. Comply with Level 1 equipment according to NFPA 110.
- B. Switching Arrangement: Double-throw type, with time adjustable intermediate switching position where load is disconnected from both power sources during normal functioning, unless otherwise indicated.
- C. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.

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- D. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.
- E. Digital Communication Interface: To provide the capability to add remote annunciation or remote annunciation and control in the future.
- F. Transfer Switch Control System:
 - 1. The control module shall direct the operation of the transfer switch. The module's sensing and logic shall be microprocessor-based. The control settings shall be stored in non-volatile memory.
 - 2. The control module shall have a three-position, key-operated, programming control switch. The key shall be removable in any position. The positions shall be:
 - a. Off – Allows all enabled accessories to be monitored only. Settings cannot be changed while in this position.
 - b. Local – Allows all enabled accessory settings to be changed locally at the transfer switch control panel.
 - c. Remote – Allows all enabled accessories to be altered via the remote communications port.
- G. Automatic Transfer-Switch Features:
 - 1. Under-voltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
 - 2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
 - 3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
 - 4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
 - 5. Test Switch: Simulate normal-source failure.
 - 6. Switch-Position Pilot Lights: Indicate source to which load is connected.
 - 7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
 - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
 - 8. Unassigned Auxiliary Contacts: Two sets of timed normally open/normally closed (Form C), single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.

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9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts: Time delay adjustable from zero to thirty minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
 - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
 - b. Push-button programming control with digital LCD display of settings.
 - c. Integral battery operation of time switch when normal control power is not available.
13. Anti single phasing protection shall detect regenerative voltage as failed source condition. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes; factory set for 5 minutes. Provides automatic defeat of delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored. If emergency power source should fail during the time delay period, the time delay shall be by passed and the switch shall return, immediately, to the normal source.
14. Signal-Before-Transfer Contacts: A set of Form C dry contacts operates in advance of retransfer to normal source.
 - a. Interval is adjustable from 1 to 30 seconds, set from the factory at 1 second.
15. Auxiliary Contacts: Two sets of timed Form C, dry contacts for each switch position, rated 10 A at 240-V ac for elevator pre-transfer signal.

2.4 BYPASS/ISOLATION SWITCHES

- A. Comply with requirements for Level 1 equipment according to NFPA 110.
- B. Description: Manual type, arranged to select and connect either source of power directly to load, isolating transfer switch from load and from both power sources. Include the following features for each combined automatic transfer switch and bypass/isolation switch:
 1. Means to lock bypass/isolation switch in the position that isolates transfer switch with an arrangement that permits complete electrical testing of transfer switch while isolated. While isolated, interlocks prevent transfer-switch operation, except for testing or maintenance.

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2. Drawout Arrangement for Transfer Switch: Provide physical separation from live parts and accessibility for testing and maintenance operations.
 3. Bypass/Isolation Switch Current, Voltage, Closing, and Short-Circuit Withstand Ratings: Equal to or greater than those of associated automatic transfer switch, and with same phase arrangement and number of poles.
 4. Contact temperatures of bypass/isolation switches shall not exceed those of automatic transfer-switch contacts when they are carrying rated load.
 5. Operability: Constructed so load bypass and transfer-switch isolation can be performed by 1 person in no more than 2 operations in 15 seconds or less.
 6. Legend: Manufacturer's standard legend for control labels and instruction signs shall describe operating instructions.
 7. Maintainability: Fabricate to allow convenient removal of major components from front without removing other parts or main power conductors.
- C. Interconnection of Bypass/Isolation Switches with Automatic Transfer Switches: Factory-installed copper bus bars; plated at connection points and braced for the indicated available short-circuit current.

2.5 SOURCE QUALITY CONTROL

- A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Four-Pole Switches: Four-pole switches are required, install neutral switching.

3.2 INSTALLATION

- A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Floor-Mounting Switch: Anchor to floor by bolting.
1. Concrete Bases: 4 inches high, reinforced, with chamfered edges. Extend base no more than 4 inches in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."
- C. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.

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- D. Identify components according to Division 26 Section "Identification for Electrical Systems."
- E. Set field-adjustable intervals and delays, relays, and engine exerciser clock.
- F. When load shed circuits are specified the Automatic Transfer Switches shall be arranged to be switched to the neutral (no load) position unless otherwise shown on the drawings:
 - 1. Emergency (Life Safety) Standby Systems as defined by the National Electrical Code shall be the highest priority and shall be first to be connected to the emergency power source. This transfer switch shall not be load shed.
 - 2. Optional Standby Systems as defined by the National Electrical Code shall be the lowest priority and shall be the last load to be connected to the emergency power source and the first to be load shed during a generator overload condition.

3.3 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.
 - 2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
 - 3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

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- a. Check for electrical continuity of circuits and for short circuits.
 - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - c. Verify that manual transfer warnings are properly placed.
 - d. Perform manual transfer operation.
5. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
- a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
 - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
 - c. Verify time-delay settings.
 - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
 - e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
 - f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
 - g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
- a. Verify grounding connections and locations and ratings of sensors.
 - b. Assist in verifying grounding connections and locations and ratings of sensors.
 - c. Assist in observing reaction of circuit-interrupting devices when simulated fault current is applied at sensors.
- C. Coordinate tests with tests of generator and run them concurrently.
- D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- E. Remove and replace malfunctioning units and retest as specified above.
- F. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

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3. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Division 01 Section "Demonstration and Training."
- B. Coordinate this training with that for generator equipment.

END OF SECTION 263600

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SECTION 264313 - SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes field-mounted SPD for low-voltage (120 to 600 V) power distribution and control equipment.

1.3 DEFINITIONS

- A. ATS: Acceptance Testing Specifications.
- B. VPR: Voltage Protective rating.
- C. SPD: Surge Protective Device(s), both singular and plural; also, transient voltage surge suppression.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating weights, electrical characteristics, furnished specialties, and accessories.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For SPD devices, from manufacturer.
- B. Field quality-control reports.
- C. Warranties: Sample of special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For SPD devices to include in emergency, operation, and maintenance manuals.

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1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Replaceable Protection Modules: One of each size and type installed.

1.8 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.
- B. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.
- C. Listed to UL 1283 and UL 1449 3rd Edition by an OSHA approved NRTL.
- D. Comply with NFPA 70.

1.9 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Owner no fewer than 14-days in advance of proposed electrical service interruptions.
 - 2. Do not proceed with interruption of electrical service without Owner's written permission.
- B. Service Conditions: Rate SPD devices for continuous operation under the following conditions unless otherwise indicated:
 - 1. Maximum Continuous Operating Voltage(MCOV): Not less than 115 percent of nominal system operating voltage. The MCOV shall be a tested value per UL1449 3rd Edition, section 37.7.3. MCOV values submitted based solely on the MCOV of the surge components used in the SPD will not be accepted.
 - 2. Operating Temperature: 30 to 120 deg F.
 - 3. Humidity: 0 to 95 percent, noncondensing.
 - 4. Altitude: Less than 20,000 feet above sea level.

1.10 COORDINATION

- A. Coordinate location of field-mounted SPD devices to allow adequate clearances for maintenance.

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1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Fifteen years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SERVICE ENTRANCE SUPPRESSORS

- A. Service Entrance SPD shall be listed as a Type 1 SPD per UL1449 3rd Edition.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
 - 1. Current Technology Inc.; Thomas & Betts Power Solutions
 - 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 3. Liebert Corporation; a division of Emerson Network Power.
- C. Surge Protection Devices:
 - 1. Listed to UL 1449 3rd Edition by an OSHA approved NRTL.
 - 2. Modular design (with field-replaceable module(s)).
 - 3. Individual, electrically isolated fusing per MOV, rated at 200-kA interrupting capacity.
 - 4. Fabrication using bolted compression lugs for internal wiring.
 - 5. Integral disconnect switch (make the integral disconnect an option).
 - 6. Redundant suppression circuits.
 - 7. Arrangement with copper bus bars and for bolted connections to phase buses, neutral bus, and ground bus.
 - 8. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
 - 9. LED indicator lights for power and protection status.
 - 10. Audible alarm, with silencing switch, to indicate when protection has failed.
 - 11. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
- D. Peak Single-Impulse Surge Current Rating: 300 kA per mode/600 kA per phase.
- E. Minimum single impulse current ratings, using 8-by-20-mic.sec waveform described in IEEE C62.41.2
 - 1. Line to Neutral: 70,000A.
 - 2. Line to Ground: 70,000A.
 - 3. Neutral to Ground: 50,000 A.

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- F. Protection modes and UL 1449 VPR, based on 6kV,3kA per UL1449 3rd Edition for grounded wye circuits with 480Y/277 V or 208Y/120 V, 3-phase, 4-wire circuits shall be as follows:

1. Line to Neutral: 1200 V for 480Y/277 V, 700 V for 208Y/120 V.
2. Line to Ground: 1200 V for 480Y/277 V, 700 V for 208Y/120 V.
3. Neutral to Ground: 1500 V for 480Y/277 V, 1000 V for 208Y/120 V.

2.2 PANELBOARD SUPPRESSORS

- A. Panelboard suppressors shall be Type1 or Type2 listed per UL1449 3rd Edition.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Current Technology Inc.; Thomas & Betts Power Solutions.
 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 3. Liebert Corporation; a division of Emerson Network Power.
- C. Surge Protection Devices:
1. Comply with UL 1449 3rd Edition.
 2. Modular design (with field-replaceable module(s)).
 3. Short-circuit current rating complying with UL 1449, and matching or exceeding the panelboard short-circuit rating and redundant suppression circuits; with individually fused metal-oxide varistors.
 4. Individual, electrically isolated fusing per MOV, rated at 200-kA interrupting capacity.
 5. Fabrication using bolted compression lugs for internal wiring.
 6. Integral disconnect switch.
 7. Redundant suppression circuits.
 8. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
 9. LED indicator lights for power and protection status.
 10. Audible alarm, with silencing switch, to indicate when protection has failed.
 11. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
- D. Peak Single-Impulse Surge Current Rating: 150 kA per mode/300 kA per phase.
- E. Minimum single impulse current ratings, using 8-by-20-mic.sec waveform described in IEEE C62.41.2:
1. Line to Neutral: 70,000A.
 2. Line to Ground: 70,000A.
 3. Neutral to Ground: 50,000A.
- F. Protection modes and UL 1449 VPR, based on 6kV,3kA per UL1449 3rd Edition for grounded wye circuits with 480Y/277 V or 208Y/120 V, 3-phase, 4-wire circuits shall be as follows:

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1. Line to Neutral: 1200 V for 480Y/277 V, 700 V for 208Y/120 V.
2. Line to Ground: 1200 V for 480Y/277 V, 700 V for 208Y/120 V.
3. Neutral to Ground: 1500 V for 480Y/277 V, 1000 V for 208Y/120 V.

- G. Protection modes and UL 1449 VPR for 240 V, 480 V, or 600 V, 3-phase, 3-wire, delta circuits shall be as follows:

1. Line to Line: 1800 V for 480 V, 1200 V for 240 V.
2. Line to Ground: 1800 V for 480 V, 1200 V for 240 V.

2.3 ENCLOSURES

- A. Indoor Enclosures: NEMA 250 Type 1.
- B. Outdoor Enclosures: NEMA 250 Type 3R.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.
- C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
1. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
- B. Perform tests and inspections.
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Testing shall include the integrity of the upstream Neutral-Ground bond, as well as a performance clamping voltage test of the installed SPD.
- C. Tests and Inspections:

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1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.
 2. After installing SPD devices but before electrical circuitry has been energized, test for compliance with requirements.
 3. Complete startup checks according to manufacturer's written instructions.
- D. SPD device will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.3 STARTUP SERVICE

- A. Do not energize or connect service entrance equipment, panelboards, control terminals or data terminals to their sources until SPD devices are installed and connected.
- B. Do not perform insulation resistance tests of the distribution wiring equipment with the SPD installed. Disconnect before conducting insulation resistance tests, and reconnect immediately after the testing is over.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to maintain SPD devices.

END OF SECTION 264313

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SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior lighting fixtures, LED array boards and electronic drivers.
 - 2. Emergency lighting units.
 - 3. Exit signs.
 - 4. Lighting fixture supports.
- B. Related Sections include the following:
 - 1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
 - 2. Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

1.3 DEFINITIONS

- A. CRI: Color-rendering index.
- B. CU: Coefficient of utilization.
- C. HID: High-intensity discharge.
- D. LED: Light Emitting Diode.
- E. Luminaire: Complete lighting fixture, including driver housing if provided.
- F. RCR: Room cavity ratio.

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1.4 SUBMITTALS

- A. Product Data: Partial submittals are not acceptable. Submittals that are incomplete shall be cause for rejection for the entire submittal. For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
1. Physical description of lighting fixture including dimensions.
 2. Emergency lighting units.
 3. Lamp data shall include the following:
 - a. Average rated life @ 3 hours per start.
 - b. Color temperature in Kelvin.
 - c. Color Rendering Index.
 - d. Approximate Lumens initial @25°C.
 - e. Nominal Wattage.
 - f. Operating ambient temperature range.
 4. Driver data for each different type used on the project. The submittal must include the following information:
 - a. Input power ratings (watts) for the driver and fixture (where multiple drivers are required) as submitted.
 5. Energy-efficiency data.
 6. Life, output, and energy-efficiency data for lamps.
 7. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with LEDs, drivers, and accessories identical to those indicated for the lighting fixture as applied in this Project.
- B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
1. Wiring Diagrams: Power and control wiring.
- C. The lighting design was based on the lighting fixture type and manufacturers as specified. Only those fixtures specified are approved for installation. If the Contractor elects to substitute an alternative fixture they shall submit in detail complete catalog information on the proposed substitution as well as the specified fixture and provide lighting calculations of areas affected by the proposed substitutions. The proposed substitution shall be in all details completely equal to or better than the specified fixture. If requested by the Engineer, the Contractor shall provide, at no cost, a sample of each proposed substitution and each specified fixture for evaluation. In all cases, all requests for substitutions shall be completed not less than ten (10) days prior to bid date. Request received less than ten (10) days prior to bid will not be evaluated and will be returned "NOT ACCEPTABLE".
- D. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

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1. Lighting fixtures.
 2. Suspended ceiling components.
 3. Structural members to which suspension systems for lighting fixtures will be attached.
 4. Other items in finished ceiling including the following:
 - a. Air outlets and inlets.
 - b. Speakers.
 - c. Sprinklers.
 - d. Smoke and fire detectors.
 - e. Occupancy sensors.
 - f. Photo electric sensors for daylighting control.
 - g. Location of proposed access doors for non-accessible electrical equipment located above non-accessible ceilings.
 - 1) Junction boxes.
 - 2) Lighting fixtures equipped with junction boxes that are non-accessible through the bottom of the fixture.
 5. Perimeter moldings.
- E. Product Certificates: For each type of driver for bi-level and dimmer-controlled fixtures, signed by product manufacturer.
- F. Qualification Data: For agencies providing photometric data for lighting fixtures.
- G. Field quality-control test reports.
- H. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
- I. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 70.

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1.6 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 WARRANTY

- A. Special Warranty for Drivers and LED Array Boards: Manufacturer's standard form in which drivers and LED array board manufacturer agrees to repair or replace drivers or LED array boards that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Drivers and LED Array Boards: Ten (10) years from date of Final Acceptance of the Work.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. LED Array Boards: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Drivers: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 4. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
- B. On the Lighting Fixture Schedule located on the drawings or where titles within this specification section that introduce lists, the following requirements apply to product selection:
 - 1. Basis-of-Design Product: The design for each lighting fixture is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified on the Lighting Fixture Schedule or as listed herein for LED array boards and electronic drivers.

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2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

- A. A UL listing shall be provided for each fixture type, and the appropriate label or labels shall be affixed to each fixture in a position concealing it from normal view. UL labels shall not be installed on reflectors. Fixtures shall be listed according to their exposure in respective environments, e.g. wet location, damp location, shower light, etc.
- B. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit replacement of LED array boards or electronic drivers. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during maintenance and when secured in operating position.
- F. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
 - 4. Laminated Silver Metallized Film: 90 percent.
- G. Plastic Diffusers, Covers, and Globes:
 - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least 0.125 inch minimum unless different thickness is indicated.
 - b. UV stabilized.
 - 2. Glass: Annealed crystal glass, unless otherwise indicated.
- H. Electromagnetic-Interference Filters: Factory installed to suppress conducted electromagnetic-interference as required by MIL-STD-461E. Fabricate lighting fixtures with one filter on each electronic driver indicated to require a filter.

2.3 LIGHTING FIXTURES

- A. See lighting fixture schedule drawing for lighting fixture specifications.
- B. Miscellaneous
 - 1. All fixtures shall be completely wired at the factory.

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2. All fixtures shall be listed on the LED Lighting Facts website (www.lightingfacts.com), the Energy Star website (www.energystar.gov), or the Design Light Consortium website (www.designlights.org).
3. Light fixtures shall meet NEMA Standard 410-2011 for flicker.
4. Each recessed and semi-recessed fixture shall be finished with a mounting frame or ring compatible with the ceiling in which they are to be installed. The frames and rings shall be one (1) piece or constructed with electrically welded butt joints, and of sufficient size and strength to sustain the weight of the fixture.
5. It shall be the responsibility of the Contractor to make certain that all recessed fixtures have trims and mounting components compatible with the ceiling in which they are to be installed. Shop drawings shall clearly indicate the compatibility of the fixture to the ceiling.
6. The contractor shall use factory accessories for mounting and supporting the lighting fixtures in the ceilings.
 - a. Conduit sections installed and wired horizontally across ceiling grids and used for supporting lighting fixtures will not be accepted.
7. All materials, accessories, and other related fixture parts herein mentioned shall conform to the requirements of the drawings, specifications, and the agencies heretofore mentioned. They shall be new and free from defects which in any manner may impair their character, appearance, strength, durability and function, and shall be of prime quality intended for their respective purpose, and effectively protected from any damage or injury from the time of fabrication to the time of delivery and until final acceptance of the work. The above items shall meet with the approval of the Architect and Engineer who reserves the right of rejection prior to or after installation if found to be not in strict accordance with the true intent of the Contract.
8. All sheet metal work shall be free from tool marks and dents, and shall have accurate angles bent as sharp as compatible with the gauges of the required metal. All intersections and joints shall be formed true of adequate strength and structural rigidity to prevent any distortion after assembly. All sheet metal shall be void of light leaks. All edges shall be finished so there are no sharp edges exposed. All miters shall be in accurate alignment with abutting intersection members. Piecing of plates in individual runs on single plans, and the use of spliced pieces of filler materials to cover defective workmanship, will not be tolerated. Sheet metal work shall be properly fabricated in order that planes will not deform, that is, become concave or convex, due to normal expected ambient and operating conditions.
9. All lighting fixtures shall include a disconnecting means either internal or external to each luminaire to disconnect simultaneously from the supply source all conductors of the electronic driver, including the grounded conductor if any. The line side terminals of the disconnecting means shall be guarded. The disconnecting means shall be readily accessible and mounted either directly on the external housing or on the interior of the housing, so that no fixture parts, ceiling tiles or other building components are required be removed to access and operate the disconnect. The disconnect switch shall be in full compliance with the NEC 410.130 (G).

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2.4 ELECTRONIC LED DRIVERS

A. Characteristics:

1. Inrush Current: Meet NEMA 410-2011 standard for maximum inrush current.
2. Power Factor: 90% (minimum).
3. Total Harmonic Distortion: 10% (maximum).
4. Integral Surge Suppression: 2.5V (minimum).

2.5 EXIT SIGNS

A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction and with fixture specified.

1. Emergency Exit Sign: It shall be completely self-contained. Fixture must be third-party listed as emergency lighting equipment, and meet or exceed the following standards; NEC, N.C. Building Code, North Carolina Energy Code, NFPA-101, and NEMA Standards. LED: The use of LED is required due to their reliable performance, low power consumption, and limited maintenance requirements. Maximum LED failure rate shall be 25% within a seven (7) year period; otherwise, if exceeded, manufacturer shall replace the complete unit at no charge to the owner.

B. Internally Lighted Signs:

1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.

2.6 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.
- F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

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- H. Aircraft Cable Support: Use cable, anchorages, and intermediate supports recommended by fixture manufacturer.

2.7 REQUIREMENTS FOR INDIVIDUAL LIGHTING FIXTURES

- A. See Lighting Fixture Schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture. Lamp and socket orientations for similar fixtures shall be identical within each individual space.
- B. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Do not use grid as a support element.
 - 1. Where a recessed or downlight fixture replaces a section or a part of a ceiling tile, the fixture is to be supported:
 - a. At the two (2) opposite ends to the steel frame of the building with the same type of wire as used to support the lay-in ceiling track. Attach one end of the wire to one corner of the luminaire and the other end to the building's structural system.
 - b. The lay-in luminaire shall then be screwed to the main runners of the lay-in ceiling track at all four (4) corners using sheet metal screws.
 - c. For fire rated suspended ceiling, luminaire shall be supported to the Building Structure as per the Ceiling Design Criteria.
 - 2. Light leaks between ceiling trims of recessed lighting equipment and the ceiling will not be tolerated. Locate not more than 6 inches from fixture corners.
 - 3. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
 - 4. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees with listed clips installed per manufacturer's instructions.
 - 5. Install at least two independent support rods or wires from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- C. Suspended Lighting Fixture Support:
 - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging. Pendant rods shall be all-thread, minimum of 3/8" diameter Galvanized carbon steel.
 - 2. Stem-Mounted, Single-Unit Fixtures:

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- a. Common and office areas with non-industrial type fixtures:
 - 1) Suspend with single pendant or aircraft cable as indicated on the drawings.
 - 2) Provide swivel plate/connection at top of stem for stem hangers.
- b. Mechanical, Electrical Storage, Misc. rooms with industrial type fixtures:
 - 1) Suspend with twin-stem hangers or provide steel strut attached along the length of the fixture and a single stem attached to the strut.
 - 2) Provide swivel plate/connection at top of stem for stem hangers.
- 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
- 4. The Contractor shall furnish and install all necessary channels, support wires or rods, etc. to provide a structurally sound system.
- D. Provide adjustments to lighting fixtures that are designed to be modified in the field for light intensity aiming purposes.
 - 1. This shall be directed in the field by the engineer. The contractor shall notify the engineer in writing fourteen (14) days in advance to arrange a date and time for the adjustments.
 - 2. Lighting fixtures installed exterior to the building and/or in interior areas with exterior glass shall be adjusted after sunset.
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- F. Yokes, brackets and supplementary supporting members needed to mounting lighting fixtures to two (2) inch carrier channels or other suitable ceiling members shall be furnished and installed by the Contractor.

3.2 ACCESS DOORS

- A. Provide access doors for all electrical equipment that requires accessibility where installed concealed in non-accessible walls or ceilings.
 - 1. Minimum size door shall be 8" x 8".
 - 2. Suitable for installation in wall or ceiling type as specified on the architectural drawings.
 - 3. Where equipment is located more than 16" from the access door the door size must be increase to a minimum of 24" x 24".
 - 4. Coordinate all access door locations with the architect and Owner prior to installing any equipment in non-accessible walls and/or ceilings.

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3.3 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.4 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Verify normal operation of each fixture after installation.
- C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.
- D. Corroded Fixtures: During warranty period, replace fixtures that show any signs of corrosion.
- E. Reflectors, reflector cones and visible trim of all lighting fixtures shall not be installed until completion of plastering, ceiling tile work, painting and general cleanup. They shall be carefully handled to avoid scratching or fingerprinting and shall be, at the time of acceptance by the Owner, completely clean. All Alzak parabolic cones shall be guaranteed against discoloration for a minimum of two (2) years, and, in the event of premature discoloration, shall be replaced by the manufacturer, including both materials and the cost of labor.
- F. Upon completion of the installation, all lighting fixtures shall be cleaned to the satisfaction of the Engineer.
- G. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation.

END OF SECTION 265100

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SECTION 265600 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Exterior luminaires with lamps and ballasts.
 - 2. Luminaire-mounted photoelectric relays.
 - 3. Poles and accessories.
 - 4. Luminaire lowering devices.
- B. Related Sections include the following:
 - 1. Division 26 Section "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 DEFINITIONS

- A. CRI: Color-rendering index.
- B. HID: High-intensity discharge.
- C. Luminaire: Complete lighting fixture, including ballast housing if provided.
- D. Pole: Luminaire support structure, including tower used for large area illumination.
- E. Standard: Same definition as "Pole" above.

1.4 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

- A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4.
- B. Live Load: Single load of 500 lbf, distributed as stated in AASHTO LTS-4.
- C. Ice Load: Load of 3 lbf/sq. ft., applied as stated in AASHTO LTS-4.

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- D. Wind Load: Pressure of wind on pole and luminaire, calculated and applied as stated in AASHTO LTS-4.
1. Wind speed for calculating wind load for poles exceeding 50 feet in height is **[110 mph] [70 mph] <Insert value from AASHTO LTS-4 for this Project>.**
 2. Wind speed for calculating wind load for poles 50 feet or less in height is **[110 mph] [70 mph] <Insert value from AASHTO LTS-4 for this Project>.**

1.5 SUBMITTALS

- A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
 2. Details of attaching luminaires and accessories.
 3. Details of installation and construction.
 4. Luminaire materials.
 5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.
 - a. For indicated luminaires, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
 - b. Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 6. Photoelectric relays.
 7. Ballasts, including energy-efficiency data.
 8. Lamps, including life, output, and energy-efficiency data.
 9. Materials, dimensions, and finishes of poles.
 10. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
 11. Anchor bolts for poles.
 12. Manufactured pole foundations.
- B. Shop Drawings:
1. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
 2. Design calculations, certified by a qualified professional engineer, indicating strength of screw foundations and soil conditions on which they are based.
 3. Wiring Diagrams: Power[**and control**] wiring.
- C. Samples for Verification: For products designated for sample submission in Exterior Lighting Device Schedule. Each sample shall include lamps and ballasts.

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- D. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4 and that load imposed by luminaire has been included in design.
- E. Qualification Data: For agencies providing photometric data for lighting fixtures.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For **[luminaires][and poles] [luminaire lowering devices]** to include in emergency, operation, and maintenance manuals.
- H. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with IEEE C2, "National Electrical Safety Code."
- E. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Package aluminum poles for shipping according to ASTM B 660.
- B. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C. Handle wood poles so they will not be damaged. Do not use pointed tools that can indent pole surface more than 1/4 inch deep. Do not apply tools to section of pole to be installed below ground line.
- D. Retain factory-applied pole wrappings on fiberglass and laminated wood poles until right before pole installation. Handle poles with web fabric straps.
- E. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

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1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.
1. Warranty Period for Luminaires: **[Five]** <Insert number> years from date of Final Acceptance of the Work.
 2. Warranty Period for Metal Corrosion: **[Five]** <Insert number> years from date of Final Acceptance of the Work.
 3. Warranty Period for Color Retention: **[Five]** <Insert number> years from date of Final Acceptance of the Work.
 4. Warranty Period for Lamps: Replace lamps and fuses that fail within **[12]** <Insert number> months from date of Substantial Completion; furnish replacement lamps and fuses that fail within the second **[12]** <Insert number> months from date of Final Acceptance of the Work.
 5. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than **[three]** <Insert number> years from date of Final Acceptance of the Work.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Lamps: **[10 for every 100]** <Insert quantity> of each type and rating installed. Furnish at least one of each type.
 2. Glass and Plastic Lenses, Covers, and Other Optical Parts: **[10 for every 100]** <Insert quantity> of each type and rating installed. Furnish at least one of each type.
 3. Ballasts: **[10 for every 100]** <Insert quantity> of each type and rating installed. Furnish at least one of each type.
 4. Globes and Guards: **[10 for every 20]** <Insert quantity> of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
- B. In Exterior Lighting Device Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:

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1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
3. Basis of Design Product: The design of each item of exterior luminaire and its support is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 LUMINAIRES, GENERAL REQUIREMENTS

- A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
- B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
- G. Exposed Hardware Material: Stainless steel.
- H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
- J. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
 1. White Surfaces: 85 percent.
 2. Specular Surfaces: 83 percent.
 3. Diffusing Specular Surfaces: 75 percent.
- K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

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- L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- M. Factory-Applied Finish for Steel luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
 - 2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - a. Color: As selected from manufacturer's standard catalog of colors.
 - b. Color: Match Architect's sample of **[manufacturer's standard] [custom]** color.
 - c. Color: As selected by Architect from manufacturer's full range.
- N. Factory-Applied Finish for Aluminum luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - 2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
 - 3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
 - 4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
 - a. Color: **[Light bronze] [Medium bronze] [Dark bronze] [Black]**.

2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

- A. Comply with UL 773 or UL 773A.
- B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. **[Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.]**
 - 1. Relay with locking-type receptacle shall comply with NEMA C136.10.

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2. Adjustable window slide for adjusting on-off set points.

2.4 FLUORESCENT BALLASTS AND LAMPS

- A. Low-Temperature Ballast Capability: Rated by its manufacturer for reliable starting and operation of indicated lamp(s) at temperatures [0 deg F] [minus 20 deg F] and higher.
- B. Ballast Characteristics:
 1. Power Factor: 90 percent, minimum.
 2. Sound Rating: [A] [A, except B for T12/HO ballasts].
 3. Total Harmonic Distortion Rating: Less than [10] [20] percent.
 4. Electromagnetic Ballasts: Comply with ANSI C82.1, energy-saving, high power factor, Class P, automatic-reset thermal protection.
 5. Case Temperature for Compact Lamp Ballasts: 65 deg C, maximum.
 6. Transient-Voltage Protection: Comply with IEEE C62.41 Category A or better.
- C. Low-Temperature Lamp Capability: Rated for reliable starting and operation with ballast provided at temperatures [0 deg F] [minus 20 deg F] and higher.
- D. Fluorescent Lamps: Low-mercury type. Comply with the EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.

2.5 BALLASTS FOR HID LAMPS

- A. Comply with ANSI C82.4 and UL 1029 and capable of open-circuit operation without reduction of average lamp life. Include the following features, unless otherwise indicated:
 1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
 2. Minimum Starting Temperature: Minus 22 deg F.
 3. Normal Ambient Operating Temperature: 104 deg F.
 4. Ballast Fuses: One in each ungrounded power supply conductor. Voltage and current ratings as recommended by ballast manufacturer.
- B. Auxiliary, Instant-On, Quartz System: Factory-installed feature automatically switches quartz lamp on when fixture is initially energized and when momentary power outages occur. System automatically turns quartz lamp off when HID lamp reaches approximately 60 percent of light output.
- C. High-Pressure Sodium Ballasts: Electromagnetic type with solid-state igniter/starter and capable of open-circuit operation without reduction of average lamp life. Igniter/starter shall have an average life in pulsing mode of 10,000 hours at an igniter/starter-case temperature of 90 deg C.

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1. Instant-Restrike Device: Integral with ballast, or solid-state potted module, factory installed within fixture and compatible with lamps, ballasts, and mogul sockets up to 150 W.
 - a. Restrike Range: 105- to 130-V ac.
 - b. Maximum Voltage: 250-V peak or 150-V ac RMS.
2. Minimum Starting Temperature: Minus 40 deg F.

2.6 HID LAMPS

- A. High-Pressure Sodium Lamps: ANSI C78.42, CRI 21 (minimum), color temperature [1900] <Insert value> K, and average rated life of 24,000 hours, minimum.
 1. Dual-Arc Tube Lamp: Arranged so only one of two arc tubes is lighted at one time and, when power is restored after an outage, the cooler arc tube, with lower internal pressure, lights instantly, providing an immediate 8 to 15 percent of normal light output.
- B. Metal-Halide Lamps: ANSI C78.1372, with a minimum CRI [65] <Insert value>, and color temperature [4000] <Insert value> K.
- C. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature [4000] <Insert value> K.
- D. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI [80] <Insert value>, and color temperature [4000] <Insert value> K.

2.7 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

- A. Structural Characteristics: Comply with AASHTO LTS-4.
 1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in Part 1 "Structural Analysis Criteria for Pole Selection" Article, with a gust factor of 1.3.
 2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of [1.1] <Insert number> to obtain the equivalent projected area to be used in pole selection strength analysis.
- B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.
- C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
 1. Materials: Shall not cause galvanic action at contact points.
 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, unless stainless-steel items are indicated.

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3. Anchor-Bolt Template: Plywood or steel.

- D. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."
- E. Power-Installed Screw Foundations: Factory fabricated by pole manufacturer, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole base flange and strength required to support pole, luminaire, and accessories.
- F. Breakaway Supports: Frangible breakaway supports, tested by an independent testing agency acceptable to authorities having jurisdiction, according to AASHTO LTS-4.

2.8 STEEL POLES

- A. Poles: Comply with ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psig; 1-piece construction up to 40 feet in height with access handhole in pole wall.
 - 1. Shape: **[Round, tapered]** **[Round, straight]** **[Square, tapered]** **[Square, straight]**.
 - 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- B. Steel Mast Arms: **[Single-arm]** **[Truss]** **[Davit]** type, continuously welded to pole attachment plate. Material and finish same as pole.
- C. Brackets for Luminaires: Detachable, cantilever, without underbrace.
 - 1. Adapter fitting welded to pole and bracket, then bolted together with **[stainless]** **[galvanized]**-steel bolts.
 - 2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire.
 - 3. Match pole material and finish.
- D. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- E. Steps: Fixed steel, with nonslip treads, positioned for 15-inch vertical spacing, alternating on opposite sides of pole; first step at elevation 10 feet above finished grade.
- F. Intermediate Handhole and Cable Support: Weathertight, 3-by-5-inch handhole located at midpoint of pole with cover for access to internal welded attachment lug for electric cable support grip.
- G. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

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- H. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported cable times a 5.0 safety factor.
- I. Platform for Lamp and Ballast Servicing: Factory fabricated of steel with finish matching that of pole.
- J. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.
- K. Galvanized Finish: After fabrication, hot-dip galvanize complying with ASTM A 123/A 123M.
- L. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
 - 2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
 - 3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - a. Color: **[As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range].**

2.9 ALUMINUM POLES

- A. Poles: Seamless, extruded structural tube complying with ASTM B 429, Alloy 6063-T6 with access handhole in pole wall.
- B. Poles: ASTM B 209, 5052-H34 marine sheet alloy with access handhole in pole wall.
 - 1. Shape: **[Round, tapered] [Round, straight] [Square, tapered] [Square, straight].**
 - 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- C. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- D. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- E. Brackets for Luminaires: Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.

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1. Tapered oval cross section, with straight tubular end section to accommodate luminaire.
2. Finish: Same as [pole] [luminaire].

F. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

G. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
5. <Insert finish.>
 - a. Color: [Light bronze] [Medium bronze] [Dark bronze] [Black] [As selected by Architect from manufacturer's full range].

2.10 FIBERGLASS POLES

A. Poles: Comply with ANSI C136.20, with access handhole in pole wall.

1. Mounting: Embedded.
2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

B. Resin Color: [Dark bronze] <Insert color>; provide uniform coloration throughout entire wall thickness.

C. Surface Finish: Pigmented polyurethane, with a minimum dry film thickness of 1.5 mils.

2.11 DECORATIVE POLES

A. Pole Material:

1. Cast ductile iron.
2. Cast gray iron, according to ASTM A 48/A 48M, Class 30.
3. Cast aluminum.
4. Cast concrete.
5. Spun concrete.
6. Steel tube, covered with closed-cell polyurethane foam, with a polyethylene exterior.

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7. <Insert material.>

B. Mounting Provisions:

1. Bolted to concrete foundation.
2. Embedded.

C. Fixture Brackets:

1. Cast ductile iron.
2. Cast gray iron.
3. Cast aluminum.

D. Pole Finish: <Insert finish.>

2.12 LAMINATED WOOD POLES

- A. Species and Grades for Structural Glulam Timber: Engineer and fabricate structural laminated wood poles, complying with AITC 190.1. Use [southern pine] [Douglas fir] [Alaska cedar] [any species listed in AITC 117 - MANUFACTURING] to withstand indicated structural loads without exceeding allowable design working stresses according to AITC 117 - DESIGN.
- B. Features: Include [wood bracket] [wood crossarm] [pole-top adapter] <Insert other items> for mounting luminaire(s), [metal pole cap,]and concealed raceway path connected to access handhole.
- C. Mounting Provisions: [Embedded] <Insert description of other mounting, unless detailed on Drawings>.
- D. Appearance Grade: Architectural appearance grade complying with AITC 110.
- E. Preservative Treatment: Pressure treat lumber before gluing according to AWPAC28 for waterborne preservatives. After dressing and end-cutting each member to final size and shape, apply a field-treatment preservative to comply with AWPAC M4 to surfaces cut to a depth of more than 1/16 inch.
- F. Adhesive: Wet-use type complying with ASTM D 2559.
- G. End Sealer: Manufacturer's standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.
- H. Penetrating Sealer: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.
- I. Finish: [Natural, unstained wood] [Semitransparent stain applied after erection] [Semitransparent stain applied at factory], color as selected by Architect.

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2.13 WOOD POLES

- A. Poles: [**Douglas fir**] [**Southern yellow pine**], [**machine trimmed by turning**], complying with ANSI O5.1 and with AWP A C4 for wood species used; and bored, roofed, and galled before treatment.
 - 1. Mounting Provisions: Embedded.
- B. Preservative Treatment: Pressure treat poles with [**creosote**] [**pentachlorophenol**] [**ammoniacal copper arsenate**] according to AWP A C1 and AWP A C4.
- C. Luminaire Brackets: Comply with ANSI C136.13.

2.14 PRESTRESSED CONCRETE POLES

- A. Poles: Manufactured [**by centrifugal spin-casting process**] [**of cast concrete**].
 - 1. Shape: [**Round, tapered**] [**Round, straight**] [**Square, tapered**] [**Square, straight**].
 - 2. Mounting Provisions: [**Steel butt flange for bolted mounting to foundation or breakaway support**] [**Embedded**].
 - 3. Finishing: Capped at top and plugged at bottom. Seal each steel reinforcing strand with epoxy adhesive.
 - 4. Grounding: Continuous copper ground wire cast into pole. Terminate at top of pole [**and attach to 24-inch lightning rod**].
- B. Cure with wet steam and age for a minimum of 15 days before installation.
- C. Fabricate poles with a hard, nonporous surface that is resistant to water, frost, and road and soil chemicals and that has a maximum water-absorption rate of 3 percent.
- D. Cast aluminum nameplate into pole wall at approximately 5 feet above ground line, listing name of manufacturer, Project identifier, overall height, and approximate weight.
- E. Pole Brackets: Comply with ANSI C136.13.
- F. Finish Color: Provided by color material complying with ASTM C 979, uniformly impregnated throughout the pole concrete. Color material shall provide a uniform, stable, permanent **<Insert other adjectives>** color and be as follows:
 - 1. Inert, and carbon free.
 - 2. Unaffected by environmental conditions and contaminants including, but not limited to, UV solar radiation, salts, and alkalis.
- G. Finish Texture: [**Standard form**] [**Polished exposed aggregate**] [**Etched exposed aggregate**].
 - 1. Exposed aggregate shall be of **<Insert aggregate type selected from manufacturers' lists>** type.

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2.15 POLE ACCESSORIES

- A. Duplex Receptacle: 120 V, 20 A in a weatherproof assembly complying with Division 26 Section "Wiring Devices" for ground-fault circuit-interrupter type.
 - 1. **[Surface mounted] [Recessed], [12 inches] <Insert other mounting height>** above finished grade.
 - 2. Nonmetallic polycarbonate plastic or reinforced fiberglass cover, **<Insert color to match pole,>** that when mounted results in NEMA 250, Type **[3R] [4X]** enclosure.
 - 3. With cord opening.
 - 4. With lockable hasp and latch that complies with OSHA lockout and tag-out requirements.
- B. Minimum 1800-W transformer, protected by replaceable fuses, mounted behind access cover.
- C. Base Covers: Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.
- D. Transformer Type Base: Same material and color as pole. Coordinate dimensions to suit pole's base flange and accept **[ballast(s)] [indicated accessories]**.
- E. Decorative accessories, supplied by decorative pole manufacturer, include the following:
 - 1. Banner Arms: **<Insert material.>**
 - 2. Flag Holders: **<Insert material.>**
 - 3. Ladder Rests: **<Insert material.>**

2.16 LOWERING SYSTEM FOR LUMINAIRES

- A. Arrange system to lower luminaire**[assembly]** to a servicing position within 36 inches of finished grade in winds up to 30 mph and to provide for manual plug connection to electrical power in the lowered position for testing.
- B. Coordinate with luminaire and pole manufacturers for assembly details, wind-load and vibration analysis, and compatibility of materials for electrolysis-free attachment and connection for luminaire mounting assembly, lowering device, lowering cable, and portable winch.
- C. Structural and Mechanical Design: Use a minimum safety factor of 5.0 for static and dynamic loads of load-bearing components, including cable.
- D. Luminaire Mounting and Disconnect Arrangement: Multiple **[ring] [carriage]**-mounted luminaires, arranged for lowering and raising as a group.
 - 1. Electrical cable for normal operating power to luminaires manually disconnects inside pole base, using weatherproof multipin connector, and shall be arranged to move within the pole during lowering and raising of luminaire assembly.
 - 2. Electrical cable for normal operating power to luminaires automatically disconnects at a weatherproof multipin connector within the pole-top lowering head at the beginning of

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the lowering cycle and reconnects when luminaire or luminaire assembly is raised to the operating position.

- E. Lowering Device: Weatherproof, cast-aluminum housing and multiple mechanical latches. Moving parts of latching assembly shall be located in the portion of the unit that is lowered to the servicing position. Positive latching in the operating position shall be indicated to the operator at the base of the pole by a clear visual signal, or by other means acceptable to Owner or authorities having jurisdiction.
- F. Lowering Cable: [**Zinc-electroplated-**] [**Stainless-**] [**Zinc-electroplated- or stainless-**]steel aircraft cable.
- G. Portable Winch: [**Manual**] [**120 V electric**] type. [**One**] <Insert number> required.
 - 1. Winch Power Connection: Cord and plug.
 - 2. Winch Raise-Lower Control: Remote-control station with [**15 feet**] <Insert length> of cable.
- H. Winch Transformer: Portable, totally enclosed, encapsulated, single-phase, dry type. Primary rated at lighting-circuit voltage; secondary rated at 120 V. Permanent, primary and secondary, twist-locking plug connectors on pigtails shall match pole-base power outlet and winch plug.

2.17 REQUIREMENTS FOR INDIVIDUAL EXTERIOR LIGHTING DEVICES

- A. See Lighting Fixture Schedule.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

- A. Install lamps in each luminaire.
- B. Fasten luminaire to indicated structural supports.
 - 1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Adjust luminaires that require field adjustment or aiming.[**Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources.**]

3.2 POLE INSTALLATION

- A. Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.

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- B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features, unless otherwise indicated on Drawings:
1. Fire Hydrants and Storm Drainage Piping: **[60 inches] <Insert dimension>**.
 2. Water, Gas, Electric, Communication, and Sewer Lines: **[10 feet] <Insert dimension>**.
 3. Trees: **[15 feet] <Insert dimension>**.
 4. **<Insert features and clearance dimensions.>**
- C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer.
1. Forms for Cylindrical Columns, Pedestals, and Supports:
 - a. Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
 2. Form-Release Agent:
 - a. Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 3. Rubbed Finish:
 - a. Apply the following to exposed above grade smooth-formed finished concrete:
 - 1) Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
 - 2) Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
 - 3) Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
 4. Repairing Formed Surfaces:

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- a. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - b. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension in solid concrete but not less than 1 inch (25 mm) in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - c. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - d. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
 2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
 3. Install base covers, unless otherwise indicated.
 4. Use a short piece of 1/2-inch- diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
- E. Embedded Poles with Tamped Earth Backfill: Set poles to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height.
1. Dig holes large enough to permit use of tampers in the full depth of hole.
 2. Backfill in 6-inch layers and thoroughly tamp each layer so compaction of backfill is equal to or greater than that of undisturbed earth.
- F. Embedded Poles with Concrete Backfill: Set poles in augered holes to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height.
1. Make holes 6 inches in diameter larger than pole diameter.
 2. Fill augered hole around pole with air-entrained concrete having a minimum compressive strength of 3000 psi at 28 days, and finish in a dome above finished grade.
 3. Use a short piece of 1/2-inch- diameter pipe to make a drain hole through concrete dome. Arrange to drain condensation from interior of pole.
 4. Cure concrete a minimum of 72 hours before performing work on pole.
- G. Poles and Pole Foundations Set in Concrete Paved Areas: Install poles with minimum of 6-inch- wide, unpaved gap between the pole or pole foundation and the edge of adjacent concrete slab. Fill unpaved ring with **[pea gravel]** <Insert material> to a level 1 inch below top of concrete slab.

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- H. Raise and set poles using web fabric slings (not chain or cable).

3.3 BOLLARD LUMINAIRE INSTALLATION

- A. Align units for optimum directional alignment of light distribution.
- B. Install on concrete base with top [4 inches] <Insert height> above finished grade or surface at bollard location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 03 Section "Cast-in-Place Concrete."

3.4 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINAIRES

- A. Install on concrete base with top [4 inches] <Insert height> above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 03 Section "Cast-in-Place Concrete."

3.5 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.6 GROUNDING

- A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
 - 1. Install grounding electrode for each pole, unless otherwise indicated.
 - 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.
- B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
 - 1. Install grounding electrode for each pole.
 - 2. Install grounding conductor and conductor protector.
 - 3. Ground metallic components of pole accessories and foundations.

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3.7 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.
 - 1. Verify operation of photoelectric controls.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain luminaire lowering devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 265600

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SECTION 270500 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Communications equipment coordination and installation.
 - 2. Common communications installation requirements.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 COORDINATION

- A. Coordinate arrangement, mounting, and support of communications equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting pathways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for communications items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

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PART 2 - EXECUTION

2.1 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

2.2 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

2.3 GUARANTEE:

- A. All wiring, etc., shall be in strict accordance with the local Electrical Code requirements. The Contractor shall guarantee all equipment and wiring free from inherent mechanical and electrical defects for a period of one (1) year from date of installation. The final connection between the equipment and wiring system shall be made under the direct supervision of a qualified technical representative of the manufacturer.

END OF SECTION 270500

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SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Grounding conductors.
 - 2. Grounding connectors.
 - 3. Grounding busbars.
 - 4. Grounding labeling.

1.3 DEFINITIONS

- A. BCT: Bonding conductor for telecommunications.
- B. TGB: Telecommunications grounding busbar.
- C. TMGB: Telecommunications main grounding busbar.
- D. Service Provider: The operator of a service that provides telecommunications transmission delivered over access provider facilities.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For communications equipment room signal reference grid. Include plans, elevations, sections, details, and attachments to other work.

1.5 INFORMATIONAL SUBMITTALS

- A. As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following:
 - 1. Ground rods.

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2. Ground and roof rings.
3. BCT, TMGB, TGBs, and routing of their bonding conductors.

B. Qualification Data: For installation supervisor, and field inspector.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Installation Supervision: Installation shall be under the direct supervision of ITS Technician who shall be present at all times when Work of this Section is performed at Project site.
2. Field Inspector: Currently registered by BICSI as a designer RCDD to perform the on-site inspection.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.
- C. Comply with TIA-607-B.

2.2 CONDUCTORS

- A. Comply with UL 486A-486B.
- B. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.
 1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
 2. Cable Tray Equipment Grounding Wire: No. 6 AWG.
- C. Cable Tray Grounding Jumper:

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1. Not smaller than No. 6 AWG and not longer than 12 inches (300 mm). If jumper is a wire, it shall have a crimped grounding lug with two holes and long barrel for two crimps. If jumper is a flexible braid, it shall have a one-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.

D. Bare Copper Conductors:

1. Solid Conductors: ASTM B3.
2. Stranded Conductors: ASTM B8.
3. Tinned Conductors: ASTM B33.
4. Bonding Cable: 28 kmils (14.2 sq. mm), 14 strands of No. 17 AWG conductor, and 1/4 inch (6.3 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.3 CONNECTORS

- A. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.
- B. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.
 1. Electroplated tinned copper, C and H shaped.
- C. Signal Reference Grid Connectors: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.
- D. Busbar Connectors: Cast silicon bronze, solderless compression-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch (15.8- or 25.4-mm) centers for a two-bolt connection to the busbar.
- E. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING BUSBARS

- A. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, length as indicated on Drawings. The busbar shall be NRTL listed for use as TMGB and shall comply with TIA-607-B.
 1. Predrilling shall be with holes for use with lugs specified in this Section.
 2. Mounting Hardware: Stand-off brackets that provide a 4-inch (100-mm) clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.

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3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- B. TGB: Predrilled rectangular bars of hard-drawn solid copper, **1/4 by 2 inches (6.3 by 50 mm)** in cross section, length as indicated on Drawings. The busbar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with TIA-607-B.
 1. Predrilling shall be with holes for use with lugs specified in this Section.
 2. Mounting Hardware: Stand-off brackets that provide at least a **2-inch (50-mm)** clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
 3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

2.5 IDENTIFICATION

- A. Comply with requirements for identification products in Section 270553 "Identification for Communications Systems."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.
- B. Inspect the test results of the ac grounding system measured at the point of BCT connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.
- B. Comply with NECA 1.
- C. Comply with TIA-607-B.

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3.3 APPLICATION

- A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
 - 1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
 - 2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
- B. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.
- C. Conductor Support:
 - 1. Secure grounding and bonding conductors at intervals of not less than 36 inches (900 mm).
- D. Grounding and Bonding Conductors:
 - 1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
 - 2. Install without splices.
 - 3. Support at not more than 36-inch (900-mm) intervals.
 - 4. Install grounding and bonding conductors in 3/4-inch (21-mm) PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.
 - a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 270528 "Pathways for Communications Systems," and bond both ends of the conduit to a TGB.

3.4 GROUNDING ELECTRODE SYSTEM

- A. The BCT between the TMGB and the ac service equipment ground shall not be smaller than No. 1/0 AWG.

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3.5 GROUNDING BUSBARS

- A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers **2 inches (50 mm)** minimum from wall, **12 inches (300 mm)** above finished floor unless otherwise indicated.
- B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

3.6 CONNECTIONS

- A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.
- B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
- C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:
 - 1. Use crimping tool and the die specific to the connector.
 - 2. Pretwist the conductor.
 - 3. Apply an antioxidant compound to all bolted and compression connections.
- D. Primary Protector: Bond to the TMGB with insulated bonding conductor.
- E. Interconnections: Interconnect all TGBs with the TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than **2 kcmils/linear foot (1 sq. mm/linear meter)** of conductor length, up to a maximum size of No. 3/0 AWG unless otherwise indicated.
- F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install vertically mounted rack grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the TGB No. 2 AWG bonding conductors.
- G. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.
- H. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each TGB to the ground bar of the panelboard.
- I. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.

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3.7 IDENTIFICATION

- A. Labels shall be preprinted or computer-printed type.
 - 1. Label TMGB(s) with "fs-TMGB," where "fs" is the telecommunications space identifier for the space containing the TMGB.
 - 2. Label TGB(s) with "fs-TGB," where "fs" is the telecommunications space identifier for the space containing the TGB.
 - 3. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - 2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB and a TGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.
 - a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.
 - 3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.
 - a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB and in each TGB. Maximum acceptable ac current level is 1 A.
- C. Excessive Ground Resistance: If resistance to ground at the BCT exceeds 5 ohms, notify Architect promptly and include recommendations to reduce ground resistance.
- D. Grounding system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 270526

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SECTION 270528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings.
 - 2. Nonmetallic conduits and fittings.
 - 3. Optical-fiber-cable pathways and fittings.
 - 4. Metal wireways and auxiliary gutters.
 - 5. Nonmetallic wireways and auxiliary gutters.
 - 6. Metallic surface pathways.
 - 7. Nonmetallic surface pathways.
 - 8. Tele-power poles.
 - 9. Hooks.
 - 10. Boxes, enclosures, and cabinets.

1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid conduit.
- C. IMC: Intermediate metal conduit.
- D. RTRC: Reinforced thermosetting resin conduit.

1.4 ACTION SUBMITTALS

- A. Product data for the following:
 - 1. Surface pathways
 - 2. Wireways and fittings.
 - 3. Tele-power poles.
 - 4. Boxes, enclosures, and cabinets.

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- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.
- C. Samples: For surface pathways and tele-power poles and for each color and texture specified, 12 inches (300 mm) long.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of pathway groups with common supports.
 - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
 - 3. Underground ducts, piping, and structures in location of underground enclosures and handholes.
- B. Qualification Data: For professional engineer.
- C. Seismic Qualification Data: Provide seismic bracing for all pathway racks, enclosures, cabinets, equipment racks, and their mounting provisions, including those for internal components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which certification is based and their installation requirements.
 - 4. Detailed description of conduit support devices and interconnections on which certification is based and their installation requirements.
- D. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

- A. Description: Metal raceway of circular cross section with manufacturer-fabricated fittings.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - 3. Anamet Electrical, Inc.; Anaconda Metal Hose.

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4. Electri-Flex Co.
5. Manhattan/CDT/Cole-Flex.
6. Maverick Tube Corporation.
7. O-Z Gedney; a unit of General Signal.
8. Wheatland Tube Company.

C. General Requirements for Metal Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
2. Comply with TIA-569-D.

D. GRC: Comply with ANSI C80.1 and UL 6.

E. ARC: Comply with ANSI C80.5 and UL 6A.

F. IMC: Comply with ANSI C80.6 and UL 1242.

G. PVC-Coated Steel Conduit: PVC-coated IMC.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch (1 mm), minimum.

H. EMT: Comply with ANSI C80.3 and UL 797.

I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
2. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Compression.
3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

J. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Description: Nonmetallic raceway of circular section with manufacturer-fabricated fittings.

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- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFC Cable Systems, Inc.
 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
 3. Arnco Corporation.
 4. CANTEX Inc.
 5. CertainTeed Corp.; Pipe & Plastics Group.
 6. Condux International, Inc.
 7. ElecSYS, Inc.
 8. Electri-Flex Co.
 9. Lamson & Sessions; Carlon Electrical Products.
 10. Manhattan/CDT/Cole-Flex.
 11. RACO; a Hubbell Company.
 12. Thomas & Betts Corporation.
- C. General Requirements for Nonmetallic Conduits and Fittings:
1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
 2. Comply with TIA-569-D.
- D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- E. Rigid HDPE: Comply with UL 651A.
- F. Continuous HDPE: Comply with UL 651A.
- G. RTRC: Comply with UL 2515A and NEMA TC 14.
- H. Fittings: Comply with NEMA TC 3; match to conduit or tubing type and material.
- I. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

- A. Description: Comply with UL 2024; flexible-type pathway with a circular cross section, approved for plenum installation unless otherwise indicated.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Arnco Corporation.
 2. Endot Industries Inc.
 3. IPEX Inc.
 4. Lamson & Sessions; Carlon Electrical Products.

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- C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with TIA-569-D.

2.4 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal trough of rectangular cross section fabricated to required size and shape, without holes or knockouts, and with hinged or removable covers.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman.
 - 3. Square D; Schneider Electric.
- C. General Requirements for Metal Wireways and Auxiliary Gutters:
 - 1. Comply with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
 - 2. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
 - 3. Comply with TIA-569-D.
- D. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- E. Wireway Covers: Screw-cover type unless otherwise indicated.
- F. Finish: Manufacturer's standard enamel finish.

2.5 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Allied Moulded Products, Inc.
 - 2. Hoffman.
 - 3. Niedax Inc.
- C. General Requirements for Nonmetallic Wireways and Auxiliary Gutters:
 - 1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

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2. Comply with TIA-569-D.
- D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- E. Solvents and Adhesives: As recommended by conduit manufacturer.

2.6 SURFACE METAL PATHWAYS

- A. Description: Galvanized steel with snap-on covers, complying with UL 5.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Monosystems, Inc.
 2. Panduit.
 3. Niedax Inc.
 4. Wiremold / Legrand.
- C. Finish: Manufacturer's standard enamel finish in color selected by Architect.
- D. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- E. Comply with TIA-569-D.

2.7 SURFACE NONMETALLIC PATHWAYS:

- A. Description: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Monosystems, Inc.
 2. Panduit.
 3. Wiremold / Legrand.
- C. Finish: Texture and color selected by Architect from manufacturer's standard colors.
- D. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.
- E. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- F. Comply with TIA-569-D.

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2.8 HOOKS

- A. Description: Prefabricated sheet metal cable supports for telecommunications cable.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Monosystems, Inc.
 - 2. Panduit.
 - 3. Wiremold / Legrand.
 - 4. Erico.
- C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with TIA-569-D.
- E. Galvanized steel.
- F. J shape.

2.9 BOXES, ENCLOSURES, AND CABINETS

- A. Description: Enclosures for communications.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 - 2. EGS/Appleton Electric.
 - 3. Erickson Electrical Equipment Company.
 - 4. Hoffman.
 - 5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
 - 6. O-Z/Gedney; a unit of General Signal.
 - 7. RACO; a Hubbell Company.
 - 8. Scott Fetzer Co.; Adalet Division.
 - 9. Spring City Electrical Manufacturing Company.
 - 10. Thomas & Betts Corporation.
 - 11. Walker Systems, Inc.; Wiremold Company (The).
 - 12. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
 - 13. Highline Products.
 - 14. FSR for Audio/Visual system applications.
- C. General Requirements for Boxes, Enclosures, and Cabinets:
 - 1. Comply with TIA-569-D.
 - 2. Boxes, enclosures, and cabinets installed in wet locations shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for use in wet locations.
 - 3. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

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4. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).
5. Gangable boxes are prohibited.
- D. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- E. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.
- F. Metal Floor Boxes:
 1. Material: sheet metal.
 2. Type: Fully adjustable.
 3. Shape: Rectangular.
 4. Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Nonmetallic Floor Boxes: Nonadjustable, rectangular.
 1. Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- J. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- K. Cabinets:
 1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 2. Hinged door in front cover with flush latch and concealed hinge.
 3. Key latch to match panelboards.
 4. Metal barriers to separate wiring of different systems and voltage.
 5. Accessory feet where required for freestanding equipment.
 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

- A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
 1. Exposed Conduit: GRC.

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2. Concealed Conduit, Aboveground: IMC.
3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: GRC. Pathway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts.
 - c. Mechanical rooms.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Damp or Wet Locations: GRC.
6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, communications-cable pathway or EMT.
7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: EMT.
8. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: Plenum-type, communications-cable pathway.
9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel units in damp or wet locations.

C. Minimum Pathway Size: 3/4-inch (21-mm) trade size for copper and aluminum cables, and 1 inch (25 mm) for optical-fiber cables.

D. Pathway Fittings: Compatible with pathways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface pathways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.2 INSTALLATION

- A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:

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1. NECA 1.
 2. NECA/BICSI 568.
 3. TIA-569-D.
 4. NECA 101
 5. NECA 102.
 6. NECA 105.
 7. NECA 111.
- B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- C. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- D. Comply with requirements in Section 270529 "Hangers and Supports for Communications Systems" for hangers and supports.
- E. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling" for sleeves and sleeve seals for communications.
- F. Keep pathways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- G. Complete pathway installation before starting conductor installation.
- H. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- I. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches (300 mm) of changes in direction. Utilize long radius ells for all optical-fiber cables.
- J. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- K. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- L. Pathways Embedded in Slabs:
1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot (3-m) intervals.
 2. Arrange pathways to cross building expansion joints at right angles with expansion fittings. Comply with requirements for expansion joints specified in this article.
 3. Arrange pathways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions.
 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 5. Change from nonmetallic conduit and fittings to GRC and fittings before rising above floor.

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- M. Stub-ups to Above Recessed Ceilings:
1. Use EMT, IMC, or RMC for pathways.
 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- O. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.
- P. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus one additional quarter-turn.
- Q. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure, to assure a continuous ground path.
- R. Cut conduit perpendicular to the length. For conduits of 2-inch (50-mm) trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- S. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.
- T. Surface Pathways:
1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
 2. Install surface pathway with a minimum 2-inch (50-mm) radius control at bend points.
 3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- U. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
1. 3/4-Inch (21-mm) Trade Size and Smaller: Install pathways in maximum lengths of 50 feet (15 m).
 2. 1-Inch (25-mm) Trade Size and Larger: Install pathways in maximum lengths of 75 feet (23 m).
 3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

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- V. Install pathway-sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway-sealing fittings according to NFPA 70.
- W. Install devices to seal pathway interiors at accessible locations. Locate seals, so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service pathway enters a building or structure.
 - 3. Where otherwise required by NFPA 70.
- X. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
- Y. Expansion-Joint Fittings:
 - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT that is located where environmental temperature change may exceed 100 deg F (55 deg C), and that has straight-run length that exceeds 100 feet (30 m).
 - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
 - d. Attics: 135 deg F (75 deg C) temperature change.
 - 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
 - 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 - 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- Z. Hooks:

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1. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.
 2. Shall be supported by dedicated support wires. Do not use ceiling grid support wire or support rods.
 3. Hook spacing shall allow no more than 6 inches (150 mm) of slack. The lowest point of the cables shall be no less than 6 inches (150 mm) adjacent to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power and telecommunications outlets, and other electrical and communications equipment.
 4. Space hooks no more than 5 feet (1.5 m) o.c.
 5. Provide a hook at each change in direction.
- AA. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- BB. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- CC. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.
- DD. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- EE. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- FF. Set metal floor boxes level and flush with finished floor surface.
- GG. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.4 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

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3.5 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage or deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 270528

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SECTION 270529 - HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel slotted support systems for communication raceways.
2. Aluminum slotted support systems for communication raceways.
3. Conduit and cable support devices.
4. Support for conductors in vertical conduit.
5. Structural steel for fabricated supports and restraints.
6. Mounting, anchoring, and attachment components, including mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
7. Fabricated metal equipment support assemblies.

B. Related Requirements:

1. Section 270548 "Seismic Controls for Communications Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Slotted support systems, hardware, and accessories.
 - b. Clamps.
 - c. Hangers.
 - d. Sockets.
 - e. Eye nuts.
 - f. Fasteners.
 - g. Anchors.
 - h. Saddles.
 - i. Brackets.

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2. Include rated capacities and furnished specialties and accessories.
- B. Shop Drawings: For fabrication and installation details for communications hangers and support systems.
1. Trapeze hangers. Include product data for components.
 2. Steel slotted-channel systems.
 3. Aluminum slotted-channel systems.
 4. Equipment supports.
 5. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated-Design Submittal: For hangers and supports for communications systems.
1. Include design calculations and details of trapeze hangers.
 2. Include design calculations for seismic restraints.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Suspended ceiling components.
 2. Ductwork, piping, fittings, and supports.
 3. Structural members to which hangers and supports will be attached.
 4. Size and location of initial access modules for acoustical tile.
 5. Items penetrating finished ceiling, including the following:
 - a. Luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
- B. Seismic Qualification Data: Certificates, for hangers and supports for communications equipment and systems, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Welding certificates.

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1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design hanger and support system.
- B. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to [ASCE/SEI 7] <Insert requirement>.
 - 1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified."
 - 2. Component Importance Factor: 1.0.
- C. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame Rating: Class 1.
 - 2. Self-extinguishing according to ASTM D635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch- (10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
 - 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 3. Material for Channel, Fittings, and Accessories: Galvanized steel.
 - 4. Channel Width: Selected for applicable load criteria.
 - 5. Channel Dimensions: Selected for applicable load criteria.

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- B. Aluminum Slotted Support Systems: Extruded aluminum channels and angles with minimum 13/32-inch- (10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper B-Line, Inc.; a division of Cooper Industries.
 - b. Flex-Strut Inc.
 - c. Thomas & Betts Corporation.
 - d. Unistrut; Tyco International, Ltd.
 - 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 3. Channel Material: 6063-T6 aluminum alloy.
 - 4. Fittings and Accessories Material: 5052-H32 aluminum alloy.
 - 5. Channel Width: Selected for applicable load criteria.
 - 6. Channel Dimensions: Selected for applicable load criteria.
- C. Conduit and Cable Support Devices: Steel and malleable-iron clamps, hangers, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored communications conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
 - 2. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
 - 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.

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4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325 (Grade A325M).
5. Toggle Bolts: All-steel springhead type.
6. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
 1. NECA 1.
 2. NECA/BICSI 568.
 3. TIA-569-D.
 4. NECA 101.
 5. NECA 102.
 6. NECA 105.
 7. NECA 111.
- B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for pathways specified in Section 270528 "Pathways for Communications Systems."
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as scheduled in NECA 1, where its Table 1 lists maximum spacings that are less than those stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

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3.2 SUPPORT INSTALLATION

- A. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, according to NFPA 70.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten communications items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Use approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Use expansion anchor fasteners.
 - 5. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
 - 6. To Light Steel: Sheet metal screws.
 - 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor communications materials and equipment.
- B. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

- A. Touchup: Comply with requirements in Section 099123 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 270529

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SECTION 270536 - CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Ladder cable tray.
- 2. Wire-mesh cable tray.
- 3. Cable tray accessories.
- 4. Warning signs.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of cable tray.

- 1. Include data indicating dimensions and finishes for each type of cable tray indicated.

- B. Shop Drawings: For each type of cable tray.

- 1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.
- 2. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - a. Vertical and horizontal offsets and transitions.
 - b. Clearances for access above and to sides of cable trays.
 - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
 - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

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1. Scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements.
 2. Vertical and horizontal offsets and transitions.
 3. Clearances for access above and to side of cable trays.
 4. Vertical elevation of cable trays above the floor or below bottom of ceiling structure.
- B. Seismic Qualification Data: Certificates, for cable trays, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Cable trays and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. The term "withstand" means "the cable trays will remain in place without separation of any parts when subjected to the seismic forces specified."
 2. Component Importance Factor: 1.0.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes in cable tray installed outdoors.
1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 GENERAL REQUIREMENTS FOR CABLE TRAYS

- A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
1. Source Limitations: Obtain cable trays and components from single manufacturer.
- B. Sizes and Configurations: See the Cable Tray Schedule on Drawings for specific requirements for types, materials, sizes, and configurations.

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- C. Structural Performance: See articles for individual cable tray types for specific values for the following parameters:
1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
 2. Concentrated Load: A load applied at midpoint of span and centerline of tray.
 3. Load and Safety Factors: Applicable to both side rails and rung capacities.

2.3 LADDER CABLE TRAY

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. B-line, an Eaton Business.
 2. Chalfant Manufacturing Co.
 3. Cope Cable Tray.
 4. MonoSystems, Inc.
 5. Niedax Inc.
 6. Thomas & Betts Corporation.
- B. Description:
1. Configuration: Two longitudinal side rails with transverse rungs swaged or welded to side rails, complying with NEMA VE 1.
 2. Width: 12 inches (300 mm) unless otherwise indicated on Drawings.
 3. Minimum Usable Load Depth: 4 inches (100 mm).
 4. Straight Section Lengths: 10 feet (3.0 m), except where shorter lengths are required to facilitate tray assembly.
 5. Rung Spacing: 9 inches (225 mm) o.c.
 6. Radius-Fitting Rung Spacing: 9 inches (225 mm) at center of tray's width.
 7. Minimum Cable-Bearing Surface for Rungs: 7/8-inch (22-mm) width with radius edges.
 8. No portion of the rungs shall protrude below the bottom plane of side rails.
 9. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb (90-kg) concentrated load, when tested according to NEMA VE 1.
 10. Fitting Minimum Radius: 12 inches (300 mm).
 11. Splicing Assemblies: Bolted type using serrated flange locknuts.
 12. Splice-Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
- C. Materials and Finishes:
1. Steel:
 - a. Straight Section and Fitting Side Rails and Rungs: Steel complies with the minimum mechanical properties of ASTM A1011/A1011M, SS, Grade 33.
 - b. Steel Tray Splice Plates: ASTM A1011/A1011M, HSLAS, Grade 50, Class 1.

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- c. Fasteners: Steel complies with the minimum mechanical properties of ASTM A510/A510M, Grade 1008.
- d. Finish: Powder-coat enamel paint.
 - 1) Powder-Coat Enamel: Cable tray manufacturer's recommended primer and corrosion-inhibiting treatment, with factory-applied powder-coat paint.
- 2. Aluminum:
 - a. Materials: Alloy 6063-T6 according to ANSI H35.1/H 35.1M for extruded components, and Alloy 6061-T6 according to ANSI H35.1/H 35.1M for fabricated parts.
 - b. Hardware: Chromium-zinc-plated steel, ASTM F1136.
 - c. Hardware for Aluminum Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F593 and ASTM F594.

2.4 WIRE-MESH CABLE TRAY

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. B-line, an Eaton Business.
 - 2. Chalfant Manufacturing Co.
 - 3. Cooper Industries.
 - 4. Cope Cable Tray.
 - 5. Legrand US.
 - 6. MonoSystems, Inc.
 - 7. Niedax Inc.
 - 8. Thomas & Betts Corporation.
- B. Description:
 - 1. Configuration: Galvanized- steel wire mesh, complying with NEMA VE 1.
 - 2. Width: 12 inches (300 mm) unless otherwise indicated on Drawings.
 - 3. Minimum Usable Load Depth: 4 inches (100 mm).
 - 4. Straight Section Lengths: 10 feet (3.0 m), except where shorter lengths are required to facilitate tray assembly.
 - 5. Structural Performance: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb (90-kg) concentrated load, when tested according to NEMA VE 1.
 - 6. Splicing Assemblies: Bolted type using serrated flange locknuts.
 - 7. Splice-Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
- C. Materials and Finishes:
 - 1. Steel:

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- a. Straight Sections and Fittings: Steel complies with the minimum mechanical properties of ASTM A1011/A1011M, SS, Grade 33.
- b. Steel Tray Splice Plates: ASTM A1011/A1011M, HSLAS, Grade 50, Class 1.
- c. Fasteners: Steel complies with the minimum mechanical properties of ASTM A510/A510M, Grade 1008.
- d. Finish: Hot-dip galvanized after fabrication, complying with ASTM A123/A123M, Class B2.

- 1) Hardware: Galvanized, ASTM B633.

2.5 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
- B. Barrier Strips: Same materials and finishes as for cable tray.
- C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.6 WARNING SIGNS

- A. Comply with requirements for identification in Section 270553 "Identification for Communications Systems."
- B. Lettering: 1-1/2-inch- (40-mm-) high, black letters on yellow background with legend "Warning! Not To Be Used as Walkway, Ladder, or Support for Ladders or Personnel."

2.7 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect cable trays according to NEMA VE 1.

PART 3 - EXECUTION

3.1 CABLE TRAY INSTALLATION

- A. Install cable trays according to NEMA VE 2.
- B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.
- C. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.

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- D. Remove burrs and sharp edges from cable trays.
- E. Join aluminum cable tray with splice plates; use four square neck-carriage bolts and locknuts.
- F. Fasten cable tray supports to building structure and install seismic restraints.
- G. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of 200 lb (90 kg). Comply with requirements in Section 270529 "Hangers and Supports for Communications Systems." Comply with seismic-restraint details according to Section 270548.16 "Seismic Controls for Communications Systems."
- H. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.
- I. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
- J. Support bus assembly to prevent twisting from eccentric loading.
- K. Install center-hung supports for single-rail trays designed for 60 versus 40 percent eccentric loading condition, with a safety factor of 3.
- L. Locate and install supports according to NEMA VE 2. Do not install more than one cable tray splice between supports.
- M. Support wire-basket cable trays with trapeze hangers.
- N. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA VE 2. Space connectors and set gaps according to applicable standard.
- O. Make changes in direction and elevation using manufacturer's recommended fittings.
- P. Make cable tray connections using manufacturer's recommended fittings.
- Q. Seal penetrations through fire and smoke barriers. Comply with requirements in Section 078413 "Penetration Firestopping."
- R. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.
- S. Install cable trays with enough workspace to permit access for installing cables.
- T. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15 000 V.

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- U. Install permanent covers, if used, after installing cable. Install cover clamps according to NEMA VE 2.
- V. Clamp covers on cable trays installed outdoors with heavy-duty clamps.
- W. Install warning signs in visible locations on or near cable trays after cable tray installation.

3.2 CABLE TRAY GROUNDING

- A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems."
- B. Cable trays shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.
- C. When using powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.
- D. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

3.3 CABLE INSTALLATION

- A. Install cables only when each cable tray run has been completed and inspected.
- B. Fasten cables on horizontal runs with cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.
- C. Fasten cables on vertical runs to cable trays every 18 inches (450 mm).
- D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches (1800 mm).
- E. In existing construction, remove inactive or dead cables from cable trays.

3.4 CONNECTIONS

- A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.
- B. Connect pathways to cable trays according to requirements in NEMA VE 2 and NEMA FG 1.

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3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorquer in suspect areas.
7. Check for improperly sized or installed bonding jumpers.
8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.

B. Prepare test and inspection reports.

3.6 PROTECTION

A. Protect installed cable trays and cables.

1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.
2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION 270536

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SECTION 270544 - SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Sleeves for pathway and cable penetration of non-fire-rated construction walls and floors.
 - 2. Sleeve-seal systems.
 - 3. Sleeve-seal fittings.
 - 4. Grout.
 - 5. Silicone sealants.

- B. Related Requirements:

- 1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Wall Sleeves:

- 1. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
 - 2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

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- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. PVC-Pipe Sleeves: ASTM D1785, Schedule 40.
- D. Sleeves for Rectangular Openings:
 - 1. Material: Galvanized-steel sheet.
 - 2. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. CALPICO, Inc.
 - 3. Metraflex Co.
 - 4. Pipeline Seal and Insulation.
 - 5. Proco Products, Inc.
- C. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- D. Pressure Plates: Carbon steel.
- E. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. HOLDRITE
4. Metraflex Co.
5. Pipeline Seal and Insulation.
6. Proco Products, Inc.

2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

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- a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed.
 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between pathway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at pathway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

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- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 270544

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SECTION 270548.16 - SEISMIC CONTROLS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Restraint channel bracings.
 - 2. Restraint cables.
 - 3. Seismic-restraint accessories.
 - 4. Mechanical anchor bolts.
 - 5. Adhesive anchor bolts.

- B. Related Requirements:

- 1. Section 270528 "Hangers and Supports for Communications Systems" for commonly used supports and installation requirements.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.

- B. Delegated-Design Submittal: For each seismic-restraint device.

- 1. Include design calculations and details for selecting seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

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2. Design Calculations: Calculate static and dynamic loading caused by equipment weight, operation, and seismic forces required to select seismic restraints and for designing vibration isolation bases.
 - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
3. Seismic- Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
 - d. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints. Communications components include:
 1. Racks.
 2. Frames.
 3. Cabinets.
 4. Cable tray.
 5. Conduits.
- B. Qualification Data: For testing agency.
- C. Welding certificates.
- D. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated and that is acceptable to authorities having jurisdiction.

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- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis. They shall bear anchorage preapproval from OSHPD in addition to preapproval, showing maximum seismic-restraint ratings, by ICC-ES or another agency acceptable to authorities having jurisdiction. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) that support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- E. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
 - 1. Site Class as Defined in the NCSBC: C.
 - 2. Assigned Seismic Use Group or Building Category as Defined in the IBC: II.

2.2 RESTRAINT CHANNEL BRACINGS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Amber/Booth Company, Inc.
 - 2. California Dynamics Corporation.
 - 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 4. Hilti Inc.
 - 5. Loos & Co.; Seismic Earthquake Division.
 - 6. Mason Industries.
 - 7. TOLCO Incorporated; a brand of NIBCO INC.
- B. Unistrut; Tyco International, LtdDescription: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end, with other matching components, and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

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2.3 RESTRAINT CABLES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Amber/Booth Company, Inc.
 - 2. California Dynamics Corporation.
 - 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 4. Hilti Inc.
 - 5. Loos & Co.; Seismic Earthquake Division.
 - 6. Mason Industries.
 - 7. TOLCO Incorporated; a brand of NIBCO INC.
- B. Unistrut; Tyco International, Ltd
- C. Restraint Cables: ASTM A492 stainless-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.4 SEISMIC-RESTRAINT ACCESSORIES

- A. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.
- D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.
- E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.5 MECHANICAL ANCHOR BOLTS

- A. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

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2.6 ADHESIVE ANCHOR BOLTS

- A. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods caused by seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."
- B. Equipment and Hanger Restraints:
 - 1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
 - 2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

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- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- F. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.

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4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.

- B. Seismic controls will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 270548.16

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SECTION 270553 - IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Color and legend requirements for labels and signs.
2. Labels.
3. Bands and tubes.
4. Tapes.
5. Signs.
6. Cable ties.
7. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for communications identification products.

- B. Identification Schedule:

1. Outlets: Scaled drawings indicating location and proposed designation.
2. Backbone Cabling: Riser diagram showing each communications room, backbone cable, and proposed backbone cable designation.
3. Racks: Scaled drawings indicating location and proposed designation.
4. Patch Panels: Enlarged scaled drawings showing rack row, number, and proposed designations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 70 and TIA 606-B.

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- B. Comply with ANSI Z535.4 for safety signs and labels.
- C. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Equipment Identification Labels:
 - 1. Black letters on a white field.

2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Ideal Industries Inc.
 - c. LEM Products, Inc.
- B. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- (0.08-mm-) thick, vinyl flexible labels with acrylic pressure-sensitive adhesive.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Ideal Industries Inc.
 - c. LEM Products, Inc.
 - 2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating protective shields over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
 - 3. Marker for Labels: Machine-printed, permanent, waterproof black ink recommended by printer manufacturer.
- C. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil- (0.08-mm-) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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- a. Brady Corporation.
- b. Ideal Industries Inc.
- c. LEM Products, Inc.

2. Minimum Nominal Size:

- a. 1-1/2 by 6 inches (37 by 150 mm) for raceway and conductors.
- b. 3-1/2 by 5 inches (76 by 127 mm) for equipment.
- c. As required by authorities having jurisdiction.

2.4 SIGNS

A. Baked-Enamel Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Carlton Industries.
 - c. Marking Services, Inc.
2. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
3. 1/4-inch (6.4-mm) grommets in corners for mounting.
4. Nominal Size: 7 by 10 inches (180 by 250 mm).

B. Laminated-Acrylic or Melamine-Plastic Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Carlton Industries.
 - c. Marking Services, Inc.
2. Engraved legend.
3. Thickness:
 - a. For signs up to 20 sq. in. (129 sq. cm), minimum 1/16 inch (1.6 mm) thick.
 - b. For signs larger than 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick.
 - c. Engraved legend with black letters on white face.
 - d. Self-adhesive.
 - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.5 CABLE TIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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1. Hellermann Tyton
2. Ideal Industries Inc.
3. Panduit Corp.

- B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C) according to ASTM D638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black, except where used for color-coding.

2.6 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying communications identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.

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- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of communications systems and connected items.
- G. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- H. Vinyl Wraparound Labels:
 - 1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
 - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
 - 3. Provide label 6 inches (150 mm) from cable end.
- I. Self-Adhesive Wraparound Labels:
 - 1. Secure tight to surface at a location with high visibility and accessibility.
 - 2. Provide label 6 inches (150 mm) from cable end.
- J. Self-Adhesive Labels:
 - 1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
- K. Snap-Around, Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
- L. Cable Ties: General purpose, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations with high visibility. Identify by system and circuit designation.
- C. Accessible Fittings for Raceways and Cables within Buildings: Identify covers of each junction and pull box with self-adhesive labels containing wiring system legend.
 - 1. System legends shall be as follows:

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- a. Telecommunications.
 - b. Security.
 - c. Public Address.
- D. Faceplates: Label individual faceplates with self-adhesive labels. Place label at top of faceplate. Each faceplate shall be labeled with its individual, sequential designation, numbered clockwise when entering room from primary egress, composed of the following, in the order listed:
1. Wiring closet designation.
 2. Colon.
 3. Faceplate number.
- E. Equipment Room Labeling:
1. Racks, Frames, and Enclosures: Identify front and rear of each with self-adhesive labels containing equipment designation.
 2. Patch Panels: Label individual rows and outlets, starting at top left and working down, with self-adhesive labels.
 3. Data Outlets: Label each outlet with a self-adhesive label indicating the following, in the order listed:
 - a. Room number being served.
 - b. Colon.
 - c. Faceplate number.
- F. Backbone Cables: Label each cable with a self-adhesive wraparound label indicating the location of the far or other end of the backbone cable. Patch panel or punch down block where cable is terminated should be labeled identically.
- G. Horizontal Cables: Label each cable with a self-adhesive wraparound label indicating the following, in the order listed:
1. Room number.
 2. Colon.
 3. Faceplate number.
- H. Locations of Underground Lines: Underground-line warning tape for copper, coaxial, hybrid copper/fiber, and optical-fiber cable.
- I. Instructional Signs: Self-adhesive labels.
- J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures: Self-adhesive labels.
1. Apply to exterior of door, cover, or other access.
- K. Equipment Identification Labels:
1. Indoor Equipment: Baked-enamel signs.
 2. Outdoor Equipment: Laminated-acrylic or melamine-plastic sign.

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3. Equipment to Be Labeled:
 - a. Communications cabinets.
 - b. Uninterruptible power supplies.
 - c. Computer room air conditioners.
 - d. Fire-alarm and suppression equipment.
 - e. Egress points.
 - f. Power distribution components.

END OF SECTION 270553

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SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Backboards.
 - 2. Boxes, enclosures, and cabinets.
 - 3. Power strips.

- B. Related Requirements:

- 1. Section 270536 "Cable Trays for Communications Systems" for cable trays and accessories.
 - 2. Section 271313 "Communications Copper Backbone Cabling" for copper data cabling associated with system panels and devices.
 - 3. Section 271323 "Communications Optical Fiber Backbone Cabling" for optical-fiber data cabling associated with system panels and devices.
 - 4. Section 271513 "Communications Copper Horizontal Cabling" for copper data cabling associated with system panels and devices.
 - 5. Section 271523 "Communications Optical Fiber Horizontal Cabling" for coaxial data cabling associated with system panels and devices.

1.3 DEFINITIONS

- A. Access Provider: An operator that provides a circuit path or facility between the service provider and user. An access provider can also be a service provider.
- B. BICSI: Building Industry Consulting Service International.
- C. RCDD: Registered communications distribution designer.
- D. Service Provider: The operator of a telecommunications transmission service delivered through access provider facilities.
- E. TGB: Telecommunications grounding bus bar.

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- F. TMGB: Telecommunications main grounding bus bar.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

- B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.

- B. Seismic Qualification Data: Certificates, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions. Base certification on the maximum number of components capable of being mounted in each rack type. Identify components on which certification is based.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings shall be under direct supervision of RCDD.
2. Installation Supervision: Installation shall be under direct supervision of Technician, who shall be present at all times when Work of this Section is performed at Project site.

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3. Field Inspector: Currently registered by BICSI as RCDD to perform the on-site inspection.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Equipment shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.2 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm).

2.3 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Crouse-Hinds, an Eaton business
 2. Hoffman, a brand of nVent.
 3. Hubbell Inc.
 4. MonoSystems, Inc.
 5. Thomas & Betts Corporation
 6. Wiremold/Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets shall be listed and labeled for intended location and use.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, Type FD, ferrous alloy with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

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- H. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- I. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).
- J. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Fiberglass.
 - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- K. Cabinets:
 - 1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.
 - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.4 POWER STRIPS

- A. Power Strips: Comply with UL 1363.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Rack mounting, with detachable flanges.
 - 3. Height: 1 RU.
 - 4. Housing: Metal.
 - 5. Six, 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
 - 6. Rear-facing receptacles.
 - 7. LED indicator lights for power and protection status.
 - 8. LED indicator lights for reverse polarity and open outlet ground.
 - 9. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.
 - 10. Cord connected with 15-foot (4.5-m) line cord.
 - 11. Rocker-type on-off switch, illuminated when in on position.
 - 12. Surge Protection: UL 1449, Type 3.
 - a. Maximum Surge Current, Line to Neutral: 27 kA.
 - b. Protection modes shall be line to neutral, line to ground, and neutral to ground.
 - c. UL 1449 Voltage Protection Rating for line to neutral and line to ground shall be 600 V and 500 V for neutral to ground.

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PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Comply with BICSI's "Telecommunications Distribution Methods Manual" for layout of communications equipment spaces.
- C. Comply with BICSI's "Information Technology Systems Installation Methods Manual" for installation of equipment in communications equipment spaces.
- D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- E. Coordinate layout and installation of communications equipment in tracks and in room. Coordinate service entrance configuration with service provider.
 - 1. Meet jointly with systems providers, equipment suppliers, and Owner to exchange information and agree on details of equipment configurations and installation interfaces.
 - 2. Record agreements reached in meetings and distribute them to other participants.
 - 3. Adjust configurations and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize configurations and space requirements of communications equipment.
 - 4. Adjust configurations and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in equipment room.
- F. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.
- G. Backboards:
 - 1. Install from 8 inches (150 mm) to 8 feet, 8 inches (2588 mm) above finished floor. If plywood is fire rated, ensure that fire-rating stamp is visible after installation.
 - 2. Paint all sides of backboard with two coats of paint, leaving fire rating stamp visible.
 - 3. Comply with requirements for backboard installation in BICSI's "Information Technology Systems Installation Methods Manual" and TIA-569-D.

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3.3 SLEEVE AND SLEEVE SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.4 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with BICSI's "Information Technology Systems Installation Methods Manual," "Firestopping Practices" Ch.

END OF SECTION 271100

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SECTION 271116 - COMMUNICATIONS RACKS, FRAMES, AND ENCLOSURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. 19-inch freestanding equipment cabinets.
 - 2. Power strips.
 - 3. Grounding.
 - 4. Labeling.
- B. Related Requirements:
 - 1. Section 271110 "Communications Equipment Room Fittings" for backboards and accessories.
 - 2. Section 270526 "Grounding and Bonding for Telecommunications Equipment" for TMGBs and TGBs.
 - 3. Section 270536 "Cable Trays for Communications Systems" for cable trays and cable tray accessories.
 - 4. Section 271313 "Communications Copper Backbone Cabling" for copper data cabling associated with system panels and devices.
 - 5. Section 271323 "Communications Optical Fiber Backbone Cabling" for optical-fiber data cabling associated with system panels and devices.
 - 6. Section 271513 "Communications Copper Horizontal Cabling" for copper data cabling associated with system panels and devices.
 - 7. Section 271523 "Communications Optical Fiber Horizontal Cabling" for optical-fiber data cabling associated with system panels and devices.

1.3 DEFINITIONS

- A. Access Provider: An operator that provides a circuit path or facility between the service provider and user. An access provider can also be a service provider.
- B. BICSI: Building Industry Consulting Service International.
- C. LAN: Local area network.
- D. RCDD: Registered communications distribution designer.

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- E. Service Provider: The operator of a telecommunications transmission service delivered through access provider facilities.
- F. TGB: Telecommunications grounding bus bar.
- G. TMGB: Telecommunications main grounding bus bar.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, certifications, standards compliance, and furnished specialties and accessories.
- B. Shop Drawings: For communications racks, frames, and enclosures. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
 - 3. Grounding: Indicate location of TGB and its mounting detail showing standoff insulators and wall-mounting brackets.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.
- B. Seismic Qualification Data: Certificates, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions. Base certification on the maximum number of components capable of being mounted in each rack type. Identify components on which certification is based.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling installer must have personnel certified by BICSI on staff.

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1. Layout Responsibility: Preparation of Shop Drawings shall be under direct supervision of RCDD.
2. Installation Supervision: Installation shall be under direct supervision of Technician, who shall be present at all times when Work of this Section is performed at Project site.
3. Field Inspector: Currently registered by BICSI as RCDD to perform on-site inspection.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Equipment shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified."
- B. UL listed.
- C. RoHS compliant.

2.2 19-INCH EQUIPMENT CABINETS

- A. Description: Manufacturer-assembled four-post frame enclosed by side and top panels and front and rear doors, designed for mounting telecommunications equipment. Width is compatible with EIA/ECIA 310-E, 19-inch (482.6-mm) equipment mounting with an opening of 17.72 inches (450 mm) between rails.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Chatsworth Products, Inc.
 2. CommScope, Inc.
 3. Hubbell Premise Wiring.
 4. Panduit Corp.
- C. General Cabinet Requirements:
 1. Modular units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
 2. Material: Extruded aluminum.
 3. Finish: Manufacturer's standard, baked-polyester powder coat.
 4. Color: Black.
- D. Modular Freestanding Cabinets:
 1. Overall Height: As indicated on Drawings.
 2. Overall Depth: 32 inches (736.6 mm).

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3. Load Rating: 3000 lb (1362 kg).
4. Number of Rack Units: 45.
 - a. Numbering: Every five rack units, on interior of rack.
5. Threads: 10-32.
6. Removable and lockable side and top panels.
7. Hinged and lockable front and rear doors.
8. Adjustable feet for leveling.
9. Screened ventilation openings in roof and rear door.
10. Cable access provisions in roof and base.
11. TGB.
12. Roof-mounted, 550-cfm (260-L/s) fan with filter.
13. Power strip.
14. Each cabinet keyed per user, as indicated on Drawings.

E. Cable Management:

1. Metal, with integral wire retaining fingers.
2. Baked-polyester powder coat finish.
3. Vertical cable management panels shall have front and rear channels, with covers.
4. Provide horizontal crossover cable manager at top of each relay rack, with a minimum height of two rack units each.

2.3 POWER STRIPS

A. Power Strips: Comply with UL 1363.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Rack mounting.
3. Six 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
4. LED indicator lights for power and protection status.
5. LED indicator lights for reverse polarity and open outlet ground.
6. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.
7. Close-coupled, direct plug-in line cord.
8. Rocker-type on-off switch, illuminated when in on position.
9. Peak Single-Impulse Surge Current Rating: 26 kA per phase.
10. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all three modes shall be not more than 330 V.

2.4 GROUNDING

- ### A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.

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- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Chatsworth Products, Inc.
 - 2. Harger Lightning & Grounding
 - 3. Panduit Corp.
- C. Rack and Cabinet TGBs: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with TIA-606-B. Predrilling shall be with holes for use with lugs specified in this Section.
 - 1. Cabinet-Mounted TGB: Terminal block, with stainless-steel or copper-plated hardware for attachment to cabinet.
 - 2. Rack-Mounted Horizontal TGB: Designed for mounting in 19- or 23-inch (482.6- or 584.2-mm) equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.
 - 3. Rack-Mounted Vertical TGB: 72 or 36 inches (1828.8 or 914.4 mm) long, with stainless-steel or copper-plated hardware for attachment to rack.

2.5 LABELING

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Comply with BICSI TDMM for layout of communications equipment spaces.
- C. Comply with BICSI ITSIMM for installation of communications equipment spaces.
- D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- E. Coordinate layout and installation of communications equipment in racks and room. Coordinate service entrance configuration with service provider.
 - 1. Meet jointly with system providers, equipment suppliers, and Owner to exchange information and agree on details of equipment configurations and installation interfaces.
 - 2. Record agreements reached in meetings and distribute them to other participants.
 - 3. Adjust configurations and locations of distribution frames, cross-connects, and patch panels in equipment spaces to accommodate and optimize configuration and space requirements of telecommunications equipment.

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4. Adjust configurations and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in equipment room.
- F. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.2 GROUNDING

- A. Comply with NECA/BICSI 607.
- B. Install grounding according to BICSI ITSIMM, "Bonding, Grounding (Earthing) and Electrical Protection" Ch.
- C. Locate TGB to minimize length of bonding conductors. Fasten to wall, allowing at least 2 inches (50 mm) of clearance behind TGB. Connect TGB with a minimum No. 4 AWG grounding electrode conductor from TGB to suitable electrical building ground. Connect rack TGB to near TGB or the TMGB.

3.3 IDENTIFICATION

- A. Coordinate system components, wiring, and cabling complying with TIA-606-B. Comply with requirements in Section 270553 "Identification for Electrical Systems."
- B. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 3 level of administration.
- D. Labels shall be machine printed. Type shall be 3/16 inch (5 mm) in height.

END OF SECTION 271116

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SECTION 271313 - COMMUNICATIONS COPPER BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. High-count Category 3 twisted pair cable.
- 2. High-count Category 5e twisted pair cable.
- 3. Category 6 twisted pair cable.
- 4. Twisted pair cable hardware, including plugs, jacks, patch panels, and cross-connects.
- 5. Grounding provisions for twisted pair cable.
- 6. Cabling identification.
- 7. Source quality control requirements for twisted pair cable.

- B. Related Requirements:

- 1. Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for data cabling associated with system panels and devices.

1.3 DEFINITIONS

- A. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- B. EMI: Electromagnetic interference.
- C. F/FTP: Overall foil screened cable with foil screened twisted pair.
- D. FTP: Shielded twisted pair.
- E. F/UTP: Overall foil screened cable with unscreened twisted pair.
- F. IDC: Insulation displacement connector.
- G. Jack: Also commonly called an "outlet," it is the fixed, female connector.
- H. LAN: Local area network.

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- I. Plug: Also commonly called a "connector," it is the removable, male telecommunications connector.
- J. RCDD: Registered Communications Distribution Designer.
- K. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.
- L. S/FTP: Overall braid screened cable with foil screened twisted pair.
- M. Shield: A metallic layer, either a foil or braid, placed around a pair or group of conductors.
- N. S/UTP: Overall braid screened cable with unscreened twisted pairs.
- O. UTP: Unscreened (unshielded) twisted pair.

1.4 COPPER BACKBONE CABLING DESCRIPTION

- A. Copper backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.
- B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Reviewed and stamped by RCDD.
 - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 - 2. Cabling administration Drawings and printouts.
 - 3. Wiring diagrams to show typical wiring schematics, including the following:
 - a. Telecommunications rooms plans and elevations.
 - b. Telecommunications pathways.
 - c. Telecommunications system access points.
 - d. Telecommunications grounding system
 - e. Cross-connects.
 - f. Patch panels.
 - g. Patch cords.
 - 4. Cross-Connects and Patch Panels: Detail mounting assemblies, and show elevations and physical relationship between the installed components.

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- C. Twisted pair cable testing plan.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Product Certificates: For each type of product.
- D. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For splices and connectors to include in maintenance manuals.
- B. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On USB media or compact disk, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Connecting Blocks: One of each type.
 - 2. Patch-Panel Units: One of each type.
 - 3. Plugs: Ten of each type.
 - 4. Jacks: Ten of each type.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings and cabling administration Drawings by an RCDD.
 - 2. Installation Supervision: Installation shall be under the direct supervision of Technician, who shall be present at all times when Work of this Section is performed at Project site.
 - 3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Testing Agency Qualifications: Testing agency must have personnel certified by BICSI on staff.

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1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.

1. Test each pair of twisted pair cable for open and short circuits.

1.11 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.12 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Backbone cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Flame-Spread Index: 25 or less.
 2. Smoke-Developed Index: 50 or less.
- C. Telecommunications Pathways and Spaces: Comply with TIA-569-D.
- D. Grounding: Comply with TIA-607-B.

2.2 GENERAL CABLE CHARACTERISTICS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:

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1. Communications, Plenum Rated: Type CMP complying with UL 1685[or Type CMP in listed plenum communications raceway] [or Type CMP in listed cable routing assembly].
 2. Communications, Riser Rated: Type CMP or Type CMR in listed plenum or riser communications raceway.
- B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: 25 or less.
 2. Smoke-Developed Index: 50 or less.
- C. RoHS compliant.

2.3 HIGH-COUNT CATEGORY 3 TWISTED PAIR CABLE

- A. Description: Balanced-twisted pair cable, pair count indicated on drawings, certified to meet transmission characteristics of Category 3 cable at frequencies up to 16MHz.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. General Cable.
 2. Mohawk.
 3. Belden
- C. Standard: Comply with ICEA S-90-661, NEMA WC 63.1, and TIA-568-C.2 for Category 3 cables.
- D. Conductors: 100-ohm, 24 AWG solid copper.
- E. Shielding/Screening: Unshielded balanced twisted pairs (UTP).
- F. Cable Rating: Plenum.
- G. Jacket: Gray thermoplastic.

2.4 HIGH-COUNT CATEGORY 5e TWISTED PAIR CABLE

- A. Description: Balanced-twisted pair cable, pair count indicated on drawings, certified to meet transmission characteristics of Category 5e cable at frequencies up to 100 MHz.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. General Cable.
 2. Mohawk.
 3. Belden

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- C. Standard: Comply with ICEA S-90-661, NEMA WC 63.1, and TIA-568-C.2 for Category 5e cables.
- D. Conductors: 100-ohm, 24 AWG solid copper.
- E. Shielding/Screening: Unshielded balanced twisted pairs (UTP).
- F. Cable Rating: Plenum.
- G. Jacket: Gray thermoplastic.

2.5 CATEGORY 6 TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250MHz.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. General Cable.
 - 2. Mohawk.
 - 3. Belden
 - 4. Superior Essex.
 - 5. Systimax Solutions.
- C. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.
- D. Conductors: 100-ohm, 23 AWG solid copper.
- E. Shielding/Screening: Unshielded balanced twisted pairs (UTP).
- F. Cable Rating: Plenum.
- G. Jacket: Blue thermoplastic.

2.6 TWISTED PAIR CABLE HARDWARE

- A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. General Cable.
 - 2. Mohawk.
 - 3. Belden
 - 4. Superior Essex.
 - 5. Systimax Solutions.

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- C. General Requirements for Cable Connecting Hardware:
 - 1. Twisted pair cable hardware shall meet the performance requirements of Category 6.
 - 2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
 - 3. Cables shall be terminated with connecting hardware of same category or higher.
 - 4. Source Limitations: Obtain twisted pair cable hardware from same manufacturer as twisted pair cable, from single source.
- D. Connecting Blocks: 110-style IDC for Category 5e. Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.
- E. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
 - 1. Number of Terminals per Field: One for each conductor in assigned cables.
- F. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
 - 1. Features:
 - a. Universal T568A and T568B wiring labels.
 - b. Labeling areas adjacent to conductors.
 - c. Replaceable connectors.
 - d. 24 or 48 ports.
 - 2. Construction: 16-gauge steel and mountable on 19-inch (483 mm) equipment racks.
 - 3. Number of Jacks per Field: One for each four-pair twisted pair cable indicated.
- G. Plugs and Plug Assemblies:
 - 1. Male; eight position (8P8C); color-coded modular telecommunications connector designed for termination of a single four-pair 100-ohm unshielded or shielded twisted pair cable.
 - 2. Standard: Comply with TIA-568-C.2.
 - 3. Marked to indicate transmission performance.
- H. Jacks and Jack Assemblies:
 - 1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair 100-ohm unshielded or shielded twisted pair cable.
 - 2. Designed to snap-in to a patch panel or faceplate.
 - 3. Standard: Comply with TIA-568-C.2.
 - 4. Marked to indicate transmission performance.
- I. Patch Cords: Factory-made, four-pair cables in 48-inch (1200-mm) lengths; terminated with an eight-position modular plug at each end.

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1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.

J. Faceplates:

1. Four port, vertical single gang faceplates designed to mount to single gang wall boxes.
2. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
3. Metal Faceplate: Stainless steel, complying with requirements in Section 262726 "Wiring Devices."
4. For use with snap-in jacks accommodating any combination of twisted pair, optical-fiber, and coaxial work-area cords.
 - a. Flush-mount jacks, positioning the cord at a 45-degree angle.

K. Legend:

1. Snap-in, clear-label covers and machine-printed paper inserts.

2.7 CABLING IDENTIFICATION

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.8 GROUNDING

- A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
- B. Comply with TIA-607-B.

2.9 SOURCE QUALITY CONTROL

- A. Factory test cables on reels according to TIA-568-C.1.
- B. Factory test cables according to TIA-568-C.2.
- C. Cable will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

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PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays, except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, attics, and gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables, except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for raceways and boxes specified in Section 270528 "Pathways for Communications Systems."
- B. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools. Install cables parallel with or at right angles to sides and back of enclosure.

3.3 INSTALLATION OF PATHWAYS

- A. Comply with requirements for demarcation point, cabinets, and racks specified in Section 271100 "Communications Equipment Room Fittings."
- B. Comply with Section 270528 "Pathways for Communications Systems."
- C. Comply with Section 270529 "Hangers and Supports for Communications Systems."
- D. Comply with Section 270536 "Cable Trays for Communications Systems."
- E. Drawings indicate general arrangement of pathways and fittings.

3.4 INSTALLATION OF COPPER BACKBONE CABLES

- A. Comply with NECA 1 and NECA/BICSI 568.
- B. General Requirements for Cabling:
 - 1. Comply with TIA-568-C.0, TIA-568-C.1, and TIA-568-C.2.

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2. Comply with BICSI's "Information Transport Systems Installation Methods Manual (ITSIMM)," Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
 3. Install 110-style IDC termination hardware unless otherwise indicated.
 4. Do not untwist twisted pair cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
 5. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 6. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 7. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
 8. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section Use lacing bars and distribution spools.
 9. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation, and replace it with new cable.
 10. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 11. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
 12. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems," "Pulling and Installing Cable" Section. Monitor cable pull tensions.
- C. Group connecting hardware for cables into separate logical fields.
- D. Separation from EMI Sources:
1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.
 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).
 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).

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- b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
- 4. Separation between communications cables in grounded metallic raceways, power lines, and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
- 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
- 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.5 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with "Firestopping Systems" Article in BICSI's "Telecommunications Distribution Methods Manual."

3.6 GROUNDING

- A. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."
- B. Comply with TIA-607-B and NECA/BICSI-607.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall, allowing at least a 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar to suitable electrical building ground, using a minimum No. 4 AWG grounding electrode conductor.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than a No. 6 AWG equipment grounding conductor.

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3.7 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."
 - 1. Administration Class: 3.
 - 2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.
- B. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 3 level of administration.
- C. Comply with requirements in Section 271513 "Communications Copper Horizontal Cabling" for cable and asset management software.
- D. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.
- F. Cable and Wire Identification:
 - 1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at the device if wire color is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
 - 4. Label each terminal strip, and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group, extended from a panel or cabinet to a building-mounted device, with the name and number of a particular device.
 - b. Label each unit and field within distribution racks and frames.
 - 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and -connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

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- G. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

- B. Tests and Inspections:

1. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

- a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

- C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similarly to Table 10.1 in BICSI's "Telecommunications Distribution Methods Manual," or shall be transferred from the instrument to the computer, saved as text files, printed, and submitted.

- D. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

- F. Prepare test and inspection reports.

END OF SECTION 271313

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SECTION 271323 - COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. 850 nanometer laser-optimized 50/125 micrometer multimode optical fiber cable (OM3).
 - 2. 850 nanometer laser-optimized 50/125 micrometer multimode optical fiber cable (OM4).
 - 3. 9/125 micrometer single-mode, inside plant optical fiber cable (OS2).
 - 4. Optical fiber cable connecting hardware, patch panels, and cross-connects.
 - 5. Cabling identification products.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. RCDD: Registered Communications Distribution Designer.

1.4 OPTICAL FIBER BACKBONE CABLING DESCRIPTION

- A. Optical fiber backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.
- B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.

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B. Shop Drawings: Reviewed and stamped by RCDD.

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. Cabling administration drawings and printouts.
3. Wiring diagrams to show typical wiring schematics including the following:
 - a. Telecommunications rooms plans and elevations.
 - b. Telecommunications pathways.
 - c. Telecommunications system access points.
 - d. Telecommunications grounding system.
 - e. Cross-connects.
 - f. Patch panels.
 - g. Patch cords.
4. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

C. Optical fiber cable testing plan.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For installer, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Product Certificates: For each type of product.
- D. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For optical fiber cable, splices, and connectors to include in maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Patch-Panel Units: One of each type.
 2. Plugs: Ten of each type.
 3. Jacks: Ten of each type.

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1.9 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings by an RCDD.
 - 2. Installation Supervision: Installation shall be under the direct supervision of Technician, who shall be present at all times when Work of this Section is performed at Project site.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical fiber flashlight or optical loss test set.
 - 2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.

1.11 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.12 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Backbone cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 50 or less.

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- C. Telecommunications Pathways and Spaces: Comply with TIA-569-D.
- D. Grounding: Comply with TIA-607-B.

2.2 850 NANOMETER LASER-OPTIMIZED, 50/125 MICROMETER, MULTIMODE OPTICAL FIBER CABLE (OM3)

- A. Description: Multimode, 50/125-micrometer, nonconductive, tight buffer, optical fiber cable, strand count indicated on Drawings.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Commscope, Inc.
 - 2. Corning Cable Systems.
 - 3. TE Connectivity.
- C. Standards:
 - 1. Comply with ICEA S-83-596 for mechanical properties.
 - 2. Comply with TIA-568-C.3 for performance specifications.
 - 3. Comply with TIA-492AAAC for detailed specifications.
- D. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
- E. Minimum Overfilled Modal Bandwidth-length Product: 1500 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
- F. Minimum Effective Modal Bandwidth-length Product: 2000 MHz-km at 850 nm.
- G. Jacket:
 - 1. Jacket Color: Aqua.
 - 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
 - 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).
- H. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - 1. Plenum Rated, Nonconductive: Type OFNP in listed plenum communications raceway.

2.3 850 NANOMETER LASER-OPTIMIZED, 50/125 MICROMETER, MULTIMODE OPTICAL FIBER CABLE (OM4)

- A. Description: Multimode, 50/125-micrometer, nonconductive, tight buffer, optical fiber cable, strand count indicated on Drawings.

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- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Commscope, Inc.
 - 2. Corning Cable Systems.
 - 3. Superior Essex Inc.
 - 4. TE Connectivity.
- C. Standards:
 - 1. Comply with ICEA S-83-596 for mechanical properties.
 - 2. Comply with TIA-568-C.3 for performance specifications.
 - 3. Comply with TIA-492AAAD for detailed specifications.
- D. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
- E. Minimum Overfilled Modal Bandwidth-length Product: 3500 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
- F. Minimum Effective Modal Bandwidth-length Product: 4700 MHz-km at 850 nm.
- G. Jacket:
 - 1. Jacket Color: Aqua.
 - 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
 - 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).
- H. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - 1. Plenum Rated, Nonconductive: Type OFNP in listed plenum communications raceway.

2.4 9/125 MICROMETER SINGLE-MODE, INSIDE PLANT OPTICAL FIBER CABLE (OS2)

- A. Description: Single mode, 9/125-micrometer, single loose tube, optical fiber cable, strand count indicated on Drawings.
- B. Description: Single mode, 9/125-micrometer, stranded loose tube, optical fiber cable, strand count indicated on Drawings.
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Commscope, Inc.
 - 2. Corning Cable Systems.
 - 3. Superior Essex Inc.
 - 4. TE Connectivity.
- D. Standards:

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1. Comply with TIA-492CAAB for detailed specifications.
 2. Comply with TIA-568-C.3 for performance specifications.
 3. Comply with ICEA S-83-596 for mechanical properties.
- E. Maximum Attenuation: 0.5 dB/km at 1310 nm; 0.5 dB/km at 1550 nm.
- F. Jacket:
1. Jacket Color: Yellow.
 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).
- G. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
1. Plenum Rated, Nonconductive: Type OFNP in listed plenum communications raceway.

2.5 OPTICAL FIBER CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Commscope, Inc.
 2. Corning Cable Systems.
 3. Hubbell Premise Wiring.
- B. Standards:
1. Comply with Fiber Optic Connector Intermateability Standard (FOCIS) specifications of the TIA-604 series.
 2. Comply with TIA-568-C.3.
- C. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.
- D. Patch Cords: Factory-made, dual-fiber cables in 36-inch (900-mm) lengths.
- E. Connector Type: Type LC complying with TIA-604-10-B connectors.
- F. Plugs and Plug Assemblies:
1. Male; color-coded modular telecommunications connector designed for termination of a single optical fiber cable.
 2. Insertion loss not more than 0.75 dB.
 3. Marked to indicate transmission performance.

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G. Jacks and Jack Assemblies:

1. Female; quick-connect, simplex and duplex; fixed telecommunications connector designed for termination of a single optical fiber cable.
2. Insertion loss not more than 0.75 dB.
3. Marked to indicate transmission performance.
4. Designed to snap-in to a patch panel or faceplate.

2.6 GROUNDING

- A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
- B. Comply with TIA-607-B.

2.7 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.8 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test multimode optical fiber cables according to TIA-526-14-B and TIA-568-C.3.
- C. Factory test pre-terminated optical fiber cable assemblies according to TIA-526-14-B and TIA-568-C.3.
- D. Cable will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
 1. Install plenum cable in environmental air spaces, including plenum ceilings.

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2. Comply with requirements for pathways specified in Section 270528 "Pathways for Communications Systems."

- B. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.2 INSTALLATION OF OPTICAL FIBER BACKBONE CABLES

- A. Comply with NECA 1, NECA 301, and NECA/BICSI 568.
- B. General Requirements for Optical Fiber Cabling Installation:
 1. Comply with TIA-568-C.1 and TIA-568-C.3.
 2. Comply with BICSI ITSIMM, Ch. 6, "Cable Termination Practices."
 3. Terminate all cables; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 6. Bundle, lace, and train cable to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
 7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 9. In the communications equipment room, provide a 10-foot- (3-m-) long service loop on each end of cable.
 10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
 11. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
- C. Group connecting hardware for cables into separate logical fields.

3.3 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with BICSI ITSIMM, "Firestopping" Chapter.

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3.4 GROUNDING

- A. Install grounding according to BICSI ITSIMM, "Grounding (Earthing), Bonding, and Electrical Protection" Chapter.
- B. Comply with TIA-607-B and NECA/BICSI-607.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.5 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."
 - 1. Administration Class: Class 3.
 - 2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.
- B. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 3 level of administration.
- C. Comply with requirements in Section 271523 "Communications Optical Fiber Horizontal Cabling" for cable and asset management software.
- D. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.
- F. Cable and Wire Identification:
 - 1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

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2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
 4. Label each unit and field within distribution racks and frames.
 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- G. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606-B, for the following:
1. Flexible vinyl or polyester that flexes as cables are bent.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
1. Visually inspect optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.
 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 3. Optical Fiber Cable Tests:
 - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - b. Link End-to-End Attenuation Tests:
 - 1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in one direction according to TIA-526-14-B, Method B, One Reference Jumper.
 - 2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than those calculated according to equation in TIA-568-C.1.
- C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

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- D. Remove and replace cabling where test results indicate that it does not comply with specified requirements.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 271323

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SECTION 271513 - COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Category 5e twisted pair cable.
 - 2. Category 6 twisted pair cable.
 - 3. Twisted pair cable hardware, including plugs and jacks.
 - 4. Cabling identification products.
 - 5. Grounding provisions for twisted pair cable.

1.3 DEFINITIONS

- A. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- B. EMI: Electromagnetic interference.
- C. IDC: Insulation displacement connector.
- D. LAN: Local area network.
- E. Jack: Also commonly called an "outlet," it is the fixed, female connector.
- F. Plug: Also commonly called a "connector," it is the removable, male telecommunications connector.
- G. RCDD: Registered Communications Distribution Designer.
- H. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.
- I. Shield: A metallic layer, either a foil or braid, placed around a pair or group of conductors.
- J. UTP: Unscreened (unshielded) twisted pair.

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1.4 COPPER HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C, and the equipment outlet, otherwise known as "Cabling Subsystem 1," in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.
 - 1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.
 - 2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.
 - 3. Bridged taps and splices shall not be installed in the horizontal cabling.
- B. A work area is approximately 100 sq. ft. (9.3 sq. m), and includes the components that extend from the equipment outlets to the station equipment.
- C. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment or in the horizontal cross-connect.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Reviewed and stamped by RCDD.
 - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 - 2. Cabling administration Drawings and printouts.
 - 3. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment, including the following:
 - a. Telecommunications rooms plans and elevations.
 - b. Telecommunications pathways.
 - c. Telecommunications system access points.
 - d. Telecommunications grounding system.
 - e. Telecommunications conductor drop locations.
 - f. Typical telecommunications details.
 - g. Mechanical, electrical, and plumbing systems.
- C. Twisted pair cable testing plan.
- D. Samples: For telecommunications jacks and plugs, in specified finish, one for each type and configuration and faceplates for color selection and evaluation of technical features.

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1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, installation supervisor, and field inspector.
- B. Product Certificates: For each type of product.
- C. Source quality-control reports.
- D. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For splices and connectors to include in maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Connecting Blocks: One of each type.
 - 2. Faceplates: One of each type.
 - 3. Jacks: Ten of each type.
 - 4. Patch-Panel Units: One of each type.
 - 5. Plugs: Ten of each type.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings and cabling administration Drawings by an RCDD.
 - 2. Installation Supervision: Installation shall be under the direct supervision of Technician, who shall be present at all times when Work of this Section is performed at Project site.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test each pair of twisted pair cable for open and short circuits.

1.11 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining

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ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.12 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.
- B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.
- C. Grounding: Comply with TIA-607-B.

2.2 GENERAL CABLE CHARACTERISTICS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:
 - 1. Communications, Plenum Rated: Type CMP in listed plenum communications raceway.
- B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 50 or less.
- C. RoHS compliant.

2.3 CATEGORY 5e TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 5e cable at frequencies up to 100 MHz.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Commscope, Inc.
 - 2. General Cable.
 - 3. Systemax Solutions.

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4. West Penn Wire.

- C. Standard: Comply with ICEA S-90-661, NEMA WC 63.1, and TIA-568-C.2 for Category 5e cables.
- D. Conductors: 100-ohm, 24 AWG solid copper.
- E. Shielding/Screening: Unshielded twisted pairs (UTP).
- F. Cable Rating: Plenum.
- G. Jacket: White thermoplastic.

2.4 CATEGORY 6 TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250MHz.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Commscope, Inc.
 - 2. General Cable.
 - 3. Systimax Solutions.
 - 4. West Penn Wire.
- C. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.
- D. Conductors: 100-ohm, 23 AWG solid copper.
- E. Shielding/Screening: Unshielded twisted pairs (UTP).
- F. Cable Rating: Plenum.
- G. Jacket: Blue thermoplastic.

2.5 TWISTED PAIR CABLE HARDWARE

- A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Commscope, Inc.
 - 2. General Cable.
 - 3. Hubbell Premise Wiring.
 - 4. Superior Essex

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5. Systimax Solutions.
- B. General Requirements for Twisted Pair Cable Hardware:
 1. Comply with the performance requirements of Category 5e and Category 6.
 2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
 3. Cables shall be terminated with connecting hardware of same category or higher.
- C. Source Limitations: Obtain twisted pair cable hardware from same manufacturer as twisted pair cable, from single source.
- D. Connecting Blocks:
 1. 110-style IDC for Category 5e.
 2. 110-style IDC for Category 6.
 3. Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.
- E. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
 1. Number of Terminals per Field: One for each conductor in assigned cables.
- F. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.
 1. Features:
 - a. Universal T568A and T568B wiring labels.
 - b. Labeling areas adjacent to conductors.
 - c. Replaceable connectors.
 - d. 24 or 48 ports.
 2. Construction: 16-gauge steel and mountable on 19-inch (483 mm) equipment racks.
 3. Number of Jacks per Field: One for each four-pair cable indicated.
- G. Patch Cords: Factory-made, four-pair cables in 48-inch (1200-mm) lengths; terminated with an eight-position modular plug at each end.
 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.
- H. Plugs and Plug Assemblies:
 1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
 2. Standard: Comply with TIA-568-C.2.
 3. Marked to indicate transmission performance.

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I. Jacks and Jack Assemblies:

1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
2. Designed to snap-in to a patch panel or faceplate.
3. Standard: Comply with TIA-568-C.2.
4. Marked to indicate transmission performance.

J. Faceplate:

1. Four port, vertical single gang faceplates designed to mount to single gang wall boxes.
2. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
3. Metal Faceplate: Stainless steel, complying with requirements in Section 262726 "Wiring Devices."
4. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.
 - a. Flush mounting jacks, positioning the cord at a 45-degree angle.

K. Legend:

1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.

2.6 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.7 GROUNDING

- A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
- B. Comply with TIA-607-B.

2.8 SOURCE QUALITY CONTROL

- A. Factory test cables on reels according to TIA-568-C.1.
- B. Factory test twisted pair cables according to TIA-568-C.2.
- C. Cable will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

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PART 3 - EXECUTION

3.1 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays, except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, attics, and gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables, except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for raceways and boxes specified in Section 270528 "Pathways for Communications Systems."
- B. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools. Install conductors parallel with or at right angles to sides and back of enclosure.

3.2 INSTALLATION OF PATHWAYS

- A. Comply with requirements for demarcation point, cabinets, and racks specified in Section 271100 "Communications Equipment Room Fittings."
- B. Comply with Section 270528 "Pathways for Communications Systems."
- C. Comply with Section 270529 "Hangers and Supports for Communications Systems."
- D. Comply with Section 270536 "Cable Trays for Communications Systems."
- E. Drawings indicate general arrangement of pathways and fittings.

3.3 INSTALLATION OF TWISTED-PAIR HORIZONTAL CABLES

- A. Comply with NECA 1 and NECA/BICSI 568.
- B. General Requirements for Cabling:
 - 1. Comply with TIA-568-C.0, TIA-568-C.1, and TIA-568-C.2.
 - 2. Comply with BICSI's "Information Transport Systems Installation Methods Manual (ITSIMM), Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
 - 3. Install 110-style IDC termination hardware unless otherwise indicated.
 - 4. Do not untwist twisted pair cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
 - 5. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.

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6. MUTOA shall not be used as a cross-connect point.
 7. Consolidation points may be used only for making a direct connection to equipment outlets:
 - a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
 - b. Locate consolidation points for twisted-pair cables at least 49 feet (15 m) from communications equipment room.
 8. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 9. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
 10. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI Information Transport Systems Installation Methods Manual , Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.
 11. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation, and replace it with new cable.
 12. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 13. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
 14. Pulling Cable: Comply with BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Pulling and Installing Cable" Section. Monitor cable pull tensions.
- C. Group connecting hardware for cables into separate logical fields.
- D. Separation from EMI Sources:
1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.
 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).
 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

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- a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
4. Separation between communications cables in grounded metallic raceways, power lines, and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
- a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.4 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with "Firestopping Systems" Article in BICSI's "Telecommunications Distribution Methods Manual."

3.5 GROUNDING

- A. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."
- B. Comply with TIA-607-B and NECA/BICSI-607.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall, allowing at least a 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar to suitable electrical building ground, using a minimum No. 4 AWG grounding electrode conductor.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than a No. 6 AWG equipment grounding conductor.

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3.6 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."
 - 1. Administration Class: Class 3.
 - 2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.
- B. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 3 level of administration.
- C. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.
- E. Cable and Wire Identification:
 - 1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at the device if wire color is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
 - 4. Label each terminal strip, and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group, extended from a panel or cabinet to a building-mounted device, with the name and number of a particular device.
 - b. Label each unit and field within distribution racks and frames.
 - 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and -connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- F. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:
 - 1. Cables use flexible vinyl or polyester that flexes as cables are bent.

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3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Test twisted pair cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similarly to Table 10.1 in BICSI's "Telecommunications Distribution Methods Manual," or shall be transferred from the instrument to the computer, saved as text files, printed, and submitted.
- D. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 271513

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SECTION 271523 - COMMUNICATIONS OPTICAL FIBER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. 850 nanometer laser-optimized 50/125 micrometer multimode optical fiber cable (OM3).
 - 2. 9/125 micrometer, single mode, optical fiber cable (OS1).
 - 3. Optical fiber cable connecting hardware, patch panels, and cross-connects.
 - 4. Grounding.
 - 5. Cabling identification products.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. RCDD: Registered Communications Distribution Designer.

1.4 OPTICAL FIBER HORIZONTAL CABLING DESCRIPTION

- A. Optical fiber horizontal cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C and the equipment outlet, otherwise known as "Cabling Subsystem 1" in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.
 - 1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.
 - 2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the equipment outlet.
 - 3. Bridged taps and splices shall not be installed in the horizontal cabling.
- B. A work area is approximately 100 sq. ft. (9.3 sq. m), and includes the components that extend from the equipment outlets to the equipment.

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- C. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment or in the horizontal cross-connect.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Reviewed and stamped by RCDD.
 - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 - 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
 - 3. Cabling administration Drawings and printouts.
 - 4. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment, including the following:
 - a. Telecommunications rooms plans and elevations.
 - b. Telecommunications pathways.
 - c. Telecommunications system access points.
 - d. Telecommunications grounding system.
 - e. Telecommunications conductor drop locations.
 - f. Typical telecommunications details.
 - g. Mechanical, electrical, and plumbing systems.
- C. Fiber optic cable testing plan.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, installation supervisor, and field inspector.
- B. Product Certificates: For each type of product.
- C. Source quality-control reports.
- D. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For optical fiber cable, splices, and connectors to include in maintenance manuals.

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1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Connecting Blocks: One of each type.
 - 2. Jacks: Ten of each type.
 - 3. Patch-Panel Units: One of each type.
 - 4. Plugs: Ten of each type.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings[and Cabling Administration Drawings by an RCDD.
 - 2. Installation Supervision: Installation shall be under the direct supervision of Technician, who shall be present at all times when Work of this Section is performed at Project site.
- B. Testing Agency Qualifications: Testing agency must have personnel certified by BICSI on staff.
 - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical fiber flashlight or optical loss test set.
 - 2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.

1.11 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.12 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications equipment and service suppliers.

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PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.
- B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.
- C. Grounding: Comply with TIA-607-B.

2.2 850 NANOMETER LASER-OPTIMIZED, 50/125 MICROMETER, MULTIMODE OPTICAL FIBER CABLE (OM3)

- A. Description: Multimode, 50/125-micrometer, nonconductive, tight buffer, optical fiber cable, strand count as indicated on Drawings.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Commscope, Inc.
 - 2. General Cable.
 - 3. Superior Essex Inc.
- C. Standards:
 - 1. Comply with ICEA S-83-596 for mechanical properties.
 - 2. Comply with TIA-568-C.3 for performance specifications.
 - 3. Comply with TIA-492AAAC for detailed specifications.
- D. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
- E. Minimum Overfilled Modal Bandwidth-length Product: 1500 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
- F. Minimum Effective Modal Bandwidth-length Product: 2000 MHz-km at 850 nm.
- G. Jacket:
 - 1. Jacket Color: Aqua.
 - 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
 - 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).
- H. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - 1. Plenum Rated, Nonconductive: Type OFNP in listed plenum communications raceway.

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2.3 9/125 MICROMETER SINGLE-MODE, INDOOR-OUTDOOR OPTICAL FIBER CABLE (OS1)

- A. Description: Single mode, 9/125-micrometer, tight buffered, nonconductive optical fiber cable, strand count as indicated on Drawings.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Commscope, Inc.
 - 2. General Cable.
 - 3. Superior Essex, Inc.
- C. Maximum Attenuation: 0.5 dB/km at 1310 nm; 0.5 dB/km at 1550 nm.
- D. Jacket:
 - 1. Jacket Color: Yellow.
 - 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
 - 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).
- E. Standards:
 - 1. Comply with TIA-492CAAA for detailed specifications.
 - 2. Comply with TIA-568-C.3 for performance specifications.
 - 3. Comply with ICEA S-104-696 for mechanical properties.
- F. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - 1. Plenum Rated, Nonconductive: Type OFNP in listed plenum communications raceway.

2.4 OPTICAL FIBER CABLE HARDWARE

- A. <Double click here to find, evaluate, and insert list of manufacturers and products>.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Commscope.
 - 2. Corning Cable Systems.
 - 3. Hubbell Premise Wiring.
- C. Standards:
 - 1. Comply with Fiber Optic Connector Intermateability Standard (FOCIS) specifications of the TIA-604 series.
 - 2. Comply with TIA-568-C.3.

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- D. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
 - 1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.
- E. Patch Cords: Factory-made, single-fiber cables in 36-inch (900-mm) lengths.
- F. Connector Type: Type LC complying with TIA-604-10-B, connectors.
- G. Plugs and Plug Assemblies:
 - 1. Male; color-coded modular telecommunications connector designed for termination of a single optical fiber cable.
 - 2. Insertion loss not more than 0.75 dB.
 - 3. Marked to indicate transmission performance.
- H. Jacks and Jack Assemblies:
 - 1. Female; quick-connect, simplex and duplex; fixed telecommunications connector designed for termination of a single optical fiber cable.
 - 2. Insertion loss not more than 0.75 dB.
 - 3. Marked to indicate transmission performance.
 - 4. Designed to snap-in to a patch panel or faceplate.
- I. Faceplate:
 - 1. Four -port, vertical single-gang faceplates designed to mount to single-gang wall boxes.
 - 2. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
 - 3. Metal Faceplate: Stainless steel, complying with requirements in Section 262726 "Wiring Devices."
 - 4. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.
 - a. Flush mounting jacks, positioning the cord at a 45-degree angle.

2.5 GROUNDING

- A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
- B. Comply with TIA-607-B.

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2.6 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.7 SOURCE QUALITY CONTROL

- A. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for pathways specified in Section 270528 "Pathways for Communications Systems."
- B. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.2 INSTALLATION OF OPTICAL FIBER BACKBONE CABLES

- A. Comply with NECA 1, NECA 301 and NECA/BICSI 568.
- B. General Requirements for Optical Fiber Cabling Installation:
 - 1. Comply with TIA-568-C.1 and TIA-568-C.3.
 - 2. Comply with BICSI ITSIMM, Ch. 6, "Cable Termination Practices."
 - 3. Terminate all cables; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 - 6. Bundle, lace, and train cable to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.

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7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
9. In the communications equipment room, provide a 10-foot- (3-m-) long service loop on each end of cable.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
11. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

- C. Group connecting hardware for cables into separate logical fields.

3.3 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with BICSI ITSIMM, "Firestopping" Chapter.

3.4 GROUNDING

- A. Install grounding according to BICSI ITSIMM, "Grounding (Earthing), Bonding, and Electrical Protection" Chapter.
- B. Comply with TIA-607-B and NECA/BICSI-607.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.5 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."
 1. Administration Class: Class 3.
 2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

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- B. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 3 level of administration.
- C. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, horizontal pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.
- E. Cable and Wire Identification:
 - 1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
 - 4. Label each unit and field within distribution racks and frames.
 - 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- F. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606-B, for the following:
 - 1. Flexible vinyl or polyester that flexes as cables are bent.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Visually inspect optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Optical Fiber Cable Tests:

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- a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- b. Link End-to-End Attenuation Tests:
 - 1) Horizontal and Multimode Horizontal Link Measurements: Test at 850 or 1300 nm in one direction according to TIA-526-14-B, Method B, One Reference Jumper.
 - 2) Attenuation test results for horizontal links shall be less than 2.0 dB. Attenuation test results shall be less than those calculated according to equation in TIA-568-C.1.
- C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- D. Remove and replace cabling where test results indicate that it does not comply with specified requirements.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 271523

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SECTION 275116 - PUBLIC ADDRESS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Preamplifiers.
 - 2. Power amplifiers.
 - 3. Microphones.
 - 4. Control console.
 - 5. Equipment cabinet.
 - 6. Telephone paging adapters.
 - 7. Noise-operated gain controllers.
 - 8. Microphone and headphone outlets.
 - 9. Conductors and cables.
 - 10. Pathways.

1.3 DEFINITIONS

- A. Channels: Separate parallel signal paths, from sources to loudspeakers or loudspeaker zones, with separate amplification and switching that permit selection between paths for speaker alternative program signals.
- B. VU: Volume unit.
- C. Zone: Separate group of loudspeakers and associated supply wiring that may be arranged for selective switching between different channels.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Power, signal, and control wiring.
 - 1. Include plans, elevations, sections, and attachment details.

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2. Include details of equipment assemblies. Indicate dimensions, weights, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Console layouts.
 4. Control panels.
 5. Rack arrangements.
 6. Calculations: For sizing backup battery.
 7. Wiring Diagrams: For power, signal, and control wiring.
 - a. Identify terminals to facilitate installation, operation, and maintenance.
 - b. Single-line diagram showing interconnection of components.
 - c. Cabling diagram showing cable routing.
- C. Delegated-Design Submittal: For supports and seismic restraints for control consoles, equipment cabinets and racks, and components indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Detail fabrication and assembly of supports and seismic restraints for control consoles, equipment cabinets and racks, and components.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings are shown and coordinated with each other, using input from installers of the items involved.
- B. Qualification Data: For Installer.
- C. Seismic Qualification Certificates: For control consoles, equipment cabinets and racks, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. Include qualification data for testing agency.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For public address systems to include in emergency, operation, and maintenance manuals.

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1. In addition to items specified in Section 017700 "Closeout Procedures" and Section 017823 "Operation and Maintenance Data," include the following:
 - a. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
 - b. Operating instructions laminated and mounted adjacent to operating console location.
 - c. Training plan.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Microphone: One.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

1. Personnel certified by NICET as Audio Systems Level III Technician.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Valcom.
 2. Bogen.
 3. Atlas Sound.
- B. Source Limitations: Obtain public address system from single source from single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NFPA 70.

2.2 FUNCTIONAL DESCRIPTION OF SYSTEM

- A. System Functions:

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1. Selectively connect any zone to any available signal channel.
2. Selectively control sound from microphone outlets and other inputs.
3. "All-call" feature shall connect the all-call sound signal simultaneously to all zones regardless of zone or channel switch settings.
4. Telephone paging adapter shall allow paging by dialing an extension from any local telephone instrument and speaking into the telephone.
5. Produce a program-signal tone that is amplified and sounded over all speakers, overriding signals currently being distributed.
6. Reproduce high-quality sound that is free of noise and distortion at all loudspeakers at all times during equipment operation including standby mode with inputs off; output free of nonuniform coverage of amplified sound.

2.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports and seismic restraints for control consoles, equipment cabinets and racks, and components, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Seismic Performance: Supports and seismic restraints for control consoles, equipment cabinets and racks, and components shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified."

2.4 SYSTEM DESCRIPTION

- A. Compatibility of Components: Coordinate component features to form an integrated system. Match components and interconnections for optimum performance of specified functions.
- B. Equipment: Comply with UL 813. Equipment shall be modular, using solid-state components, and fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz.
- C. Equipment Mounting: Where rack, cabinet, or console mounting is indicated, equipment shall be designed to mount in a 19-inch (483-mm) housing complying with EIA/ECA-310-E.

2.5 PREAMPLIFIERS

- A. Preamplifier: Integral to power amplifier.
- B. Output Power: Plus 4 dB above 1 mW at matched power-amplifier load.
- C. Total Harmonic Distortion: Less than 1 percent.
- D. Frequency Response: Within plus or minus 2 dB from 20 to 20,000 Hz.

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- E. Input Jacks: Minimum of three. One matched for low-impedance microphone; one USB port; and the other matchable to DVD or CD player, or radio tuner signals without external adapters.
- F. Minimum Noise Level: Minus 55 dB below rated output.
- G. Controls: On-off, input levels, and master gain.

2.6 POWER AMPLIFIERS

- A. Mounting: Console.
- B. Output Power: 70-V balanced line. 80 percent of the sum of wattage settings of connected for each station and speaker connected in all-call mode of operation, plus a 25 percent allowance for future stations.
- C. Total Harmonic Distortion: Less than 3 percent at rated power output from 50 to 12,000 Hz.
- D. Minimum Signal-to-Noise Ratio: 80 dB, at rated output.
- E. Frequency Response: Within plus or minus 3 dB from 20 to 12,000 Hz.
- F. Output Regulation: Less than 2 dB from full to no load.
- G. Controls: On-off, input levels, and low-cut filter.
- H. Input Sensitivity: Matched to preamplifier and to provide full-rated output with sound-pressure level of less than 10 dynes/sq. cm impinging on speaker microphone or handset transmitter.

2.7 MICROPHONES

- A. Paging Microphone:
 - 1. Type: Dynamic, with cardioid polar characteristic.
 - 2. Impedance: 250 ohms.
 - 3. Frequency Response: Uniform, 50 to 15,000 Hz.
 - 4. Sensitivity: Minus 70 dB.
 - 5. Output Level: Minus 58 dB, minimum.
 - 6. Cable: Braided shield cable with Amphenol XLR connectors. Coordinate impedance with microphone impedance.
 - 7. Mounting: Desk stand with integral-locking, press-to-talk switch.

2.8 VOLUME LIMITER/COMPRESSOR

- A. Minimum Performance Requirements:
 - 1. Frequency Response: 45 to 15,000 Hz, plus or minus 1 dB minimum.

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2. Reduction Ratio: Automatically vary compression ratio, and attack and release times for voice and music inputs.
 - a. Compression Ratio Range: 3:1 to 10:1 minimum.
 - b. Averaging Compressor Attack Time: Up to 500 milliseconds.
 - c. Signal Fast Compression Attack Time: Less than 10 milliseconds.
 - d. Release time: Up to 500 milliseconds.
3. Distortion: 0.5 percent, maximum.
4. Rated Output: Minimum of plus 14 dB.
5. Inputs: Minimum of two inputs with variable front-panel gain controls and VU or decibel meter for input adjustment.
6. Rack mounted.

2.9 CONTROL CONSOLE

- A. Cabinet: Modular, desktop; complying with EIA/ECA-310-E.
- B. Housing: Steel, 0.0478 inch (1.2 mm) minimum, with removable front and rear panels. Side panels are removable for interconnecting side-by-side mounting.
- C. Panel for Equipment and Controls: Rack mounted.
- D. Controls:
 1. Switching devices to select signal sources for distribution channels.
 2. Program selector switch to select source for each program channel.
 3. Switching devices to select zones for paging.
 4. All-call selector switch.
- E. Indicators: A visual annunciation for each distribution channel to indicate source being used.
- F. Self-Contained Power and Control Unit: A single assembly of basic control, electronics, and power supply necessary to accomplish specified functions.
- G. Spare Positions: 20 percent spare zone control and annunciation positions on console.
- H. Microphone jack.

2.10 EQUIPMENT CABINET

- A. Comply with EIA/ECA-310-E.
- B. House amplifiers and auxiliary equipment at each location.
- C. Cabinet Housing:

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1. Constructed of 0.0478-inch (1.2-mm) steel, minimum, with front- and rear-locking doors and standard EIA/ECA-310-E-compliant, 19-inch (483-mm) racks.
 2. Arranged for floor or wall mounting as indicated.
 3. Sized to house all equipment indicated, plus spare capacity.
 4. Include 20 percent minimum spare capacity for future equipment in addition to space required for future DVD or CD player.
- D. Power Provisions: A single switch in cabinet shall disconnect cabinet power distribution system and electrical outlets, which shall be uniformly spaced to accommodate ac-power cords for each item of equipment.
- E. Ventilation: A low-noise fan for forced-air cabinet ventilation. Fan shall be equipped with a filtered input vent and shall be connected to operate from 105- to 130-V ac, 60 Hz; separately fused and switched; arranged to be powered when main cabinet power switch is on.

2.11 TELEPHONE PAGING ADAPTER

- A. Adapters shall accept voice signals from telephone extension dialing access and automatically provide amplifier input and program override for preselected zones.
1. Minimum Frequency Response: Flat, 200 to 2500 Hz.
 2. Impedance Matching: Adapter matches telephone line to public address equipment input.
 3. Cabinet mounted.

2.12 TONE GENERATOR

- A. Tone generator shall provide clock and program interface with public address system.
- B. Signals: Minimum of seven distinct, audible signal types including wail, warble, high/low, alarm, repeating and single-stroke chimes, and tone.
- C. Pitch Control: Chimes and tone.
- D. Volume Control: All outputs.
- E. Activation-Switch Network: Establishes priority and hierarchy of output signals produced by different activation setups.
- F. Mounting: Cabinet.

2.13 MONITOR PANEL

- A. Monitor power amplifiers.
- B. Components: VU or dB meter, speaker with volume control, and multiple-position rotary selector switch.

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- C. Selector Switch and Volume Control: Selective monitoring of output of each separate power amplifier via VU or dB meter and speaker.
- D. Mounting: Cabinet.

2.14 NOISE-OPERATED GAIN CONTROLLER

- A. Gain controller shall be designed to continuously sense space noise level and automatically adjust signal level to local speakers.
- B. Frequency Response: 20 to 20,000 Hz, plus or minus 1 dB.
- C. Level Adjustment Range: 30 dB minimum.
- D. Maximum Distortion: 0.5 percent.
- E. Control: Permits adjustment of sensing level of device.

2.15 OUTLETS

- A. Volume Attenuator Station: Wall-plate-mounted autotransformer type with paging priority feature.
 - 1. Wattage Rating: 10 W unless otherwise indicated.
 - 2. Attenuation per Step: 3 dB, with positive off position.
 - 3. Insertion Loss: 0.4 dB maximum.
 - 4. Attenuation Bypass Relay: SPDT. Connected to operate and bypass attenuation when all-call, paging, program signal, or prerecorded message features are used. Relay returns to normal position at end of priority transmission.
 - 5. Label: "PA Volume."
- B. Microphone Outlet: Three-pole, polarized, locking-type, microphone receptacles in single-gang boxes. Equip wall outlets with brushed stainless-steel device plates. Equip floor outlets with gray tapered rubber or plastic cable nozzles and fixed outlet covers.

2.16 CONDUCTORS AND CABLES

- A. Jacketed, twisted pair and twisted multipair, untinned solid copper.
 - 1. Insulation for Wire in Conduit: Thermoplastic, not less than 1/32 inch (0.8 mm) thick.
 - 2. Microphone Cables: Neoprene jacketed, not less than 2/64 inch (0.8 mm) thick, over shield with filled interstices. Shield No. 34 AWG, tinned, soft-copper strands formed into a braid or approved equivalent foil. Shielding coverage on conductors is not less than 60 percent.
 - 3. Plenum Cable: Listed and labeled for plenum installation.

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2.17 PATHWAYS

- A. Conduit and Boxes: Comply with Section 270528 "Pathways for Communications Systems." Flexible metal conduit shall not be used.
 - 1. Outlet boxes shall be not less than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

PART 3 - EXECUTION

3.1 WIRING METHODS

- A. Wiring Method: Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters, and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal pathway and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for pathways and boxes specified in Section 270528 "Pathways for Communications Systems."
- B. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.2 INSTALLATION OF PATHWAYS

- A. Comply with requirements in Section 270528 "Pathways for Communications Systems." for installation of conduits and wireways.
- B. Install manufactured conduit sweeps and long-radius elbows whenever possible.

3.3 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Cable Installation Requirements:
 - 1. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
 - 2. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables may not be spliced.

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3. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
 5. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 6. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used.
- C. Separation of Wires: Separate speaker-microphone, line-level, speaker-level, and power wiring runs. Install in separate pathways or, where exposed or in same enclosure, separate conductors at least 12 inches (300 mm) apart for speaker microphones and adjacent parallel power and telephone wiring. Separate other communication equipment conductors as recommended by equipment manufacturer.

3.4 INSTALLATION

- A. Coordinate layout and installation of system components and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.
- B. Match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.
- C. Identification of Conductors and Cables: Color-code conductors and apply wire and cable marking tape to designate wires and cables so they identify media in coordination with system wiring diagrams.
- D. Equipment Cabinets and Racks:
1. Group items of same function together, either vertically or side by side, and arrange controls symmetrically. Mount monitor panel above the amplifiers.
 2. Arrange all inputs, outputs, interconnections, and test points so they are accessible at rear of rack for maintenance and testing, with each item removable from rack without disturbing other items or connections.
 3. Blank Panels: Cover empty space in equipment racks so entire front of rack is occupied by panels.
- E. Volume Limiter/Compressor: Equip each zone with a volume limiter/compressor. Install in central equipment cabinet. Arrange to provide a constant input to power amplifiers.
- F. Wall-Mounted Outlets: Flush mounted.
- G. Floor-Mounted Outlets: Conceal in floor and install cable nozzles through outlet covers. Secure outlet covers in place. Trim with carpet in carpeted areas.

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- H. Conductor Sizing: Unless otherwise indicated, size speaker circuit conductors from racks to loudspeaker outlets not smaller than No. 18 AWG and conductors from microphone receptacles to amplifiers not smaller than No. 22 AWG.
- I. Weatherproof Equipment: For units that are mounted outdoors, in damp locations, or where exposed to weather, install consistent with requirements of weatherproof rating.
- J. Speaker-Line Matching Transformer Connections: Make initial connections using tap settings indicated on Drawings.
- K. Connect wiring according to Section 271500 "Communications Horizontal Cabling" and Section 280513 "Conductors and Cables for Electronic Safety and Security."

3.5 GROUNDING

- A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- B. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.
- C. Install grounding electrodes as specified in Section 270526 "Grounding and Bonding for Communications Systems."

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Schedule tests with at least seven days' advance notice of test performance.
 - 2. After installing public address system and after electrical circuitry has been energized, test for compliance with requirements.
 - 3. Operational Test: Perform tests that include originating program and page messages at microphone outlets, preamplifier program inputs, and other inputs. Verify proper routing and volume levels and that system is free of noise and distortion.
 - 4. Signal-to-Noise Ratio Test: Measure signal-to-noise ratio of complete system at normal gain settings as follows:
 - a. Disconnect microphone at connector or jack closest to it and replace it in the circuit with a signal generator using a 1000-Hz signal. Replace all other microphones at corresponding connectors with dummy loads, each equal in impedance to microphone it replaces. Measure signal-to-noise ratio.
 - b. Repeat test for each separately controlled zone of loudspeakers.
 - c. Minimum acceptance ratio is 50 dB.

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5. Distortion Test: Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 50, 200, 400, 1000, 3000, 8000, and 12,000 Hz into each preamplifier channel. For each frequency, measure distortion in the paging and all-call amplifier outputs. Maximum acceptable distortion at any frequency is 3 percent total harmonics.
 6. Acoustic Coverage Test: Feed pink noise into system using octaves centered at 500 and 4000 Hz. Use sound-level meter with octave-band filters to measure level at five locations in each zone. For spaces with seated audiences, maximum permissible variation in level is plus or minus 2 dB. In addition, the levels between locations in same zone and between locations in adjacent zones must not vary more than plus or minus 3 dB.
 7. Power Output Test: Measure electrical power output of each power amplifier at normal gain settings of 50, 1000, and 12,000 Hz. Maximum variation in power output at these frequencies must not exceed plus or minus 1 dB.
 8. Signal Ground Test: Measure and report ground resistance at public address equipment signal ground. Comply with testing requirements specified in Section 270526 "Grounding and Bonding for Communications Systems."
- C. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified. Prepare a list of final tap settings of paging speaker-line matching transformers.
- D. Public address system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
1. Include a record of final speaker-line matching transformer-tap settings and signal ground-resistance measurement certified by Installer.

3.7 STARTUP SERVICE

- A. Perform startup service.
1. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements.
 2. Complete installation and startup checks according to manufacturer's written instructions.

3.8 ADJUSTING

- A. On-Site Assistance: Engage a factory-authorized service representative to provide on-site assistance in adjusting sound levels, resetting transformer taps, and adjusting controls to meet occupancy conditions.
- B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

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3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain the public address system and equipment. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 275116

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SECTION 281500 - ACCESS CONTROL HARDWARE DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Card readers, credential cards, and keypads
 - 2. Biometric identity-verification equipment
 - 3. Cables
 - 4. Transformers

1.3 DEFINITIONS

- A. Credential: Data assigned to an entity and used to identify that entity.
- B. DTS: Digital Termination Service. A microwave-based, line-of-sight communication provided directly to the end user.
- C. Identifier: A credential card; keypad personal identification number; or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.
- D. Location: A Location on the network having a PC-to-controller communications link, with additional controllers at the Location connected to the PC-to-controller link with a TIA 485-A communications loop. Where this term is presented with an initial capital letter, this definition applies.
- E. PC: Personal computer. Applies to the central station, workstations, and file servers.
- F. RAS: Remote access services.
- G. RF: Radio frequency.
- H. ROM: Read-only memory. ROM data are maintained through losses of power.
- I. TCP/IP: Transport control protocol/Internet protocol.

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- J. TWAIN: Technology without an Interesting Name. A programming interface that lets a graphics application, such as an image editing program or desktop publishing program, activate a scanner, frame grabber, or other image-capturing device.
- K. WMP: Windows media player.
- L. Wiegand: Patented magnetic principle that uses specially treated wires embedded in the credential card.
- M. WYSIWYG: What You See Is What You Get. Text and graphics appear on the screen the same as they will in print.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Reference each product to a location on Drawings. Test and evaluation data presented in Product Data shall comply with SIA BIO-01.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Diagrams for cable management system.
 - 2. System labeling schedules, including electronic copy of labeling schedules that are part of the cable and asset identification system of the software specified in Parts 2 and 3.
 - 3. Wiring Diagrams. For power, signal, and control wiring. Show typical wiring schematics including the following:
 - a. Workstation outlets, jacks, and jack assemblies.
 - b. Patch cords.
 - c. Patch panels.
 - 4. Cable Administration Drawings: As specified in "Identification" Article.
 - 5. Battery and charger calculations for central station, workstations, and controllers.
- C. Product Schedules.
- D. Samples: For workstation outlets, jacks, jack assemblies, and faceplates. For each exposed product and for each color and texture specified.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

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1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For security system to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on USB media of the hard-copy submittal.
 - 2. System installation and setup guides with data forms to plan and record options and setup decisions.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Credential card blanks, ready for printing. Include enough credential cards for all personnel to be enrolled at the site plus an extra 50 percent for future use.
 - 2. Fuses of all kinds, power and electronic, equal to 10 percent of amount installed for each size used, but no fewer than three units.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
 - 1. Cable installer must have on staff an RCDD certified by Building Industry Consulting Service International.
- B. Source Limitations: Obtain central station, workstations, controllers, Identifier readers, and all software through one source from single manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store in temperature- and humidity-controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 50 and 85 deg F (10 and 30 deg C), and not more than 80 percent relative humidity, noncondensing.
- B. Open each container; verify contents against packing list; and file copy of packing list, complete with container identification, for inclusion in operation and maintenance data.
- C. Mark packing list with the same designations assigned to materials and equipment for recording in the system labeling schedules that are generated by software specified in "Cable and Asset Management Software" Article.

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- D. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

1.10 PROJECT CONDITIONS

- A. Environmental Conditions: System shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
 - 1. Control Station: Rated for continuous operation in ambient conditions of 60 to 85 deg F (16 to 30 deg C) and a relative humidity of 20 to 80 percent, noncondensing.
 - 2. Indoor, Controlled Environment: NEMA 250, Type 1 enclosure. System components, except the central-station control unit, installed in air-conditioned temperature-controlled indoor environments shall be rated for continuous operation in ambient conditions of 36 to 122 deg F (2 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing.
 - 3. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated, listed, and installed according to NFPA 70.

PART 2 - PRODUCTS

2.1 OPERATION

- A. Security access system hardware shall use a single database for access-control and credential-creation functions.

2.2 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70, "National Electrical Code."
- C. Comply with SIA DC-03.

2.3 CARD READERS, CREDENTIAL CARDS, AND KEYPADS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB Electrification Products.
 - 2. Bosch Security Systems.
 - 3. GE Security.
 - 4. Honeywell Security Products.

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5. Schneider Electric USA.
- B. Card-Reader Power: Powered from its associated controller, including its standby power source, and shall not dissipate more than 5 W.
- C. Response Time: Card reader shall respond to passage requests by generating a signal that is sent to the controller. Response time shall be 800 ms or less, from the time the card reader finishes reading the credential card until a response signal is generated.
- D. Enclosure: Suitable for surface, semi-flush, pedestal, or weatherproof mounting. Mounting types shall additionally be suitable for installation in the following locations:
 1. Indoors, controlled environment.
- E. Display: Digital visual indicator shall provide visible and audible status indications and user prompts. Indicate power on or off, whether user passage requests have been accepted or rejected, and whether the door is locked or unlocked.
- F. Stripe Swipe Readers: Bidirectional, reading cards swiped in both directions, powered by the controller. Reader shall be set up for ABA Track.
 1. ABA Track: Magnetic stripe that is encoded on track 2, at 75-bpi density in binary-coded decimal format; for example, 5-bit, 16-character set.
 2. Readers for outdoors shall be in a polymeric plastic enclosure with all electronics potted in plastic. Rated for operation in ambient conditions of minus 40 to plus 160 deg F (minus 40 to plus 70 deg C) in a humidity range of 10 to 90 percent.
- G. Wiegand Swipe Reader: Set up for 33-bit data cards. Comply with SIA AC-01.
- H. Wiegand Key-Insert Reader: Set up for 33-bit data cards.
- I. Bar-Code Reader: Set up for Code 128.
- J. Insert Readers: Requiring the card to be inserted from the bottom, powered by the controller.
- K. Touch-Plate and Proximity Readers:
 1. Active-detection proximity card readers shall provide power to compatible credential cards through magnetic induction, and shall receive and decode a unique identification code number transmitted from the credential card.
 2. The card reader shall read proximity cards in a range from direct contact to at least 6 inches (150 mm) from the reader.
- L. Keypads:
 1. Entry-control keypads shall use a unique combination of alphanumeric and other symbols as an Identifier.
 2. Keypads shall contain an integral alphanumeric/special symbols keyboard with symbols arranged in ascending ASCII-code ordinal sequence.

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3. Communication protocol shall be compatible with the local processor.

M. Keypad Display:

1. Keypads shall include a digital visual indicator and shall provide visible and audible status indications and user prompts.
2. Display shall indicate power on or off and whether user passage requests have been accepted or rejected.
3. Design of the keypad display or keypad enclosure shall limit viewing angles of the keypad as follows:
 - a. Maximum Horizontal Viewing Angle: Plus or minus 5 degrees or less off a vertical plane perpendicular to the plane of the face of the keypad display.
 - b. Maximum Vertical Viewing Angle: Plus or minus 15 degrees or less off a horizontal plane perpendicular to the plane of the face of the keypad display.

N. Keypad Response Time:

1. The keypad shall respond to passage requests by generating a signal to the local processor. The response time shall be 800 ms or less from the time the last alphanumeric symbol is entered until a response signal is generated.

O. Keypad Power:

1. The keypad shall be powered from the source as shown and shall not dissipate more than 150 W.

P. Keypad Mounting Method:

1. Keypads shall be suitable for surface, semi-flush, pedestal, or weatherproof mounting as required.

Q. Keypad Duress Codes:

1. Keypads shall provide a means for users to indicate a duress situation by entering a special code.

R. Keypad and Wiegand-Swipe-Reader Combination: Designed to require an entry on the keypad before presenting the credential card.

1. Keypad: Allow the entry of four numeric digits that are associated with a specific credential. Keypads shall contain an integral alphanumeric/special symbol keyboard with symbols arranged in ascending ASCII-code ordinal sequence. Keypad display or enclosure shall limit viewing angles of the keypad as follows:
 - a. Maximum Horizontal Viewing Angle: Plus or minus 5 degrees or less off a vertical plane perpendicular to the plane of the face of the keypad display.
 - b. Maximum Vertical Viewing Angle: Plus or minus 15 degrees or less off a horizontal plane perpendicular to the plane of the face of the keypad display.

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2. Wiegand Swipe Reader: Set up for 33-bit data cards to generate a unique card identification code. Comply with SIA AC-01.
- S. Communication Protocol: Compatible with local processor.
- T. Touch-Plate and Contactless Card Reader: The reader shall have "flash" download capability to accommodate card format changes. The card reader shall have capability of transmitting data to security control panel and shall comply with ISO/IEC 7816.
- U. Credential Card Modification: Entry-control cards shall be able to be modified by lamination direct print process during the enrollment process without reduction of readability. The design of the credential cards shall allow for the addition of at least one slot or hole to accommodate the attachment of a clip for affixing the credential card to the badge holder used at the site.
- V. Card Size and Dimensional Stability: Credential cards shall be 2-1/8 by 3-3/8 inches (54 by 86 mm). The credential card material shall be dimensionally stable so that an undamaged card with deformations resulting from normal use shall be readable by the card reader.
- W. Card Material: Abrasion resistant, nonflammable, nontoxic, and impervious to solar radiation and effects of ultraviolet light.
- X. Card Construction:
 1. Core and laminate or monolithic construction.
 2. Lettering, logos, and other markings shall be hot stamped into the credential material or direct printed.
 3. Furnish equipment for on-site assembly and lamination of credential cards.

2.4 CABLES

- A. General Cable Requirements: Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and as recommended by system manufacturer for integration requirement.
- B. Plenum-Rated TIA 232-F Cables:
 1. Nine, No. 22 AWG, stranded (7x30) tinned copper conductors.
 2. PE insulation.
 3. Aluminum foil-polyester tape shield with 100 percent shield coverage.
 4. Fluorinated ethylene propylene jacket.
 5. Conductors are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
 6. Flame Resistance: Comply with NFPA 262.
- C. Plenum-Rated TIA 485-A Cables:
 1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
 2. Fluorinated ethylene propylene insulation.

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3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. NFPA 70 Type: Type CMP
6. Flame Resistance: NFPA 262, Flame Test.

D. Paired, Plenum-Type, Reader and Wiegand Keypad Cables:

1. Three pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, individual aluminum-foil/polypropylene-tape shielded pairs each with No. 22 AWG, stranded tinned copper drain wire, 100 percent shield coverage, and fluorinated-ethylene-propylene jacket.
2. NFPA 70, Type CMP.
3. Flame Resistance: NFPA 262 flame test.

E. Multiconductor, Plenum-Type, Reader and Wiegand Keypad Cables:

1. Six conductors, No. 20 AWG, stranded (7x28) tinned copper conductors, fluorinated-ethylene-propylene insulation, overall aluminum-foil/polyester-tape shield with 100 percent shield coverage plus tinned copper braid shield with 85 percent shield coverage, and fluorinated-ethylene-propylene jacket.
2. NFPA 70, Type CMP.
3. Flame Resistance: NFPA 262 flame test.

F. LAN Cabling:

1. Comply with requirements in Section 271513 "Communications Copper Horizontal Cabling."

2.5 TRANSFORMERS

- A. NFPA 70, Class II control transformers, NRTL listed. Transformers for security access-control system shall not be shared with any other system.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.
- B. Examine roughing-in for LAN and control cable conduit systems to PCs, controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 PREPARATION

- A. Comply with recommendations in SIA CP-01.
- B. Comply with TIA 606-B, "Administration Standard for Commercial Telecommunications Infrastructure."
- C. Product Schedules: Obtain detailed product schedules from manufacturer of access-control system or develop product schedules to suit Project. Fill in all data available from Project plans and specifications and publish as Product Schedules for review and approval.
- D. In meetings with Architect and Owner, present Product Schedules and review, adjust, and prepare final setup documents. Use approved, final Product Schedules to set up system software.

3.3 CABLING

- A. Comply with NECA 1, "Good Workmanship in Electrical Construction."
- B. Install cables and wiring according to requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use NRTL-listed plenum cable in environmental airspaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.
- D. Install LAN cables using techniques, practices, and methods that are consistent with Category 5e rating of components and optical fiber rating of components, and that ensure Category 6 and optical fiber performance of completed and linked signal paths, end to end.
- E. Boxes and enclosures containing security-system components or cabling, and which are easily accessible to employees or to the public, shall be provided with a lock. Boxes above ceiling level in occupied areas of the building shall not be considered accessible. Junction boxes and small device enclosures below ceiling level and easily accessible to employees or the public shall be covered with a suitable cover plate and secured with tamperproof screws.
- F. Install end-of-line resistors at the field device location and not at the controller or panel location.

3.4 CABLE APPLICATION

- A. Comply with TIA 569-D, "Commercial Building Standard for Telecommunications Pathways and Spaces."

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- B. Cable application requirements are minimum requirements and shall be exceeded if recommended or required by manufacturer of system hardware.
- C. TIA 232-F Cabling: Install at a maximum distance of 50 ft. (15 m) between terminations.
- D. TIA 485-A Cabling: Install at a maximum distance of 4000 ft. (1220 m) between terminations.
- E. Card Readers and Keypads:
 - 1. Install number of conductor pairs recommended by manufacturer for the functions specified.
 - 2. Unless manufacturer recommends larger conductors, install No. 22 AWG wire if maximum distance from controller to the reader is 250 ft. (75 m), and install No. 20 AWG wire if maximum distance is 500 ft. (150 m).
 - 3. For greater distances, install "extender" or "repeater" modules recommended by manufacturer of the controller.
 - 4. Install minimum No. 18 AWG shielded cable to readers and keypads that draw 50 mA or more.
- F. Install minimum No. 16 AWG cable from controller to electrically powered locks. Do not exceed 250 ft. (75 m) between terminations.
- G. Install minimum No. 18 AWG ac power wire from transformer to controller, with a maximum distance of 25 ft. (8 m) between terminations.

3.5 GROUNDING

- A. Comply with Section 270526 "Grounding and Bonding for Communications Systems."
- B. Comply with IEEE 1100, "Recommended Practice for Power and Grounding Electronic Equipment."
- C. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- D. Bond shields and drain conductors to ground at only one point in each circuit.
- E. Signal Ground:
 - 1. Terminal: Locate in each equipment room and wiring closet; isolate from power system and equipment grounding.
 - 2. Bus: Mount on wall of main equipment room with standoff insulators.
 - 3. Backbone Cable: Extend from signal ground bus to signal ground terminal in each equipment room and wiring closet.

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3.6 INSTALLATION

- A. Install card readers, keypads, push buttons, and biometric readers.

3.7 IDENTIFICATION

- A. In addition to requirements in this article, comply with applicable requirements in Section 270553 "Identification for Communications Systems" and with TIA 606-B.
- B. Using software specified in "Cable and Asset Management Software" Article, develop cable administration drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable, and label cable and jacks, connectors, and terminals to which it connects with the same designation. Use logical and systematic designations for facility's architectural arrangement.
- C. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - 1. All wiring conductors connected to terminal strips shall be individually numbered, and each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with the name and number of the particular device as shown.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at the device if the color of the wire is consistent with the associated wire connected and numbered within the panel or cabinet.
- D. At completion, cable and asset management software shall reflect as-built conditions.

3.8 SYSTEM SOFTWARE AND HARDWARE

- A. Develop, install, and test software and hardware, and perform database tests for the complete and proper operation of systems involved. Assign software license to Owner.

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. LAN Cable Procedures: Inspect for physical damage and test each conductor signal path for continuity and shorts. Use tester approved for type and kind of installed cable. Test for faulty connectors, splices, and terminations. Test according to TIA 568-C.1, "Commercial Building Telecommunications Cabling Standards - Part 1: General

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Requirements." Link performance for balanced twisted-pair cables must comply with minimum criteria in TIA 568-C.1.

2. Test each circuit and component of each system. Tests shall include, but are not limited to, measurements of power-supply output under maximum load, signal loop resistance, and leakage to ground where applicable. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of the calculated battery operating time. Provide special equipment and software if testing requires special or dedicated equipment.
3. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.

C. Devices and circuits will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.10 STARTUP SERVICE

A. Engage a factory-authorized service representative to supervise and assist with startup service.

1. Complete installation and startup checks according to approved procedures that were developed in "Preparation" Article and with manufacturer's written instructions.
2. Enroll and prepare badges and access cards for Owner's operators, management, and security personnel.

3.11 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain security access system. See Section 017900 "Demonstration and Training."

B. Develop separate training modules for the following:

1. Computer system administration personnel to manage and repair the LAN and databases and to update and maintain software.
2. Operators who prepare and input credentials to man the control station and workstations and to enroll personnel.
3. Security personnel.
4. Hardware maintenance personnel.
5. Corporate management.

END OF SECTION 281500

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SECTION 282000 - VIDEO SURVEILLANCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes a video surveillance system consisting of cameras, digital video recorder, data transmission wiring, and a control station with its associated equipment.

1.3 DEFINITIONS

- A. AGC: Automatic gain control.
- B. BNC: Bayonet Neill-Concelman - type of connector.
- C. B/W: Black and white.
- D. CCD: Charge-coupled device.
- E. FTP: File transfer protocol.
- F. IP: Internet protocol.
- G. LAN: Local area network.
- H. MPEG: Moving picture experts group.
- I. NTSC: National Television System Committee.
- J. PC: Personal computer.
- K. PTZ: Pan-tilt-zoom.
- L. RAID: Redundant array of independent disks.
- M. TCP: Transmission control protocol - connects hosts on the Internet.
- N. UPS: Uninterruptible power supply.
- O. WAN: Wide area network.

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1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include dimensions and data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For video surveillance. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Functional Block Diagram: Show single-line interconnections between components for signal transmission and control. Show cable types and sizes.
 - 3. Dimensioned plan and elevations of equipment racks, control panels, and consoles. Show access and workspace requirements.
 - 4. UPS: Sizing calculations.
 - 5. Wiring Diagrams: For power, signal, and control wiring.
- C. Design Data: Include an equipment list consisting of every piece of equipment by model number, manufacturer, serial number, location, and date of original installation. Add pretesting record of each piece of equipment, listing name of person testing, date of test, set points of adjustments, name and description of the view of preset positions, description of alarms, and description of unit output responses to an alarm.

1.5 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Data: Certificates, for cameras, camera-supporting equipment, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.
- C. Product Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For cameras, power supplies, infrared illuminators, monitors, videotape recorders, digital video recorders, video switches, and control-station components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

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1. Lists of spare parts and replacement components recommended to be stored at the site for ready access.

1.7 PROJECT CONDITIONS

- A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
 1. Control Station: Rated for continuous operation in ambient temperatures of 60 to 85 deg F (16 to 29 deg C) and a relative humidity of 20 to 80 percent, noncondensing.
 2. Interior, Controlled Environment: System components, except central-station control unit, installed in air-conditioned temperature-controlled interior environments shall be rated for continuous operation in ambient temperatures of 36 to 122 deg F (2 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing. Use NEMA 250, Type 1 enclosures.
 3. Security Environment: Camera housing for use in high-risk areas where surveillance equipment may be subject to physical violence.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of cameras, equipment related to camera operation, and control-station equipment that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

- A. Video-signal format shall comply with NTSC standard, composite interlaced video. Composite video-signal termination shall be 75 ohms.
- B. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor's entry connection to components.
 1. Minimum Protection for Power Connections 120 V and More: Auxiliary panel suppressors complying with requirements in Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits."
 2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Connections: Comply with requirements in Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits" as recommended by manufacturer for type of line being protected.

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- C. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station, control-unit alarm display shall identify tamper alarms and indicate locations.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Video surveillance system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NECA 1.
- D. Comply with NFPA 70.
- E. Electronic data exchange between video surveillance system with an access-control system shall comply with SIA TVAC.

2.3 STANDARD CAMERAS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Pelco
 - 2. Bosch Security Systems
 - 3. Honeywell Security Products.
- B. B/W Camera:
 - 1. Comply with UL 639.
 - 2. Pickup Device: CCD interline transfer, 252,000 512(H) by 492(V) pixels.
 - 3. Horizontal Resolution: 380 lines.
 - 4. Signal-to-Noise Ratio: Not less than 46 dB.
 - 5. With AGC, manually selectable on or off.
 - 6. Sensitivity: Camera shall deliver 1-V peak-to-peak video signal at the minimum specified light level. Illumination for the test shall be with lamps rated at approximately 2200-K color temperature, and with camera AGC off.
 - 7. Manually selectable modes for backlight compensation or normal lighting.
 - 8. Scanning Synchronization: Camera shall revert to internally generated synchronization on loss of external synch signal.
 - 9. Motion Detector: Built-in digital.
- C. Color Camera:

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1. Comply with UL 639.
2. Pickup Device: CCD interline transfer, 380,000 771(H) by 492(V) pixels.
3. Horizontal Resolution: 480 lines.
4. Signal-to-Noise Ratio: Not less than 50 dB, with camera AGC off.
5. With AGC, manually selectable on or off.
6. Sensitivity: Camera shall deliver 1-V peak-to-peak video signal at the minimum specified light level. Illumination for the test shall be with lamps rated at approximately 2200-K color temperature, and with camera AGC off.
7. Manually selectable modes for backlight compensation or normal lighting.
8. Scanning Synchronization: Camera shall revert to internally generated synchronization on loss of external synch signal.
9. White Balance: Auto-tracing white balance, with manually settable fixed balance option.
10. Motion Detector: Built-in digital.

D. Automatic Color Dome Camera: Assembled and tested as a manufactured unit, containing dome assembly, color camera, motorized pan and tilt, zoom lens, and receiver/driver.

1. Comply with UL 639.
2. Pickup Device: CCD interline transfer, 380,000 768(H) by 494(V) pixels.
3. Horizontal Resolution: 480 lines.
4. Signal-to-Noise Ratio: Not less than 50 dB, with camera AGC off.
5. With AGC, manually selectable on or off.
6. Sensitivity: Camera shall deliver 1-V peak-to-peak video signal at the minimum specified light level. Illumination for the test shall be with lamps rated at approximately 2200-K color temperature, and with camera AGC off.
7. Manually selectable modes for backlight compensation or normal lighting.
8. Pan and Tilt: Direct-drive motor, 360-degree rotation angle, and 180-degree tilt angle. Pan-and-tilt speed shall be controlled by operator. Movement from preset positions shall be not less than 300 degrees per second.
9. Preset Positioning: Eight user-definable scenes, each allowing 16-character titles. Controls shall include the following:
 - a. In "sequence mode," camera shall continuously sequence through preset positions, with dwell time and sequencing under operator control.
 - b. Motion detection shall be available at each camera position.
 - c. Up to four preset positions may be selected to be activated by an alarm. Each of the alarm positions may be programmed to output a response signal.
10. Scanning Synchronization: Camera shall revert to internally generated synchronization on loss of external synch signal.
11. White Balance: Auto-tracing white balance, with manually settable fixed balance option.
12. Motion Detector: Built-in digital.

2.4 LENSES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Pelco

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2. Bosch Security Systems
3. Honeywell Security Products.

B. Description: Optical-quality coated lens, designed specifically for video-surveillance applications and matched to specified camera. Provide color-corrected lenses with color cameras.

1. Auto-Iris Lens: Electrically controlled iris with circuit set to maintain a constant video level in varying lighting conditions.
2. Fixed Lens: With calibrated focus ring.
3. Zoom Lens: Motorized, remote-controlled unit, rated as "quiet operating." Features include the following:
 - a. Electrical Leads: Filtered to minimize video signal interference.
 - b. Motor Speed: Variable.
 - c. Lens shall be available with preset positioning capability to recall the position of specific scenes.

2.5 POWER SUPPLIES

A. Low-voltage power supplies matched for voltage and current requirements of cameras and accessories, and of type as recommended by manufacturer of camera, infrared illuminator, and lens.

1. Enclosure: NEMA 250, Type 1.

2.6 INFRARED ILLUMINATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Viontech
2. Vivotek Inc.
3. Honeywell Security Products.

B. Description: Lighting fixtures that emit light only in the infrared spectrum, suitable for use with cameras indicated, for nighttime surveillance, without emitting visible light.

1. Field-Selectable Beam Patterns: Narrow, medium, and wide.
2. Rated Lamp Life: More than 8000 hours.
3. Power Supply: 120-V ac.

C. Area Coverage: Illumination to 150 feet (50 m) in a narrow beam pattern.

D. Exterior housings shall be suitable for same environmental conditions as the associated camera.

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2.7 CAMERA-SUPPORTING EQUIPMENT

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Pelco
 - 2. Bosch Security Systems
 - 3. Honeywell Security Products.
- B. Minimum Load Rating: Rated for load in excess of the total weight supported times a minimum safety factor of two.
- C. Pan Units: Motorized automatic-scanning units arranged to provide remote-controlled manual and automatic camera panning action, and equipped with matching mounting brackets.
 - 1. Scanning Operation: Silent, smooth, and positive.
 - 2. Stops: Adjustable without disassembly, to limit the scanning arc.
- D. Pan-and-Tilt Units: Motorized units arranged to provide remote-controlled aiming of cameras with smooth and silent operation, and equipped with matching mounting brackets.
 - 1. Panning Rotation: 0 to 355 degrees, with adjustable stops.
 - 2. Tilt Movement: 90 degrees, plus or minus 5 degrees, with adjustable stops.
 - 3. Speed: 12 degrees per second in both horizontal and vertical planes.
 - 4. Wiring: Factory prewired for camera and zoom lens functions and pan-and-tilt power and control.
 - 5. Built-in encoders or potentiometers for position feedback.
 - 6. Pan-and-tilt unit shall be available with preset positioning capability to recall the position of a specific scene.
- E. Mounting Brackets for Fixed Cameras: Type matched to items supported and mounting conditions. Include manual pan-and-tilt adjustment.
- F. Protective Housings for Fixed and Movable Cameras: Steel or 6061 T6 aluminum enclosures with internal camera mounting and connecting provisions that are matched to camera/lens combination and mounting and installing arrangement of camera to be housed.
 - 1. Tamper switch on access cover sounds an alarm signal when unit is opened or partially disassembled. Central-control unit shall identify tamper alarms and indicate location in alarm display. Tamper switches and central-control unit are specified in Section 283100 "Intrusion Detection."
 - 2. Camera Viewing Window: Polycarbonate window, aligned with camera lens.
 - 3. Duplex Receptacle: Internally mounted.
 - 4. Alignment Provisions: Camera mounting shall provide for field aiming of camera and permit removal and reinstallation of camera lens without disturbing camera alignment.
 - 5. Built-in, thermostat-activated heater units. Units shall be automatically controlled so the environmental limits of the camera equipment are not exceeded.
 - 6. Sun shield shall not interfere with normal airflow around the housing.
 - 7. Mounting bracket and hardware for wall or ceiling mounting of the housing. Bracket shall be of same material as the housing; mounting hardware shall be stainless steel.

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8. Finish: Housing and mounting bracket shall be factory finished using manufacturer's standard finishing process suitable for the environment.
9. Enclosure Rating: NEMA Type 1.

2.8 MONITORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Pelco
 2. Bosch Security Systems
 3. Honeywell Security Products.
- B. Color:
 1. Metal cabinet units designed for continuous operation.
 2. Screen Size (Diagonal Dimension): 24.
 3. Horizontal Resolution: 300 lines.
 4. Minimum Front Panel Devices and Controls: Power switch; power-on indicator; and brightness, contrast, color, and tint controls.
 5. Degaussing: Automatic.
 6. Mounting: Dual, 9-inch (229-mm), vertical, EIA 19-inch (483-mm) electronic equipment rack or cabinet complying with CEA 310-E.
 7. Electrical: 120-V ac, 60 Hz.

2.9 DIGITAL VIDEO RECORDERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Pelco
 2. Bosch Security Systems
 3. Honeywell Security Products.
- B. Description: Digital, time-lapse type, full-frame and motion recorder, with removable hard drive.
 1. Recording Time: 400 hours minimum.
 2. Resolution: 720 by 480 lines, minimum.
 3. Programming shall be from trackball and push buttons on face of the recorder, settings shall be displayed on any video monitor connected to the recorder. Programming shall include the following:
 - a. Motion analysis graph.
 - b. Password protection.
 - c. Alarm and timer controls.
 - d. Continuous recording option.
 - e. Time-lapse operating modes.
 - f. Search video by time, event, or motion.

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4. Programming: SmartMedia card for software updating, image archiving, and image transfer to a PC.
5. Storage: 1-TB, removable hard drive. Software shall permit hot-swapping drives.
6. Compression: MPEG-2.
7. Time and Date Generator: Records time (hr:min:sec) and date legend of each frame.
8. Audio Recording: 70 to 7000 Hz. Phono and microphone input; phono output.
9. Mounting: Standard 19-inch (483-mm) rack complying with CEA 310-E, or freestanding desktop.

2.10 NETWORK VIDEO RECORDERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Pelco
 2. Bosch Security Systems
 3. Honeywell Security Products.
- B. External storage or internal 250-1, 500-GB hard disk drive.
 1. Video and audio recording over TCP/IP network.
 2. Video recording of MPEG-2 and MPEG-4 streams.
 3. Video recording up to 48 Mbps for internal storage and up to 100 Mbps for external storage.
 4. Duplex Operation: Simultaneous recording and playback.
 5. Continuous and alarm-based recording.
 6. Full-Featured Search Capabilities: Search based on camera, time, or date.
 7. Automatic data replenishment to ensure recording even if network is down.
 8. Digital certification by watermarking.
 9. Internal RAID storage or non-RAID storage of up to 1500 GB.
 10. Capable of adding external RAID storage up to 7000 GB for models with no internal storage.
 11. Full integration with LAN, Intranet, or Internet through standard Web browser or video management software.
 12. Integrated Web server FTP server functionality.
 13. Supports up to 64 devices.

2.11 DIGITAL SWITCHERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Pelco
 2. Bosch Security Systems
 3. Honeywell Security Products.
- B. Quad Switch: For displaying images from four cameras on a single monitor. Provide color switcher if one or more cameras or monitors are in color.

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1. Controls: Unit-mounted front panel.
 2. Resolution: 720 by 480 lines.
 3. Modes: Auto, manual, and alarm. In manual mode, each channel can also be viewed in single display mode. In the event of an alarm, alarming channel shall automatically switch to full screen. If several alarms are activated, channels in alarm shall be in auto-switching mode.
 4. Channel Loss Alarm: Audible buzzer; occurrence details shall be recorded.
 5. Time: Indicate date and time.
 6. Timing of Auto-Switcher: 1 to 30 seconds, selectable.
 7. Mounting: Standard 19-inch (483-mm) rack complying with CEA 310-E, or freestanding desktop.
- C. Manual Switch Bank: Low-loss, high-isolation, multiple-video switch to allow manual switching of multiple quad switches and cameras to a single output. Switches shall be illuminated.
- D. Sequential Switchers: Automatically sequence outputs of multiple cameras to single monitor and videotape recorder.
1. Switching Time Interval: Continuously adjustable, 5 to 20 seconds minimum, with manual override.
 2. Skip-Sequential-Hold Switch: One for each camera, with LED to indicate active camera.
 3. Camera Identification Legend: Either on-screen message or label at skip-sequential switch.
 4. Alarm Switching: In the event of an alarm, alarming channel shall automatically switch the monitor to full screen.
 5. Mounting: Standard 19-inch (483-mm) rack complying with CEA 310-E.
- E. PTZ Controls: Arranged for multiple-camera control, with switches to select camera to be controlled.
1. Pan-and-Tilt Control: Joystick type.
 2. Zoom Control: Momentary-contact, "in-out" push button.
 3. Automatic-Scan Control: A push button for each camera with pan capability that places camera in automatic-scanning mode.

2.12 IP VIDEO SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Pelco
 2. Bosch Security Systems
 3. Honeywell Security Products.
- B. Description:
1. System shall provide high-quality delivery and processing of IP-based video, audio, and control data using standard Ethernet-based networks.

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2. System shall have seamless integration of all video surveillance and control functions.
3. Graphical user interface software shall manage all IP-based video matrix switching and camera control functions, two-way audio communication, alarm monitoring and control, and recording and archive/retrieval management. IP system shall also be capable of integrating into larger system environments.
4. System design shall include all necessary compression software for high-performance, dual-stream, MPEG-2/MPEG-4 video. Unit shall provide connections for all video cameras, camera PTZ control data, bidirectional audio, discreet sensor inputs, and control system outputs.
5. All camera signals shall be compressed, encoded, and delivered onto the network for processing and control by the IP video-management software.
6. Camera system units shall be ruggedly built and designed for extreme adverse environments, complying with NEMA Type environmental standards.
7. Encoder/decoder combinations shall place video, audio, and data network stream that can be managed from multiple workstations on the user's LAN or WAN.
8. All system interconnect cables, workstation PCs, PTZ joysticks, and network intermediate devices shall be provided for full performance of specified system.

2.13 VIDEO MOTION SENSORS (INTERIOR)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. ICU Security
 2. Tyco International
 3. Visiontech
- B. Device Performance: Detect changes in video signal within a user-defined protected zone. Video inputs shall be composite video as defined in SMPTE 170M. Provide an alarm output for each video input.
 1. Detect movement within protected zone of intruders wearing clothing with a reflectivity that differs from that of background scene by a factor of two. Reject all other changes in video signal.
 2. Modular design that allows for expansion or modification of number of inputs.
 3. Controls:
 - a. Size of detection zones.
 - b. Sensitivity of detection of each protected zone.
 4. Mounting: Standard 19-inch (483-mm) rack complying with CEA 310-E.

2.14 CONTROL STATIONS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Pelco
 2. Bosch Security Systems

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3. Honeywell Security Products.

- B. Description: Heavy-duty, freestanding, modular, metal furniture units arranged to house electronic equipment. Coordinate component arrangement and wiring with components and wiring of other systems.
- C. Equipment Mounting: Standard 19-inch (483-mm) rack complying with CEA 310-E.
- D. Normal System Power Supply: 120 V, 60 Hz, through a locked disconnect device and an isolation transformer in central-station control unit. Central-station control unit shall supply power to all components connected to it unless otherwise indicated.
- E. Power Continuity for Control Station: Batteries in power supplies of central-station control units and individual system components shall maintain continuous system operation during outages of both normal and backup ac system supply.
 - 1. Batteries: Rechargeable, valve-regulated, recombinant, sealed, lead-acid type with nominal 10-year life expectancy. Capacity adequate to operate portions of system served including audible trouble signal devices for up to four hours and audible and visual alarm devices under alarm conditions for an additional 10 minutes.
 - 2. Battery Charger: Solid-state, fully automatic, variable-charging-rate type. Charger shall recharge fully discharged battery within 24 hours.
- F. Annunciation: Indicate change in system condition and switching of system or component to backup power.

2.15 SIGNAL TRANSMISSION COMPONENTS

- A. Cable: Coaxial cable elements have 75-ohm nominal impedance. Comply with requirements in Section 26519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Video Surveillance Coaxial Cable Connectors: BNC type, 75 ohms. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways and other elements for compliance with space allocations, installation tolerance, hazards to camera installation, and other conditions affecting installation.
- B. Examine roughing-in for LAN, WAN, and IP network before device installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 WIRING

- A. Comply with requirements in Section 270528 "Pathways for Communications Systems."
- B. Wiring Method: Install cables in raceways unless otherwise indicated.
 - 1. Except raceways are not required in hollow gypsum board partitions.
 - 2. Conceal raceways and wiring except in unfinished spaces.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
- D. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- E. For communication wiring, comply with the following:
 - 1. Section 271313 "Communications Copper Backbone Cabling."
 - 2. Section 271323 "Communications Optical Fiber Backbone Cabling."
 - 3. Section 271513 "Communications Copper Horizontal Cabling."
 - 4. Section 271523 "Communications Optical Fiber Horizontal Cabling."
- F. Grounding: Provide independent-signal circuit grounding recommended in writing by manufacturer.

3.3 VIDEO SURVEILLANCE SYSTEM INSTALLATION

- A. Install cameras and infrared illuminators level and plumb.
- B. Install cameras with 84-inch- (2134-mm-) minimum clear space below cameras and their mountings. Change type of mounting to achieve required clearance.
- C. Set pan unit and pan-and-tilt unit stops to suit final camera position and to obtain the field of view required for camera. Connect all controls and alarms, and adjust.
- D. Install power supplies and other auxiliary components at control stations unless otherwise indicated.
- E. Install tamper switches on components indicated to receive tamper switches, arranged to detect unauthorized entry into system-component enclosures and mounted in self-protected, inconspicuous positions.
- F. Avoid ground loops by making ground connections only at the control station.
 - 1. For 12- and 24-V dc cameras, connect the coaxial cable shields only at the monitor end.

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- G. Identify system components, wiring, cabling, and terminals according to Section 270553 "Identification for Communications Systems."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

- 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

- B. Tests and Inspections:

- 1. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.
 - 2. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Conduct tests at varying lighting levels, including day and night scenes as applicable. Prepare video-surveillance equipment for acceptance and operational testing as follows:
 - a. Prepare equipment list described in "Informational Submittals" Article.
 - b. Verify operation of auto-iris lenses.
 - c. Set back-focus of fixed focal length lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Adjust until image is in focus with and without the filter.
 - d. Set back-focus of zoom lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Additionally, set zoom to full wide angle and aim camera at an object 50 to 75 feet (17 to 23 m) away. Adjust until image is in focus from full wide angle to full telephoto, with the filter in place.
 - e. Set and name all preset positions; consult Owner's personnel.
 - f. Set sensitivity of motion detection.
 - g. Connect and verify responses to alarms.
 - h. Verify operation of control-station equipment.
 - 3. Test Schedule: Schedule tests after pretesting has been successfully completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.
 - 4. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.

- C. Video surveillance system will be considered defective if it does not pass tests and inspections.

- D. Prepare test and inspection reports.

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3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Tasks shall include, but are not limited to, the following:
 - 1. Check cable connections.
 - 2. Check proper operation of cameras and lenses. Verify operation of auto-iris lenses and adjust back-focus as needed.
 - 3. Adjust all preset positions; consult Owner's personnel.
 - 4. Recommend changes to cameras, lenses, and associated equipment to improve Owner's use of video surveillance system.
 - 5. Provide a written report of adjustments and recommendations.

3.6 CLEANING

- A. Clean installed items using methods and materials recommended in writing by manufacturer.
- B. Clean video-surveillance-system components, including camera-housing windows, lenses, and monitor screens.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain video-surveillance equipment.

END OF SECTION 282000

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SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fire-alarm control unit.
 - 2. Manual fire-alarm boxes.
 - 3. System smoke detectors.
 - 4. Heat detectors.
 - 5. Notification appliances.
 - 6. Voice evacuation/messaging system.
 - 7. Remote annunciator.
 - 8. Addressable interface device.
 - 9. Digital alarm communicator transmitter.
 - 10. System printer.

1.3 CODES AND STANDARDS:

- A. North Carolina State Building Code, 2012 Edition
- B. North Carolina Fire Prevention Code, 2012 Edition
- C. North Carolina Mechanical Code, 2012 Edition
- D. North Carolina Electrical Code, 2011 Edition
- E. NFPA 72, National Fire Alarm Code, 2007 Edition
- F. ANSI/ASME A11 Safety Code for elevators and escalators.
- G. Factory Mutual (FM), FM AG Approval Guide
- H. NFPA Standards 101, 1221 and 90A, latest adopted edition.
- I. National Electrical Code, latest adopted edition.

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- J. Local Building Code.
- K. Requirements of local Fire Departments.
- L. North Carolina Department of Insurance, Office of the State Fire Marshall- Fire Detection and Alarm Systems (FDAS), dated 2008.
 - 1. The contractor shall obtain a copy of the FDAS publication and is hereby notified that these specifications contain all relevant portions of the FDAS and the contractor shall comply with all applicable sections of these specifications and the FDAS. Where conflicts occur between these specifications and the FDAS the FDAS shall have precedence.
- M. UL Publication.

1.4 DEFINITIONS

- A. LED: Light-emitting diode.
- B. NICET: National Institute for Certification in Engineering Technologies.
- C. FAAP: Fire alarm annunciator panel.
- D. FACP: Fire alarm control panel.

1.5 SYSTEM DESCRIPTION

- A. Provide a complete, non-coded, UL certified addressable, microprocessor-based fire alarm system with addressable initiating devices, non-addressable emergency voice alarm notification appliances, and monitoring and control devices as indicated on the drawings and as specified herein.
- B. System covered by this section shall include all labor including installation, configuration and programming, equipment and materials necessary for a complete, operable and fully functional fire alarm system as shown on drawings and specified herein.

1.6 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

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1.7 SUBMITTALS

A. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Engineer.
2. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design on the specific fire alarm system being installed on this project.
 - 1) The factory training and certification must have occurred within the most recent 24 months.
 - 2) Copies of the certification must be part of the Contractor's submittal to the Engineer prior to installation.
 - 3) The submittal will not be approved without this certification.
 - b. In addition to the requirement for factory certification the person preparing the shop drawings shall be a NICET-certified fire-alarm technician, Level III minimum.

B. Product Data: For each type of product indicated.

C. Shop Drawings: For fire-alarm system. The submittal shall include all required items as indicated below. Partial submittals are not acceptable and will be rejected.

1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
2. Include voltage drop calculations for notification appliance circuits.
 - a. End Of Line (EOL) voltage drop must not exceed 14% of the expected battery voltage.
 - b. Submit calculations indicating compliance with this criteria.
3. Include battery-size calculations.
 - a. Battery:
 - 1) Sizing calculations showing compliance for:
 - a) Provide 24-hours battery capacity while in the alarm mode for 5-minutes.
 - b) Provide battery capacity for 15-minutes while in the alarm mode for fire alarm systems having a voice alarm/signaling system.
 - 2) Submit battery information indicating the rating of each battery that will be used on this project.
4. Voice Evacuation/messaging system.

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- a. Submit calculations to support the initial voice evacuation speaker power settings (wattage).
 - b. Submit calculations for each voice evacuation/messaging system power supply panel indicating the initial connected load and 50% spare capacity.
5. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
6. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
7. Include Floor Plans:
 - a. Indicate final outlet locations and routing of cable and conduits..
 - b. Show locations for isolation modules, terminal cabinet boxes, FACP, FAAP, NAP power supplies, and main FACP battery cabinet. Isolation modules shall not be located in the FACP.
 - c. Show address of each addressable device.
8. Include riser diagram:
 - a. Indicate fire alarm system per the planned installation.
 - b. Indicate wiring circuits, and wire sizes.
 - c. Indicate Terminal cabinet locations.
9. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
10. Device Address List:
 - a. Coordinate with final system programming.
 - b. Coordinate with Owner for final naming convention and room names to identify location of devices.
11. System Operation Description:
 - a. Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs.
 - b. Manufacturer's standard descriptions for generic systems are not acceptable.
- D. Operating Instructions: For mounting at the FACP.
- E. Product Certificates: Signed by manufacturers of system components certifying that products furnished comply with requirements.
- F. Field Test Reports: Indicate and interpret test results for compliance with performance requirements. Comply with NFPA 72.

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- G. Maintenance Data: For fire alarm systems to include in maintenance manuals specified in Division 1. Comply with NFPA 72.
- H. Submissions to Authorities Having Jurisdiction: In addition to distribution requirements for Submittals specified in Division 01 Section "Submittal Procedures," make an identical submission to authorities having jurisdiction. Include copies of annotated Contract Drawings as needed to depict component locations to facilitate review. Resubmit if required to make clarifications or revisions to obtain approval. On receipt of comments from authorities having jurisdiction, submit them to Engineer for review.
- I. Certificate of Completion: Comply with NFPA 72.
- J. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- K. Field quality-control reports.
- L. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 - 2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
 - 3. Record copy of site-specific software.
 - 4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
 - a. Frequency of testing of installed components.
 - b. Frequency of inspection of installed components.
 - c. Requirements and recommendations related to results of maintenance.
 - d. Manufacturer's user training manuals.
 - 5. Manufacturer's required maintenance related to system warranty requirements.
 - 6. Abbreviated operating instructions for mounting at fire-alarm control unit.
 - 7. Copy of NFPA 25.
- M. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.

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2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: All persons terminating wiring, installing fire alarm system devices and /or programming the fire alarm systems shall meet the following minimum requirements:
 1. Trained and certified by manufacturer in fire-alarm system design on the specific fire alarm system being installed on this project.
 - a. The factory training and certification must have occurred within the most recent 24 months. The manufacturer must sign the certification certifying the installer's compliance with their requirements.
 - b. Copies of the certification must be part of the Contractor's submittal to the Engineer prior to installation.
- B. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer.
- C. For any fire alarm component that will be connected to an existing fire alarm system the components shall be compatible with, and operate as, an extension of existing system.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. NFPA Certification: Obtain certification according to NFPA 72 by compliance with the Engineer's witness test. Refer to Part 3 – Execution.

1.9 PROJECT CONDITIONS

- A. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:
 1. Notify Owner no fewer than five days in advance of proposed interruption of fire-alarm service.
 2. Do not proceed with interruption of fire-alarm service without Owner's written permission.

1.10 SEQUENCING AND SCHEDULING

- A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN

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SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.

- B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

1.11 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning with Substantial Completion, provide software support for one year.
- C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within one year from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
 - 1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.12 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps for Remote Indicating Lamp Units: Quantity equal to 5 percent of amount installed, but no fewer than 1 unit.
 - 2. Lamps for Strobe Units: Quantity equal to 5 percent of amount installed, but no fewer than 1 unit.
 - 3. Smoke Detectors, Heat Detectors: Quantity equal to 6 percent of amount of each type installed, but no fewer than 1 unit of each type.
 - 4. Detector Bases: Quantity equal to 6 percent of amount of each type installed, but no fewer than 1 unit of each type.
 - 5. Keys and Tools: One extra set for access to locked and tamper proofed components.
 - 6. Fuses: Two of each type installed in the system.
 - 7. Manual Stations:
 - a. Quantity equal to 2 percent of amount installed.
 - 8. Indoor Notification Appliance:
 - a. Quantity equal to 4 percent of amount installed.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Being listed as an acceptable Manufacturer in no way relieves obligation to provide all equipment and features in accordance with these specifications.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Edwards Systems Technology; Unit of General Signal.
 - 2. NOTIFIER; a Honeywell company.
 - 3. Siemens Building Technologies, Inc.; Fire Safety Division.
 - 4. Simplex Grinnell LP; a Tyco International company.
- C. Alternate products must be submitted to the Engineer two weeks prior to bid for approval. Alternate or as-equal products submitted under this contract must provide a detailed line-by-line comparison of how the submitted product meets, exceeds, or does not comply with this specification.
- D. The equipment and service provider shall be a nationally recognized company specializing in fire alarm and detection systems. This provider shall employ factory trained and NICET Level III certified technicians, and shall maintain a service organization within 100 miles of this project location. The equipment and service provider shall have a minimum of 10 years experience in the fire protective signaling systems industry.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and/or systems:
 - 1. Manual stations.
 - 2. Heat detectors.
 - 3. Smoke detectors.
 - 4. Duct smoke detectors.
 - 5. Automatic sprinkler system water flow.
 - 6. Heat detectors in elevator shaft, machine room and pit.
 - 7. Fire-extinguishing system operation.
 - 8. Fire standpipe system.
- B. Fire-alarm signal shall initiate the following actions:
 - 1. Continuously operate alarm notification appliances.
 - 2. Identify alarm at fire-alarm control unit and remote annunciators.
 - 3. Transmit an alarm signal to the remote alarm receiving station.
 - 4. Unlock electric door locks in designated egress paths. Refer to plans for egress paths.
 - 5. Release of drop/shutter rolling steel type fire doors.
 - 6. Activate voice/alarm communication system.

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7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
 - a. Unless otherwise noted on the fire alarm matrix on the drawings the default condition shall be 'OFF' during a general fire alarm condition with a manual override switch/control for activation by the fire department.
 8. Recall elevators to primary or alternate recall floors.
 9. Record events in the system memory.
 10. Record events by the system printer.
 11. Shunt trip elevator power where sprinkler heads are installed in elevator shafts, machine rooms or pits.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.
 2. Low-air-pressure switch of a dry-pipe sprinkler system.
 3. Elevator shunt-trip supervision.
- D. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
 2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 3. Loss of primary power at fire-alarm control unit.
 - a. When 8-hours have elapsed after the power outage.
 4. Ground or a single break in fire-alarm control unit internal circuits.
 5. Abnormal ac voltage at fire-alarm control unit.
 6. Break in standby battery circuitry.
 7. Failure of battery charging.
 8. Abnormal position of any switch at fire-alarm control unit or annunciator.
 9. Low-air-pressure switch operation on a dry-pipe or preaction sprinkler system.
- E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Record the event on system printer.

2.3 FIRE-ALARM CONTROL UNIT

- A. General Requirements for Fire-Alarm Control Unit:
1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.
 - a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.

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- b. Include a real-time clock for time annotation of events on the event recorder and printer.
 - 2. Addressable initiation devices that communicate device identity and status.
 - a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control unit.
 - b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
 - 3. Addressable control circuits for operation of mechanical equipment.
- B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
 - 1. Annunciator and Display: Liquid-crystal type, 3 line(s) of 80 characters, minimum.
 - 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.
- C. Circuits:
 - 1. Addressable Systems: Notification Appliance, and Signaling Line Circuits:
 - a. Notification Appliance Circuits (NAC): Class B.
 - b. ***Initiating Device Circuits: Class A, Style D.***
 - c. Signaling Line Circuits (SLC): Class A6, T-Taps not permitted.
 - 2. Serial Interfaces: Two RS-232 ports for printers.
- D. Elevator Recall:
 - 1. Smoke detectors at the following locations shall initiate automatic elevator recall. Alarm-initiating devices, except those listed, shall not start elevator recall.
 - a. Elevator lobby detectors except the lobby detector on the designated floor.
 - b. Smoke detector in elevator machine room.
 - c. Smoke detectors in elevator hoistway.
 - d. Smoke detectors in elevator pit.
 - 2. Elevator lobby detectors located on the designated recall floors shall be programmed to move the cars to the alternate recall floor.
 - 3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.
 - a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.

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- E. Elevator Circuit Breaker Shunt Trip:
 - 1. Provide heat detectors in the elevator machine rooms and where indicated in the elevator pit with temperature settings coordinated with sprinkler heads in the same room.
 - a. Heat detector to activate prior to the sprinkler head temperature setting.
- F. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.
- G. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
- H. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided in a separate cabinet located in the fire command center or as a special module that is part of fire-alarm control unit.
 - 1. Indicated number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711 and be listed by an NRTL.
 - a. Allow the application of and evacuation signal to indicated number of zones and, at same time, allow voice paging to the other zones selectively or in any combination.
 - b. Programmable tone and message sequence selection.
 - c. Standard digitally recorded messages for "Evacuation" and "All Clear."
 - d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification appliance circuits of fire-alarm control unit.
 - 2. Status Annunciator: Indicate the status of various voice/alarm speaker zones.
 - 3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.
- I. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.
- J. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals and supervisory signals shall be powered by 24-V dc source.

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1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.
- K. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
 1. Batteries: Sealed lead calcium or Sealed, valve-regulated, recombinant lead acid
 2. Battery Nominal Life Expectancy: 20 years, minimum.
 3. Facilities with generator power to the Fire Alarm Control Panel must have 24-hours battery capacity while in the alarm mode for 5-minutes.
 4. Facilities with emergency voice evacuation/messaging systems in addition to meeting the above stated criteria, as applicable, must have battery capacity for 15-minutes while in the alarm mode.
 5. End Of Line (EOL) voltage drop must not exceed 14% of the expected battery voltage.
- L. Battery Charger:
 1. Solid-state, fully automatic, variable-charging-rate type.
 2. Provide capacity for 150 percent of the connected system load while maintaining batteries at full charge.
 3. Whenever batteries are fully discharged, the charger shall recharge them completely within four hours.
 4. Charger output is supervised as part of system power supply supervision.
- M. Integral Automatic Transfer Switch:
 1. Transfers the load to the battery without loss of signals or status indications when normal power fails.
- N. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.
- O. Air Handling Unit Shutdown Defeat:
 1. A supervised "AHU Shutdown Defeat" switch must be provided in or adjacent to the FACP, and as a key-operated function in the Remote Annunciator (where provided).
 2. Whenever the Remote Annunciator option is utilized, provide an informative engraved label at the FACP about this function.
 3. The switch must cause a system "trouble" indication when it's placed in the off-normal ("AHU Shutdown Defeated") position.

2.4 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show

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visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key- or wrench-operated switch.
3. Weatherproof Protective Shield (as shown on floor plans): Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.5 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be four-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
 - a. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).

C. Ionization Smoke Detector:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.

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2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).

D. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).
3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

E. Remote Test Switch and Indicating Lights: All duct detectors shall have a remote test switch and indicating light installed in the nearest corridor or public area and identified by an engraved label affixed to the wall or ceiling.

2.6 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
- C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.
 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.

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2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
- D. Spacing: Drawings reflect spacing based on a prescriptive design of 30 ft per NFPA 72. If heat detector supplied cannot meet this spacing requirement, contractor is responsible for providing additional heat detectors to cover area as indicated on the drawings.

2.7 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.
 1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.
- B. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- high letters on the lens.
 1. Rated Light Output:
 - a. 15/30/75/110 cd, selectable in the field.
 2. Mounting: Wall mounted unless otherwise indicated.
 3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
 4. Flashing shall be in a temporal pattern, synchronized with other units.
 5. Strobe Leads: Factory connected to screw terminals.
 6. Mounting Faceplate: Factory finished, red.
- C. Voice/Tone Notification Appliances:
 1. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.
 2. High-Range Units: Rated 2 to 15 W field selectable.
 3. Low-Range Units: Rated 1 to 2 W field selectable.
 4. Mounting: Flush.
 5. Matching Transformers: Tap range matched to acoustical environment of speaker location.

2.8 ROLLING STEEL FIRE DOORS

- A. Provide addressable module for the control of the rolling steel fire door.

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- B. Door shall be released whenever any flow switch is active (water is flowing) AND a smoke detector located near the door location is active. The door shall not be released upon just a general alarm.

2.9 REMOTE ANNUNCIATOR

- A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
 - 1. Mounting: Flush cabinet, NEMA 250, Type 1.
- B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.
- C. Wall-mounted Device Location Maps indicating the building floor plan with a “You Are Here” designation.
 - 1. Mounting: Adjacent to remote annunciator and the FACP.

2.10 ADDRESSABLE INTERFACE DEVICE

- A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- B. Multi-gang Indicating Addressable devices are not permitted. All devices shall be installed in individual boxes
- C. Integral Relay: Capable of providing a direct signal to AHU starter, smoke damper operation, elevator controller to initiate elevator recall or to circuit-breaker shunt trip for power shutdown.

2.11 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.
- B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone lines and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. Whenever service on either line is interrupted for longer than **45** seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

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- C. Local functions and display at the digital alarm communicator transmitter shall include the following:
 - 1. Verification that both telephone lines are available.
 - 2. Programming device.
 - 3. LED display.
 - 4. Manual test report function and manual transmission clear indication.
 - 5. Communications failure with the central station or fire-alarm control unit.
- D. The following signals shall be reported as applicable:
 - 1. Fire Alarm
 - 2. Sprinkler Water flow Alarm
 - 3. Fire Pump Running Alarm (if pump provided)
 - 4. Fire pump Abnormal Status
 - 5. Sprinkler Valve Tamper (Closed) Supervisory Signal
 - 6. Sprinkler Low Temperature/Air Pressure Supervisory Signal
 - 7. Burglary/Intrusion/Duress/Other Security or Emergency Alarms
 - 8. Fire Alarm System AC Power Trouble after 8-hours.
 - 9. Low Battery
- E. Secondary Power: Integral rechargeable battery and automatic charger.
- F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.
- G. Precedence of Signals:
 - 1. Fire Alarm.
 - 2. Supervisory signal.
 - 3. Trouble Signal.
 - 4. Security Alarm.
- H. Contractor: Contractor must program the PROM, connect each DACT to the telephone lines provided and verify proper signal receipt by the supervising station.
- I. The installation of this device shall include the required telecommunications cabling as specified for data outlets in these specifications.

2.12 SYSTEM PRINTER

- A. Printer shall be listed and labeled by an NRTL as an integral part of fire-alarm system. Printer shall be 120 volt ac and use ordinary (non-thermal) paper. Install as shown on drawings or as selected by Owner. For high rise buildings, the printer must be monitored by the Central FACP and be powered from an emergency circuit.
 - 1. Provide wall shelf for mounting.
 - 2. Provide dedicated 120-volt receptacle from same power source as the FACP.

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2.13 DEVICE GUARDS

- A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
 - 1. Factory fabricated and furnished by manufacturer of device.
 - 2. Finish: Paint of color to match the protected device.

2.14 WIRING

- A. Non-Power-Limited Circuits: Copper conductors with 600-V rated, 75 deg C, color-coded THHN/THWN insulation.
 - 1. Low-Voltage Circuits: Stranded No. 12 AWG, minimum.
 - 2. Line-Voltage Circuits: Solid No. 12 AWG, minimum.
- B. Power-Limited Circuits: NFPA 70, Types FPL, FPLR, or FPLP, as recommended by manufacturer.
- C. Wiring shall be color coded as follows:
 - 1. Addressable loop (signaling line) circuits shall be wired with type FPL/FPLR/FPLP fire alarm cable, low capacitance (30-pF Max.), 18 AWG minimum, twisted shielded copper pair. Cable shield drain wires are to be connected at each device on the loop to maintain continuity, taped to insulate from ground, and terminated at the FACP. Acceptable manufacturers include Atlas, Belden, West Penn or equal wire having capacitance of 30 pf/ft. maximum between conductors. The cable jacket color shall be red, with Red (+) and Black (-) conductor insulation.
 - 2. Unshielded Cable, otherwise equal to the above, is permitted where the manufacturer's installation instructions unequivocally require, or state a preference for, the use of unshielded cable for all systems.
 - 3. Alarm notification appliance circuits (horns and strobes) shall be wired with type THHN/THWN, stranded copper, AWG 12 minimum, color coded Blue (+), Black (-) conductor insulation.
 - 4. One way voice/Alarm digital audio circuits shall be wired with low capacitance (30-pF Max.), AWG 12 minimum, twisted shielded copper pair. Cable shield drain wires are to be connected continuous from the amplifier to the end of the line. Acceptable manufacturers include Atlas, Belden, West Penn or equal wire having capacitance of 30 pf/ft. maximum between conductors. The cable jacket shall be Gray outer jacket, Red (+), Black (-) conductor insulation.
 - a. Note: Where required to meet NFPA fire rating requirements MI cable shall be utilized.
 - 5. System equipment with 24VDC operating power shall be wired with type THHN/THWN, stranded copper, AWG 12 minimum, color coded Yellow (+), Brown (-) conductor insulation.

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6. Door control circuits for maglocks if supplied from fire alarm system shall be wired with type THHN/THWN, stranded copper, AWG 12 minimum, color coded Orange conductor insulation.
7. Circuits from Zone Addressable Monitored Devices shall be wired with type THHN/THWN, stranded copper, AWG 12 minimum, color coded Violet (+), Gray (-) conductor insulation.
8. For underground circuits installed in conduit, use Type TC or PLTC cable (PE insulated) to avoid problems for moisture. Color coding for specific application, as described herein, shall be followed.

2.15 POWER SUPPLIES

- A. Notification Appliance circuit booster (“ADA”) power supplies and Voice Messaging power supplies must be individually monitored for integrity and are not permitted to be located above a ceiling, or in non-conditioned space. Any 24vdc power circuits serving addressable control relays must also be monitored for integrity. Provide a smoke detector within 15 feet of the power supply.
 1. Each Power Booster shall be addressable to and supervised, per NFPA requirements, by the FACP.
 2. The FACP shall be able to distinguish each individual Power Booster and issue a digital readout for each individual Power Booster that reports a trouble signal.
 3. Provide dedicated 120-volt receptacle from the same source as the FACP.
 4. Notification Appliance circuit booster total capacity shall not be less than the total load connected to the circuit booster, as calculated from the devices Cd as shown on the drawings, plus 30% spare capacity for additional devices or a change to Cd settings.
 5. Voice messaging power supplies for the speaker system shall have a total capacity not less than the total load connected to the power supply, as calculated from the quantity and device initial settings, plus 50% spare capacity for additional devices or a change to the speaker wattage settings.

2.16 ISOLATION MODULES

- A. To minimize the impact of a wiring fault (short), isolation modules or (if the ceiling height is <10 feet) isolator base type initiating devices shall be provided as follows:
 1. After each 20 devices and control points on any addressable circuit.
 2. For each addressable circuit that extends outside the building walls.
 3. Immediately adjacent to the FACP, at each end of the addressable loop. These two isolators must be in the same room as the FACP and within 15 feet. Isolation modules shall not be located in the FACP.
 4. For loops covering more than one floor, install isolator at terminal cabinet on each floor (with additional isolator(s) on any floor with over 20 addresses).
 5. Coordinate with the Owner and the Engineer for the approved method of installation for accessibility and maintenance.

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2.17 TVSS

- A. The following protection against voltage transients and surges must be provided by the fire alarm equipment supplier, and installed by the electrical contractor for all fire alarm system panels:
1. On AC Input:
 - a. A feed through (not a shunt-type) branch circuit transient arrestor such as the EFI HWM-120, Leviton OEM-120EFI, Northern Technologies TCS-HW, Transtector ACP100BWN3, or any equivalent UL Listed device submitted to and approved by the Engineer.
 - b. Install suppressor on the outside of the electrical panelboard, and trim excess lead lengths.
 - c. Wind small coil in the branch circuit conductor just downstream of the suppressor connection. Coil to be wound using 5 to 10 turns, 3/4"-1" diameter. The coil shall be securely tie-wrapped at two points to maintain the coil diameter and winding integrity.
 - 1) This series impedance will improve the effectiveness of the arrestor in suppressing voltage transients.
 2. On DC Circuits Extending Outside Building:
 - a. Acceptable models: Simples 2081-9027 and 2081-9028, Transtector TSP8601, the Ditek DTKxLVL series, Citel American BF280-24V, Northern Technologies DLP-42. Equal products may be submitted to the Engineer for approval.
 - b. Adjacent to the FACP, and also near point of entry to outlying building, provide "pi" type filter on each leg, consisting of a primary arrestor, a series impedance, and a fast acting secondary arrestor which clamps at 30v to 40v.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. Equipment Mounting: Install fire-alarm control unit on wall as indicated on the drawings.
1. Install seismic bracing. Comply with requirements in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- C. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
1. Connect new equipment to existing control panel in existing part of the building.
 2. Connect new equipment to existing monitoring equipment at the supervising station.

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3. Expand, modify, and supplement existing **[control]** **[monitoring]** equipment as necessary to extend existing **[control]** **[monitoring]** functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

D. Control Relays

1. Control relays shall be installed to meet NFPA requirements. This shall include but not limited to control relays that actuate smoke and/or fire dampers and motors associated with smoke exhaust/removal systems.
 - a. The maximum distance from the fire alarm control relay to the motor controller shall be 3-ft.

E. Smoke- or Heat-Detector Spacing:

1. The fire alarm devices shown on the plans and details are diagrammatic in nature and are to establish the basis for bidding. The certified contractor shall install all devices in compliance with NFPA, National, Local codes as applicable to this project.
2. During installation the certified contractor shall review the design layout and adjust the fire alarm system using, but not limited to, the following guidelines:
 - a. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
 - b. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
 - c. Not less than 4 inches (100 mm) from a side wall to the near edge.
 - d. For exposed solid-joist construction, mount detectors on the bottom of joists unless the depth of the beams create a pocket as defined by NFPA.
 - e. Refer to the latest edition of the NFPA for mounting of detectors where there is no gypsum board or acoustical tile (drop) ceilings to mount detectors on. Follow NFPA requirements for mounting height.
 - f. Review all structural beam depths, spacing and structural ceilings prior to installing conduits and detectors.
 - g. On smooth ceiling, install not more than 30 feet (9 m) apart in any direction.
 - h. Wall-Mounted Smoke Detectors: Not less than 4 inches (100 mm), but not more than 12 inches (300 mm), below the ceiling.
 - i. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to the appropriate Appendix in NFPA 72.
 - j. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.
 - k. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture.

- F. Smoke detector: Mount photoelectric smoke detector within 15' of the central FACP, any FAAPs and each external power supply.

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- G. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Each duct detector installation shall have a hinged or latched duct access panel, 12x12 inches minimum, for sampling tube inspection and cleaning. Indicate airflow direction on the duct, adjacent to the detector.
 - 1. Verify that each unit is listed for the complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 - 2. Install sampling tubes so they extend the full width of the duct.
- H. Manual Pull Stations: Mount semi-flush in recessed back boxes. Mount 48" AFF to top of device.
 - 1. Coordinate with the general contractor for installation of devices required by code to be within 5-ft of exit doors.
 - a. Method of installing fire alarm cables through mullions of curtain wall systems.
 - 1) Submit to the Engineer and Engineer for approval installation drawings showing methods to be used for routing of cables and device mounting.
- I. Water-Flow Detectors and Valve Supervisory Switches: Connect for each sprinkler valve station required to be supervised.
- J. Heat Detectors in Elevator Shafts, Machine Rooms or Pits:
 - 1. Coordinate temperature rating and location with sprinkler rating and location.
 - 2. Heat detectors shall be installed within 2-ft. of each sprinkler head location.
- K. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position. Indicators shall be installed in individual boxes and not be installed in multi-gang boxes.
- L. Audible Alarm-Indicating Devices: Install 80" AFF to device bottom unless noted otherwise on the drawings..
- M. Visible Alarm-Indicating Devices: Install 80" AFF to device bottom unless noted otherwise on the drawings.
- N. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- O. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches above the finished floor.
- P. Annunciator: Install with top of panel not more than 72 inches above the finished floor.
- Q. Digital dialer: Provide two (2) data outlet jacks compatible with the digital dialer, including data cabling as specified in these specifications (Category 5e minimum rating). Connect to the

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local floor telecommunications equipment as specified in these specifications. Install in ½" conduit minimum from outlet jacks to telecommunications equipment.

- R. Smoke Detector Protection: Unless suitable protected against dust, paint, etc., spot type smoke detectors shall not be installed until the final construction clean-up has been completed. In the event of contamination during construction, the detectors must be replaced.
- S. Detector Identification: Identification of individual detectors is required. Assign each a unique number as follows, in sequence starting at the FACP: (Addressable Loop#-- Device#) Put on the as-built plans, and also permanently mount on each detector's base so that it's readable standing on the floor below without having to remove the smoke detector. Exception: for detectors with housings (i.e., air duct, projected beam, air sampling, flame), apply the identification to a suitable location on exterior of their housing.
- T. Fire Alarm System notification circuits, an end-of-line (EOL) resistor should be located as follows:
 - 1. In a location that is accessible to fire alarm maintenance personnel.
 - 2. In an area where maintenance or testing at the EOL resistor location will not be disruptive to the normal use of the facility.
 - 3. In an area that is not easily accessible to the normal building occupants (objective is to avoid accidental or malicious damage by building occupants).
 - 4. In an area that is no higher than 9 ft or lower than 7 ft from the floor level.
 - 5. Not located in a stairway or bathroom location.
- U. The branch circuit breaker(s) supplying any circuit for Fire Alarm system equipment must be physically protected by panelboard lock or handle lock and must be identified with a 1/4" permanent red dot applied to handle or exposed body area.
- V. A floor plan diagram with device identifiers shall be framed under glass and mounted near the main Fire Alarm Control Panel.

3.2 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware." Connect hardware and devices to fire-alarm system.
 - 1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 - 1. Alarm-initiating connection to smoke-control system (smoke management) at firefighter smoke-control system panel.

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2. Smoke dampers in air ducts of designated air-conditioning duct systems.
3. Alarm-initiating connection to elevator recall system and components.
4. Alarm-initiating connection to activate emergency lighting control.
5. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
6. Supervisory connections at valve supervisory switches.
7. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
8. Supervisory connections at elevator shunt trip breaker.
9. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
10. Supervisory connections at fire-pump engine control panel.

3.3 WIRING INSTALLATION

- A. Installer Qualifications: All persons terminating wiring, installing fire alarm system devices and /or programming the fire alarm systems shall meet the following minimum requirements:
1. Trained and certified by manufacturer in fire-alarm system design on the specific fire alarm system being installed on this project.
 - a. The factory training and certification must have occurred within the most recent 24 months. The manufacturer must sign the certification certifying the installer's compliance with their requirements.
 - b. Copies of the certification must be part of the Contractor's submittal to the Engineer prior to installation.
 - c. The submittal will not be approved without this certification.
 2. In addition to the requirement for factory certification the person preparing the shop drawings shall be a NICET-certified fire-alarm technician, Level III minimum.
- B. Wiring Method: Install wiring in metal raceway according to Division 26 Section "Raceways and Boxes for Electrical Systems." Conceal raceway except in unfinished spaces and as indicated.
1. Coordinate with the general contractor for installation of devices required by code to be within 5-ft of exit doors.
 - a. Method of installing fire alarm cables through mullions of curtain wall systems.
 - 1) Submit to the Engineer for approval installation drawings showing methods to be used for routing of cables and device mounting.
 2. All Class A SLC loop circuits, as required herein, shall have the supply and return 'loop' cables installed in separate raceways to insure survivability except as noted herein.
 - a. On multi-story buildings each floor shall have a dedicated Class A SLC loop.
 - b. Minimum separation distance between the Class A SLC supply and return raceways/cables shall be the corridor width, less 1-ft., for the floor being served by the Class A SLC loop.

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- 1) Exception: The supply and return Class A loop cables may occupy the same raceway from the junction box where the SLC initiating device is mounted for a maximum distance of 6-ft. where they shall enter into a common junction box where they shall be installed in separate raceways to the next device on the loop, fire alarm terminal cabinet or fire alarm control panel.
 - c. As an option on multi-story buildings, the Class A SLC supply and return raceways may be installed so that the Class A SLC loop cables terminate in fire alarm terminal cabinets located at opposite ends of the floor being served by a Class A SLC loop. From the terminal cabinets on each floor the supply and return loop cables shall be installed in raceways containing only SLC cables and shall be routed to the next fire alarm terminal cabinet on a lower floor or directly back to the fire alarm control panel.
 - d. The supply and return Class A SLC loop cables/raceways shall be kept separated back to within 10-ft. from where they enter the fire alarm control panel.
- C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by the manufacturer.
1. All wiring and splices shall be made using terminal blocks. Crimp type connectors or 'wire nuts' connectors are prohibited.
 2. All terminal block screws shall have pressure wire connectors of the self-lifting or box lug type.
 3. All terminal blocks shall be securely fastened in place using screws. Adhesive tape or glue will not be acceptable.
 4. Run fire alarm system wiring in dedicated raceway system containing only fire alarm system wiring.
 5. Install conductors parallel with or at right angles to sides and back of the enclosure.
 6. Bundle, lace, and train conductors to terminal points with no excess.
 7. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks.
 8. All doors of all enclosures shall contain a green insulated #12 copper conductor bonding the enclosure to the door. This shall not impede opening of the door to 180 degrees.
 9. Mark each terminal according to the system's wiring diagrams.
 10. Make all connections with approved crimp-on terminal spade lugs, screw terminal blocks, or plug connectors.
 11. Label all wires at all termination points.
 12. Label inside of enclosure with 120 VAC source panel board and circuit number.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
1. All system wiring shall be labeled at each termination point or splice.

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- B. Identify each enclosure with an engraved, red, laminated, phenolic-resin nameplate with lettering not less than 1 inch (25 mm) high. Identify individual components and modules within cabinets with permanent labels.
- C. Install Instructions frame in a location visible from the FACP.
- D. Label Central FACP with engraved label indicating panel location, panel name, and circuit number of power source to FACP.
- E. It is understood that the room names and numbers shown on the contract document may change prior to the final acceptance of the building by the Owner.
 - 1. The installing contractor shall coordinate with the Owner and/or the General Contractor the final room names and numbers for the entire building. This shall occur prior to the final Engineer's acceptance testing.
 - 2. The FACP programming and subsequent display readouts shall indicate these room names, numbers and identical device addresses in order as follows:
 - a. Device type.
 - b. Equipment or unit number associated with the device whenever applicable.
 - c. Location by room number.
 - d. Device address number.

3.5 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.
- B. Ground the enclosure doors using a green insulated #12 grounding conductor attached to the enclosure housing and the door. Install so that the door is free to swing open 180- degrees.
- C. The Fire Alarm Control Panel shall be grounded to the AC supply source with an insulated equipment grounding conductor installed and routed in the same raceway with the AC branch circuit conductors feeding the Fire Alarm Control Panel.

3.6 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by the Owner Representative and/or the Engineer of Record.
- B. Tests and inspections.
 - 1. Manufacturer's Field Service: The trained and certified person who terminates and programs the system shall be required to perform all field testing as described within these specifications.
- C. Contractor/Manufacturer Representative Tests and Inspections:

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1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
 - b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
 2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
 4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
 5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
 6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
- D. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- E. The engineer shall then be informed by written notification that the system is complete per plans and specifications that the 100% system test was completed and is ready for the Engineer's acceptance test.
- F. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- G. The Contractor shall notify the Engineer two (2) weeks in advance to schedule the Engineer's acceptance test of the completed system.
- H. Engineer of Record Test and Inspections:
1. The Engineer, in the presence of the contractor and an authorized factory-trained representative of the manufacturer who terminated and programmed the fire alarm system, shall perform an acceptance test to verify compliance with the plans, specifications and applicable codes.
 2. The contractor shall assist the engineer with the test.
 3. The test shall be directed and controlled by the Engineer.
 4. The contractor shall provide two-way radios, ladders and any other materials needed to test the system (smoke candles, approved test smoke, etc.).
- I. After the Engineers acceptance test has been successfully completed and all deficiencies have been corrected, the installing contractor shall provide specific documentation for the fire alarm system. This documentation shall include but is not limited to the following:

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1. System Status and Program Printout.
2. System Operation Matrix.
3. As-Built Drawings.
4. Two Bound Copies of General System Information for the Owner.
5. For buildings with a smoke control or smoke purge system, an HVAC balance report in the smoke control/purge mode.

- J. After testing and correction of deficiencies have been completed the contractor shall provide site specified FACP programming on a diskette or CD as appropriate for review. This process shall be repeated until there are no further errors or corrections to the database.

3.7 FINAL DOCUMENTATION

- A. After all system corrections have been made provide to the engineer the following documentation.
1. Riser diagram(s) showing all fire alarm panels, power booster panels, fire alarm devices and terminal boxes. The diagram shall represent how the devices are connected to the fire alarm system and shall be suitable for trouble shooting the fire alarm system connections.
 2. Documentation shall be provided in CAD file format compatible with the engineer's CAD files for the project.
 3. The contractor shall make all corrections to the file(s) as directed by the engineer.

3.8 GUARANTEE:

- A. All wiring, etc., shall be in strict accordance with the local Electrical Code requirements and shall have the written approval of all public authorities having jurisdiction. The Contractor shall guarantee all equipment and wiring free from inherent mechanical and electrical defects for a period of one (1) year from date of installation. The final connection between the equipment and wiring system and all programming shall be made under the direct supervision of a qualified technical representative of the manufacturer. All products of combustion detectors shall have sensitivities set by Factory Trained Technician, and results submitted to the Engineer.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

3.10 TRAINING:

- A. Training shall cover the following topics at a minimum:

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1. Preventative maintenance service techniques and schedules, including historical data trending of alarm and trouble records.
2. Overall system concepts, capabilities, and functions. Training shall be in-depth, so that the owner shall be able to add or delete devices to the system and to take any device out of service and return any device to service without need for Manufacturer's approval.
3. Explanation of all control functions, including training to program and operate the system software.
4. Methods and means of troubleshooting and replacement of all field wiring and devices.
5. Methods and procedures for troubleshooting the main fire alarm control panel, including field peripheral devices as to programming, bussing systems, internal panel and unit wiring, circuitry and interconnections.
6. Manuals, drawings, and technical documentation. Actual system software used for training shall be provided on 3 ½ inch floppy disk or CD and shall be left with the Owner at the completion of training for the Owner's use in the future.

PART 4 - NFPA FORMS

4.1 FIRE ALARM SYSTEM CERTIFICATION OF COMPLETION.

- A. Complete the latest revised NFPA 72-2016, Figure 4.5.2.1, "Record of Completion" Form.
 1. On the form, place the installers name and NICET number or factory authorized certification number of installing technician who is responsible for certifying the installation of the fire alarm system.
- B. Submit to Engineer for review prior to Engineer's scheduled acceptance testing.

END OF SECTION 283111

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SECTION 31 05 13 - SOILS FOR EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Subsoil materials.
 - 2. Topsoil materials.
- B. Related Sections:
 - 1. Section 31 05 16 - Aggregates for Earthwork.
 - 2. Section 31 22 13 - Rough Grading.
 - 3. Section 31 23 17 - Trenching.
 - 4. Section 31 23 23 - Fill.
 - 5. Section 32 91 19 - Landscape Grading.
 - 6. General provisions of the contract, including general and supplementary conditions apply to this section

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International:
 - 1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - 2. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 3. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Materials Source: Submit name of imported materials source.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Codes and Standards: Perform earthwork complying with requirements of North Carolina Department of Transportation.

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- B. Testing and Inspection Service: OWNER will employ a qualified independent geotechnical engineering testing agency to classify proposed on-site and borrow soils to verify that soils comply with specified requirements and to perform required field and laboratory testing. The CONTRACTOR shall include the cost of all testing in the BID.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section 01 31 00 - Project Management and Coordination.
 - 1. Before commencing earthwork, meet with representatives of the governing authorities, OWNER, THE OWNER'S REPRESENTATIVE, consultants, Geotechnical Engineer, independent testing agency, and other concerned entities. Review earthwork procedures and responsibilities including testing and inspection procedures and requirements. Notify participants at least 3 working days prior to convening conference. Record discussions and agreements and furnish a copy to each participant.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

- A. Select Materials: Select Material shall be any suitable material which is classified by gradation and performance characteristics as indicated in NCDOT Standard Specifications Section 1016.
- B. Borrow Materials: Borrow Materials shall be any suitable material as specified in NCDOT Standard Specifications Section 1018.
- C. Drainage Fill: Course of NCDOT Class VI Select Material supporting slab-on-grade placed to cut off upward capillary flow of pore water.
- D. Class B Bedding: Class B Bedding shall consist of NCDOT Class VI Select Materials. Bedding shall have a minimum thickness beneath the pipe of 4 in., or one-eighth of the outside diameter of the pipe, whichever is greater, and shall extend up the mid-point of the outside diameter of the pipe. Backfill from the top of bedding material to a level not less than 12 in. above the top of the pipe shall be carefully placed NCDOT Class I soil material.
- E. Class C Bedding: Class C Bedding shall consist of NCDOT Class VI Select Materials. Bedding shall have a minimum thickness beneath the pipe of 4 in., or one-eighth of the outside diameter of the pipe, whichever is greater, and shall extend up the sides of the pipe one-fourth of the outside diameter of the pipe. Backfill from the top of bedding material to a level not less than 12 in. above the top of the pipe shall be carefully placed NCDOT Class I soil material.
- F. Class D Bedding: Class D Bedding shall consist of NCDOT Class II or III Select Materials. Bedding shall have a minimum thickness beneath the pipe of 4 in., or one-eighth of the outside diameter of the pipe, whichever is greater, and shall be carefully placed, shaped, and compacted to conform to the bottom pipe periphery and to uniformly

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and continuously support the pipe. Backfill from the top of bedding material to a level not less than 12 in. above the top of the pipe shall be carefully placed NCDOT Class I soil materials.

- G. Satisfactory Soil Materials: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter.
- H. Unsatisfactory Soil Materials: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT.
- I. Select Materials: Select Materials shall conform to NCDOT Standard Specifications Section 1016.
- J. Borrow Materials: Borrow Materials shall conform to NCDOT Standard Specifications Section 1018.
- K. Aggregates for Asphalt Surface Treatment: Aggregates for Asphalt Surface Treatments shall conform to NCDOT Standard Specifications Section 1012-2.

2.2 ACCESSORIES

- A. Detectable Tracer Wire: A continuous “detectable” wire of minimum 12 gauge THHN shall be buried along the pipe. The wire shall be “stubbed” out into valve boxes and secured.
- B. Filter Fabric: Manufacturer's standard nonwoven pervious geotextile fabric of polypropylene, nylon or polyester fibers, or a combination.

2.3 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Testing and Inspection Services Testing and analysis of soil material.
- B. Testing and Analysis of Subsoil Material: Perform in accordance with [ASTM D698.] [ASTM D1557.] [AASHTO T180.]
- C. Testing and Analysis of Topsoil Material: Perform in accordance with [ASTM D698.] [ASTM D1557.] [AASHTO T180.]
- D. When tests indicate materials do not meet specified requirements, change material and retest.
- E. Furnish materials of each type from same source throughout the Work.

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PART 3 EXECUTION

3.1 EXCAVATION

- A. Excavate subsoil and topsoil from areas designated. Strip topsoil to full depth of topsoil in designated areas.
- B. Stockpile excavated material meeting requirements for subsoil materials and topsoil materials.
- C. Remove excess excavated materials not intended for reuse, from site.
- D. Remove excavated materials not meeting requirements for subsoil materials and topsoil materials from site.

3.2 STOCKPILING

- A. Stockpile materials on site at locations indicated designated by designer.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate differing materials with dividers or stockpile apart to prevent mixing.
- D. Stockpile topsoil.
- E. Prevent intermixing of soil types or contamination.
- F. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.
- G. Stockpile potential hazardous materials on impervious material and cover to prevent erosion and leaching, until disposed of.

3.3 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.
- B. When borrow area is indicated, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION

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SECTION 31 05 16 - AGGREGATES FOR EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Coarse aggregate materials.
 - 2. Fine aggregate materials.
- B. Related Sections:
 - 1. Section 31 05 13 - Soils for Earthwork: Fill and grading materials.
 - 2. Section 31 22 13 - Rough Grading.
 - 3. Section 31 23 23 - Fill.
 - 4. Section 32 11 23 - Aggregate Base Courses.
 - 5. Section 32 91 19 - Landscape Grading.
 - 6. Section 33 11 16 - Site Water Utility Distribution Piping.
 - 7. Section 33 31 00 - Sanitary Utility Sewerage Piping.
 - 8. Section 33 41 00 - Storm Utility Drainage Piping.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO M147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Sub-base, Base and Surface Courses.
 - 2. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International:
 - 1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - 3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 4. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
 - 5. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Materials Source: Submit name of imported materials suppliers.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements

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1.4 QUALITY ASSURANCE

- A. Codes and Standards: Perform earthwork complying with requirements of North Carolina Department of Transportation.
- B. Testing and Inspection Service: OWNER will employ a qualified independent geotechnical engineering testing agency to classify proposed on-site and borrow soils to verify that soils comply with specified requirements and to perform required field and laboratory testing. The CONTRACTOR shall include the cost of all testing in the BID.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section 01 31 00 "Project Management and Coordination."
 - 1. Before commencing earthwork, meet with representatives of the governing authorities, OWNER, THE OWNER'S REPRESENTATIVE, consultants, Geotechnical Engineer, independent testing agency, and other concerned entities. Review earthwork procedures and responsibilities including testing and inspection procedures and requirements. Notify participants at least 3 working days prior to convening conference. Record discussions and agreements and furnish a copy to each participant.

PART 2 PRODUCTS

2.1 AGGREGATE MATERIALS

- A. Aggregate Base Materials: Aggregate Base Materials shall conform to NCDOT Standard Specifications Section 1010, Type A or B.
- B. Aggregates for Asphalt Surface Treatment: Aggregates for Asphalt Surface Treatments shall conform to NCDOT Standard Specifications Section 1012-2.

2.2 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Testing and inspection services.
- B. Coarse Aggregate Material - Testing and Analysis: Perform in accordance with ASTM D698. ASTM D1557. AASHTO T180. ASTM D4318. ASTM C136.
- C. Fine Aggregate Material - Testing and Analysis: Perform in accordance with ASTM D698. ASTM D1557. AASHTO T180. ASTM D4318. ASTM C136.
- D. When tests indicate materials do not meet specified requirements, change material and retest.

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PART 3 EXECUTION

3.1 EXCAVATION

- A. Excavate aggregate materials from on-site locations as specified in Section 31 22 13 and 31 23 16.
- B. Stockpile excavated material meeting requirements for coarse aggregate materials and fine aggregate materials.
- C. Remove excess excavated materials coarse aggregate materials and fine aggregate materials not intended for reuse, from site.
- D. Remove excavated materials not meeting requirements for coarse aggregate materials and fine aggregate materials from site.

3.2 STOCKPILING

- A. Stockpile materials on site at locations indicated.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate different aggregate materials with dividers or stockpile individually to prevent mixing.
- D. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.
- E. Stockpile potentially hazardous materials on impervious material and cover to prevent erosion and leaching, until disposed of.

3.3 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.
- B. Leave unused materials in neat, compact stockpile.
- C. When borrow area is indicated, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION

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SECTION 31 10 00 - SITE CLEARING AND DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Removing surface debris.
 - 2. Removing all items required to provide a clean site for the construction of the proposed improvements.
 - 3. Removing designated trees, shrubs, and other plant life.
 - 4. Removing abandoned utilities.
- B. Related Sections:
 - 1. Section 31 22 13 - Rough Grading.
- C. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- D. Product Data: Submit data for herbicide. Indicate compliance with applicable codes for environmental protection.

1.2 QUALITY ASSURANCE

- A. Perform Work in accordance with all local, State and Federal Standards.
- B. Conform to applicable code for environmental requirements, disposal of debris, and use of herbicides.

PART 2 PRODUCTS – Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 Sections: Verification of existing conditions before starting work.
- B. Verify existing plant life designated to remain is tagged or identified.
Identify waste area for placing removed materials.
- D. Traffic: Conduct site-clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from Owner or authorities having jurisdiction.
- E. Protection of Existing Improvements: Provide protections necessary to prevent damage to existing improvements indicated to remain in place.
 - 1. Protect improvements on adjoining properties and on owner's property.
 - 2. Restore damaged improvements to their original condition, as acceptable to owners.

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3.2 PREPARATION

- A. Call Local Utility Line Information service not less than 3 working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.

3.3 PROTECTION

- A. Indicated locations of utilities are approximate. Locate, identify, and protect utilities indicated to remain, from damage before commencing work.
- B. Protect trees, plant growth, and features designated to remain, as final landscaping as specified.
- C. Protect bench marks, and existing structures from damage or displacement.
- D. Arrange and pay for disconnecting, removing, capping, and plugging utility services to be demolished or abandon. Notify affected utility companies in advance and obtain approval before starting this Work.
- E. Place markers to indicate location of disconnected services. Identify service lines and capping locations on Project Record Documents.

3.4 CLEARING

- A. Clear areas required for access to site and execution of Work.
- B. Remove trees and shrubs to include through removal of stumps and root mat as required to provide a clean site for construction of the improvements.
- C. Clear undergrowth and deadwood, without disturbing subsoil.
- D. Apply herbicide as required to inhibit growth.

3.5 REMOVAL

- A. Remove debris, rock, and extracted plant life from site.
- B. Remove paving, curbs, and other hard surface materials as required.
- C. Remove and/or relocate utilities as required. Indicated removal termination point for underground utilities on Record Documents.
- D. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.
- E. Leave site in clean condition.

3.6 TOPSOIL EXCAVATION

- A. Excavate topsoil as required without mixing with foreign materials for use in finish grading.
- B. Do not excavate wet topsoil.

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- C. Stockpile in area designated on site and protect from erosion.
- D. Remove excess topsoil not intended for reuse, from site.

END OF SECTION

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SECTION 31 20 00 - EARTHWORK FOR SITE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the Contract Documents apply to the work of this Section.
- B. Refer to Division 01 Sections and the Bid Form for information concerning required allowances and unit prices.
- C. Refer to Section 31 10 00 for topsoil stripping and Section 32 90 00 for topsoil placement.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Excavation, filling, backfilling, and grading indicated and necessary for proper completion of the work.
 - 2. Preparing of subgrade for walks and pavements.
 - 3. Excavating and backfilling of trenches.
 - 4. Excavating and backfilling for underground mechanical and electrical utilities and buried mechanical and electrical appurtenances.

1.3 SUBMITTALS

- A. NCDOT approved Job Mix for stone.
- B. Imported fill (if required): Submit location of borrow pit and a sample of the soil for approval to the Owner's Geotechnical Engineer a minimum of fourteen (14) working days prior to use.
- C. Geotextile Fabric.

1.4 DEFINITIONS

- A. Excavation: Removal of all material encountered to design subgrade elevations indicated for cut areas and to subsoil elevations in fill areas. Excavation also includes subsequent resspreading, moisture conditioning, compaction, and grading of satisfactory materials removed.
- B. Subgrade: The undisturbed earth (in cut) or the compacted soil layer (in fill) immediately below granular subbase, drainage fill, or topsoil materials.
- C. Subsoil: The undisturbed earth immediately below the existing topsoil layer.
- D. Structures: The area extending a minimum of ten (10) feet beyond the edge of foundations, slabs, curbs, underground tanks, piping or other man-made stationary features occurring above or below ground surface.
- E. Pavements: The area extending 10 feet beyond the exterior limits of paved areas and down to undisturbed soils at a one horizontal to one vertical slope. The area extending 3 feet beyond the exterior limits of walks and down to undisturbed soils at a one horizontal to one vertical slope.
- F. Subbase Material: Artificially graded mixture of crushed gravel or crushed stone meeting NCDOT specifications. Material type is indicated on the drawings.

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- G. Drainage/Porous Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel meeting the requirements of NCDOT No. 57 Stone.
- H. Rock: Hard bed rock, boulders or similar material requiring the use of rock drills and/or explosives for removal. The criteria for classification of general excavation as rock is any material which cannot be dislodged by a Caterpillar D-8 Tractor, or equivalent, equipped with a single tooth hydraulically operated power ripper. The criteria for trench rock shall be that a Caterpillar 345 Backhoe, or equivalent, with a proper width bucket cannot remove the material.

1.5 QUALITY ASSURANCE

- A. Codes and Standards: Perform excavation work in compliance with applicable requirements of authorities having jurisdiction.
- B. Environmental Compliance:
 - 1. Comply with the requirements of the latest edition of the North Carolina Erosion and Sediment Control Planning and Design Manual for erosion control during earthwork operations.
 - 2. Comply with the permit conditions for all work performed within wetlands.
- C. Testing and Inspection Service: Owner will employ and pay for an independent Geotechnical testing and inspection laboratory to perform soil testing and inspection service during earthwork operations. Cooperate with Owner's Geotechnical Engineer as required for testing and inspection of work. These services do not relieve the responsibility for compliance with Contract Document requirements.

1.6 PROJECT CONDITIONS

- A. Site Information: Data concerning subsurface materials or conditions, which are based on test borings, may have been obtained by the Owner for his use in designing the project. If provided, this data is contained in a report generally titled "REPORT OF SUBSURFACE EXPLORATION AND GEOTECHNICAL ENGINEERING ANALYSIS,." Any subsurface report is included in this project manual for information only.
 - 1. The accuracy or completeness of the data is not warranted or guaranteed by the Owner or the Architect/Engineer, and in no event shall be considered part of the Contract Documents. The Owner and Architect/Engineer expressly disclaim any responsibility for the data as being representative of the conditions and materials that may be encountered.
- B. Bidders and interested parties (prior to receipt of bids) are encouraged to conduct their own soil and subsurface investigations, examinations, tests, and exploratory borings to determine the nature of the soil conditions underlying the project site. Contact the Owner's office to make an appointment to enter the site for the purpose of conducting your own investigation prior to bid.
- C. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted under the following conditions and then only after arranging to provide acceptable temporary utility services.
 - 1. Notify Owners Representative not less than 48 hours in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without receiving Architect's written permission.
 - 3. Existing utilities across or along the line of work are indicated where evidence in the field

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was found and in an approximate location. Prior to construction, the contractor shall employ a location company to evaluate and locate shown and other utilities in potential conflict with new improvements. The contractor shall also contact “NC one call” at 1-800-632-4949 prior to construction. Along the route of new underground lines, the contractor shall pothole to determine depths and potential conflicts prior to installation. They shall notify the Owner’s representative immediately if a potential conflict exists. All costs associated with locating, (horizontal and vertical) and investigating existing utilities shall be paid by the contractor. Repair and correct any damage to underground lines and structures. It is the contractor’s option to use any means and methods to install the improvements and shall be included in their bid including excavations deeper than what is shown on the plans.

1.7 SAFETY

- A. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.
 - 1. Operate warning lights as recommended by authorities having jurisdiction and governing regulations and standards.
 - 2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Work within the road right-of-way shall meet all requirements of the latest edition of the North Carolina Department of Transportation Work Area Protection Manual.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Satisfactory soil materials are defined as those complying with ASTM D2487 USCS soil classification groups CL, GC, SC, GW, GP, GM, SM, SW, ML, and SP. CH, ML, and MH soil types can be used, but require special handling, due to difficulties in moisture adjustment and compaction.
- B. Unsatisfactory soil materials are defined as those complying with ASTM D2487 soil classification groups OL, OH, and PT. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at the time of compaction.
- C. Backfill and Fill Materials: Satisfactory soil materials free of clay, rock or gravel larger than 4 inches in any dimension (2 inches for material used in trench backfill), debris, waste, frozen materials, vegetation and other deleterious matter.
- D. Imported material for structural fill shall comply with ASTM D2487 soil classification groups CL, GC, SC, GW, GP, GM, SM, SW, and SP.

2.2 ACCESSORIES

- A. Non-woven Geotextile Fabric (for drainage): Mirafi 140N, or equivalent.
- B. Woven Geotextile Fabric (for reinforcement): AMOCO 2002, or equivalent.

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PART 3 – EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Section 31 10 00 "Site Clearing and Demolition."
- C. Protect and maintain erosion and sedimentation controls during earthwork operations.

3.2 DEWATERING

- A. Prevent surface water and subsurface or groundwater from flowing into excavations and from flooding project site and surrounding area.
 - 1. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrade and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
 - 2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or runoff areas. Do not use utility trench excavations as temporary drainage ditches.
- B. Should any springs or running water be encountered in the excavation, notify the Architect and provide discharge by trenches (or other acceptable means) and drain to an appropriate point of disposal. Provide temporary drainage facilities to minimize the flow of rainwater onto adjacent property. Repair any damage to property or to subgrade as a result of construction and/or dewatering (or lack thereof) operations at no additional cost to the Contract. If permanent provision must be made for disposal of water other than as indicated, the Contract price shall be adjusted.

3.3 EXPLOSIVES

- A. Blasting is not allowed.

3.4 EXCAVATION

- A. Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials or concrete.
 - 2. Remove rock and other unsuitable materials to lines and grades indicated to permit installation of permanent construction to the following minimum dimensions:
 - a. Two feet outside of concrete work for which forms are required, except footings.
 - b. One foot outside the perimeters of footings.
 - c. In pipe trenches, 6 inches below invert elevation of pipe and 2 feet wider than the inside diameter of pipe, but not less than 3 feet minimum trench width.

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- d. Neat outside dimensions of concrete work where no forms are required.
 - e. Under slabs on grade, 6 inches below bottom of concrete slab.
- B. Excavation consists of removal, placement and disposal of material encountered when establishing required subgrade or finish grade elevations.
 - 1. Excavation includes removal and disposal of pavements and other obstructions visible on ground surface; underground structures, utilities and other items indicated to be demolished and removed; together with earth and other materials encountered that are not classified as rock or unauthorized excavation.
- C. Rock Excavation: If Rock is encountered the Owner's Geotechnical Engineer will verify that the material qualifies for classification as rock excavation.
 - 1. If rock is encountered in grading, remove to depths as follows:
 - a. Under surfaced areas, to 6" under the respective subgrade for such areas.
 - b. Under grass and planted areas - 12" minimum.
 - c. Under footings – Two feet below bottom of footing, One foot outside of perimeter of footing.
 - d. Under trenches – 6" below bottom of trench.
 - 2. No additional payment shall be made for rock removal.

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Cut surface under pavements to comply with cross-sections, elevations and grades as indicated.

3.6 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches of clearance on both sides of pipe or conduit.
- B. Excavate trenches to depth indicated or required to establish indicated slope and invert elevations and to support bottom of pipe or conduit on undisturbed soil. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line. See utility and drainage sections specifications and plans for depths.
 - 1. Where rock is encountered, carry excavation to required elevations and backfill with NCDOT #57 crushed stone prior to installation of pipe.
 - 2. For pipes or conduit less than 6 inches in nominal size, and for flat-bottomed, multiple-duct conduit units, do not excavate beyond indicated depths. Hand-excavate bottom cut to accurate elevations and support pipe or conduit on undisturbed soil.
 - 3. For pipes and equipment 6 inches or larger in nominal size, shape bottom of trench to fit bottom of pipe for 90 degrees (bottom 1/4 of the circumference). Fill depressions with tamped sand backfill. At each pipe joint, dig bell holes to relieve pipe bell of loads ensure continuous bearing of pipe barrel on bearing surface.

3.7 EXCAVATION STABILITY

- A. General: Comply with local codes, ordinances, and requirements of agencies having jurisdiction.
- B. Slope sides of excavations to comply with local codes, ordinances, and requirements of agencies

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having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling.

- C. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross braces, in good serviceable condition. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Extend shoring and bracing as excavation progresses.

3.8 SUBGRADE INSPECTION

- A. Notify Architect when mass, trench and footing excavations have reached required subgrade. The Architect will arrange for an inspection of conditions by the Owner's Geotechnical Engineer. Alternative procedures for arranging this review may be implemented at the Owner's written option.
- B. If the Owner's Geotechnical Engineer determines that the subgrade bearing conditions are unacceptable, the Architect will authorize additional excavation until suitable bearing conditions are encountered.
- C. Upon completion of clearing and stripping compact exposed subgrades using a smooth steel drum vibratory roller with a static weight of at least 15 tons. The roller shall be operated in its vibratory mode with numerous overlapping passes.
 - 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (5 km/h).
 - 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- D. Proof-roll subgrade with a loaded tandem-axel dump truck or other approved pneumatic tired vehicle to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 - 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (5 km/h).
 - 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- E. Should any unstable sub-soil be encountered below pavement or structures, break up the top eight inches of ground surface, pulverize, moisture-condition to optimum moisture content, and compact to percentage of maximum density as stated in Percentage of Maximum Density Requirements. Perform this work at no additional cost and/or time to the Contract.
- F. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

- A Correct Unauthorized Excavation as follows:
 - 1. Under footings, foundation bases, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position when acceptable to Architect.

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2. Elsewhere, backfill and compact unauthorized excavations as indicated for authorized excavations of same classification unless otherwise directed by Architect.

3.10 STORAGE OF EXCAVATED MATERIALS

- A. Temporarily stockpile excavated materials acceptable for use as backfill and fill. Place, grade, and shape stockpiles for proper drainage. Cover to prevent windblown dust.
 1. Stockpile excavated materials away from edge of excavations. Do not store within the drip line of trees to remain.

3.11 BACKFILL AND FILL

- A. Backfill excavations as promptly as work permits, but not until completion of the following:
 1. Acceptance by local authority having jurisdiction of construction below finished grade, including perimeter insulation.
 2. Review, approval, and recording of the locations of underground utilities.
 3. Removal of concrete formwork.
 4. Removal of shoring and bracing (including backfilling of voids with satisfactory materials).
 5. Removal of trash and debris from excavation.
 6. Permanent or temporary horizontal bracing is in place on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow or ice.
- C. Ground Surface Preparation: Remove vegetation, debris, obstructions, and deleterious materials from ground surface prior to placement of fills.
- D. Bench sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material. Plow, scarify, bench or break up sloped surfaces flatter than 1 vertical to 4 horizontal so fill material will bond with existing material.
- E. Place soil material in layers to required subgrade elevations, for each area classification listed below, using materials indicated in Part 2 of this Section.
 1. Under grassed areas, use satisfactory excavated or borrow material.
 2. Under walks, curbs, and pavements, use satisfactory excavated or borrow material.

3.12 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Backfill trenches with concrete where trench excavations pass within 18 inches of column or wall footings and that are carried below bottom of such footings or that pass under wall footings. Place concrete to level of bottom of adjacent footing.
- D. Provide 4-inch- (100-mm-) thick, concrete-base slab support for piping or conduit less than 30 inches (750 mm) below surface of roadways. After installing and testing, completely encase

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piping or conduit in a minimum of 4 inches (100 mm) of concrete before backfilling or placing roadway subbase.

- E. Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch (25 mm) in any dimension, to a height of 12 inches (300 mm) over the utility pipe or conduit.
 - 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- F. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches (300 mm) over the utility pipe or conduit.
- G. Backfill voids with satisfactory soil while installing and removing shoring and bracing. H. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- I. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.
- J. Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.
- K. Do not backfill trenches until any required testing and inspections have been completed and Architect authorizes backfilling. Backfill carefully to avoid damage or displacement of pipe systems.
- L. Under piping and conduit and equipment, use crushed stone where required over rock bearing surface and for correction of unauthorized excavation. Shape excavation bottom to fit bottom 90 degrees of cylinder.
- M. Place backfill and fill materials evenly adjacent to structures, piping, or conduit to required elevations. Prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift.

3.13 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.
- B. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil material. Apply water in minimum quantity as necessary to prevent free water from appearing on surface during or subsequent to compaction operations. Maintain the moisture content of the structural fill materials to within 2% of the optimum moisture content until permanently covered.
- C. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to required density.
 - 1. Stockpile or spread soil material that has been removed because it is too wet to permit

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compaction. Assist drying by discing, harrowing, or pulverizing until moisture content is reduced to a satisfactory value.

2. Work wet materials as directed by the Owner's Geotechnical Engineer. Base bids on working material daily for a maximum of five days of acceptable weather.
3. No additional payment will be made for these operations.

3.14 COMPACTION OF SOIL BACKFILL AND FILLS

- A. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

- B. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content.

Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

- C. Control soil and fill compaction, providing minimum percentage of density indicated for each area classification indicated below. Correct improperly compacted areas or lifts as directed by Architect if soil density tests indicate inadequate compaction.

- D. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density at a moisture content within 2% of optimum in accordance with ASTM D698:

1. Under structures and pavements, compact each layer of backfill or fill material at 95 percent maximum density. The top 18 inches of fill in load bearing areas should be compacted to at least 98 percent of the Standard Proctor value. This includes ground under future expansion areas.
2. Under grass or unpaved areas, compact each layer of backfill or fill material at 90 percent maximum density.

- E. Seal all fill areas at the end of each working day, utilizing a smooth drum roller.

3.15 GRADING

- A. General: Rough grading of areas within the Project, including cut and fill sections and adjacent transition areas, shall be reasonably smooth, compacted and free from irregular surface changes. The degree of finish shall be that ordinarily obtainable from either blade-grader or motor patrol except as otherwise indicated. The finished subgrade surface from the grassed areas generally shall be not more than 0.2 feet above or below the final grade or approved cross section, with due allowance for topsoil.

- B. The tolerance for areas within 10 feet of building perimeter, walks and all areas to be paved shall not exceed 0.10 feet above or below the established subgrade. Finish all ditches, swales and gutters to drain readily. Unless otherwise indicated, evenly slope the subgrade to provide drainage away from building walls in all directions at a grade not less than ¼ inch per foot. Provide rounding at top and bottom of cut and fill slopes and at other breaks in grade.

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- C. Protection of Graded Areas: Protect newly graded areas and areas of cut, fill and design/subgrade elevations from the actions of the elements and from deterioration as a result of construction operations and weather conditions (frost, rains, snow, sleet, hail, etc.). Repair any settlement or washing that occurs prior to or after acceptance of the work. Fill to required subgrade levels any areas where settlement occurs. Protect trees to remain, and, at all areas of the Site where construction operations are in progress, provide protection for the safety of occupants of the existing facilities.
- D. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- E. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1. Lawn or Unpaved Areas: Plus or minus 1 inch (25 mm) .
 - 2. Walks: Plus or minus 1 inch (25 mm) .
 - 3. Pavements: Plus or minus 1/2 inch (13 mm) .

3.16 PAVEMENT SUBBASE COURSE

- A. General: Place subbase material, in layers of indicated thickness, over subgrade surface to support a pavement base course.
- B. Grade Control: During construction, maintain lines and grades including crown and cross-slope of subbase course.
- C. Shoulders: Place shoulders along edges of subbase course to prevent lateral movement. Construct shoulders of acceptable soil materials, placed in such quantity to compact to thickness of each subbase course layer. Compact and roll at least at 12" width of shoulder simultaneously with compacting and rolling each layer of subbase course.
- D. Placing: Place subbase course material on prepared subgrade in layers of uniform thickness, conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting subbase material during placement operations.
- E. When a compacted subbase course is 6" thick or less, place material in a single layer. When more than 6" thick, place material in equal layers, except no single layer more than 6" or less than 3" in thickness when compacted.
- F. Place subbase course on subgrades free of mud, frost, snow, or ice.
- G. On prepared subgrade, place subbase course under pavements and walks as follows:
 - 1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 - 2. Place base course material over subbase course under hot-mix asphalt pavement.
 - 3. Shape subbase course to required crown elevations and cross-slope grades.
 - 4. Place subbase course 6 inches (150 mm) or less in compacted thickness in a single layer.

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5. Place subbase course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
 6. Compact subbase course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 98 percent of maximum dry unit weight according to ASTM D 698 ASTM D 1557.
- H. Pavement Shoulders: Place shoulders along edges of subbase course to prevent lateral movement. Construct shoulders, at least 12 inches (300 mm) wide, of satisfactory soil materials and compact simultaneously with each subbase layer to not less than 98 percent of maximum dry unit weight according to ASTM D 698 ASTM D 1557.

3.17 FIELD QUALITY CONTROL

- A. Quality Control Testing During Construction: Allow testing service to inspect and approve each subgrade and fill layer before further backfill or construction work is performed.
 1. If in the opinion of the Owner's Representative, based on testing service reports and inspection, subgrade or fills have been placed that are below required density, perform additional compaction and testing until required density is obtained.
- B. The Owner will engage, and pay for, the services of a Geotechnical Engineer whose function shall be to afford complete engineering control by testing of the conditions of all footing subgrades, the placement of all structural fills under structures, and pavement areas, and all compaction where required, and to observe the proof rolling of the pavement areas.
- C. The Owner's Geotechnical Engineer will be present as deemed necessary during all phases of the Work requiring filling, compaction operations or testing. The Geotechnical Engineer will provide the Architect with written certification that fill and compaction was completed with accepted materials in accordance with the Documents, and give a professional opinion regarding shrinkage or settlement of fill and safe load bearing capacity of fill.
- D. Site Preparation and Proofrolling: The Owner's Geotechnical Engineer will determine if any additional excavation or in-place densification is necessary to prepare a subgrade for fill placement for slab or pavement support.
- E. Fill Placement and Compaction: The Owner's Geotechnical Engineer will witness all fill operations and take sufficient in-place density tests to verify that the indicated degree of fill compaction is achieved. The Owner's Geotechnical Engineer will observe and approve borrow materials used and shall determine if their existing moisture contents are suitable/acceptable.
- F. The Owner's Geotechnical Engineer will submit two (2) copies each of his reports, recommendations and/or opinions to the Architect/Engineer and the Owner. Pertinent information will be provided to the Contractor as required.

3.18 EROSION CONTROL

- A. Provide erosion control methods in accordance with requirements of authorities having jurisdiction, the North Carolina Erosion and Sediment Control Handbook, and as indicated in the Contract Documents.

3.19 PROTECTION

- A. Repair and reestablish grades in settled, eroded, and rutted areas to indicated tolerances.

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- B. Reconditioning Compacted Areas: Where subsequent construction operations or adverse weather disturbs completed compacted areas, scarify surface, reshape, and compact to required density prior to further construction.
- C. Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn, or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.
- D. Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees.

3.20 DISPOSAL OF WASTE MATERIALS

- A. Removal from Owner's Property: Remove excess and/or waste materials, including trash and debris, and dispose of it off Owner's property in a legal manner.
- B. Dispose of excess material and materials not acceptable for use as backfill or fill legally offsite.
- C. Do not remove topsoil from site until it has been demonstrated to the Owner's satisfaction that it is excess.

END OF SECTION

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SECTION 31 22 13 - ROUGH GRADING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Excavating topsoil.
 - 2. Excavating subsoil.
 - 3. Cutting, grading, filling and compacting.
- B. Related Sections:
 - 1. Section 31 05 13 - Soils for Earthwork: Soils for fill.
 - 2. Section 31 05 16 - Aggregates for Earthwork: Aggregates for fill.
 - 3. Section 31 10 00 - Site Clearing: Excavating topsoil.
 - 4. Section 31 23 16 - Excavation: Building excavation.
 - 5. Section 31 23 23 - Fill: General building area backfilling.
 - 6. Section 32 91 19 - Landscape Grading: Finish grading with topsoil to contours.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International:
 - 1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - 3. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
 - 4. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 5. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
 - 6. ASTM D2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
 - 7. ASTM D2434 - Standard Test Method for Permeability of Granular Soils (Constant Head).
 - 8. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

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9. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.3 SUBMITTALS

- A. Materials Source: Submit name of imported materials suppliers.
- B. Manufacturer's Certificate: Certify products meet or exceed specifications.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 73 00 - Execution and Section 01 77 00 Closeout Procedures: Requirements for submittals.
- B. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ASTM C136, ASTM D2419, and ASTM D2434.
- B. Perform Work in accordance with local, State and Federal Standards.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Topsoil: Type as specified in Section 31 05 13.
- B. Subsoil Fill: Type as specified in Section 31 05 13.
- C. Structural Fill: Type as specified in Section 31 05 13.
- D. Granular Fill: Type as specified in Section 31 05 16.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 Sections: Verification of existing conditions before starting work.
- B. Verify site conditions.
- C. Verify survey bench mark and intended elevations for the Work are as indicated on Drawings.

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3.2 PREPARATION

- A. Call Local Utility Line Information not less than three working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum.
- C. Notify utility company to remove and/or relocate utilities as required.
- D. Protect utilities indicated to remain from damage.
- E. Protect plant life, lawns, and other features remaining as portion of final landscaping.
- F. Protect bench marks, survey control points, existing structures, paving, etc. from excavating equipment and vehicular traffic.

3.3 TOPSOIL EXCAVATION

- A. Excavate topsoil from areas to be further excavated, or regraded, without mixing with foreign materials for use in finish grading.
- B. Stockpile in area designated on site and protect from erosion.
- C. Remove excess topsoil not intended for reuse, from site.

3.4 SUBSOIL EXCAVATION

- A. Excavate subsoil from areas to be further excavated, or regraded.
- B. Do not excavate wet subsoil.
- C. Remove excess subsoil not intended for reuse, from site.
- D. Stockpile excavated material in accordance with Section 31 05 13 and 31 05 16 as appropriate.
- E. Benching Slopes: Horizontally bench existing slopes greater than 1: 4to key placed fill material to slope to provide firm bearing.
- F. Stability: Replace damaged or displaced subsoil as specified for fill.

3.5 FILLING

- A. Fill areas to contours and elevations with unfrozen materials.
- B. Place fill material in continuous 6-inch layers and compact.

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- C. Maintain optimum moisture content of fill materials to attain required compaction density.
- D. Slope grade away from building minimum 2 percent slope for minimum distance of 10 ft, unless noted otherwise.
- E. Make grade changes gradual. Blend slope into level areas.
- F. Repair or replace items indicated to remain damaged by excavation or filling.
- G. Install Work in accordance with local, State, and Federal Standards.

3.6 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Top Surface of Sub-grade: Plus or minus 1/10 foot from required elevation.

3.7 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements, 01 73 00 – Execution, and 01 77 00 - Closeout Procedures: Field inspecting, testing, adjusting, and balancing.
- B. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D1556, ASTM D2167, or ASTM D2922.
 - 2. Moisture Tests: ASTM D3017.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

3.8 SCHEDULES

- A. Structural Fill:
 - 1. Compact uniformly to minimum 98 percent of maximum density.
- B. Previous Structural Fill:
 - 1. Compact uniformly to minimum 98 percent of maximum density.
- C. Subsoil Fill:
 - 1. Compact uniformly to minimum 98 percent of maximum density.
- D. Topsoil Fill:
 - 1. Minimum 4-inch thick.
 - 2. Compact uniformly to minimum 98 percent of maximum density.

END OF SECTION

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SECTION 31 23 16 - EXCAVATION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Soil densification.
 - 2. Excavating for building foundations.
 - 3. Excavating for paving.
 - 4. Excavating for slabs-on-grade.
 - 5. Excavating for site structures.
 - 6. Excavating for landscaping.
- B. Related Sections:
 - 1. Section 31 05 13 - Soils for Earthwork: Stockpiling excavated materials.
 - 2. Section 31 05 16 - Aggregates for Earthwork: Stockpiling excavated materials.
 - 3. Section 31 22 13 - Rough Grading: Topsoil and subsoil removal from site surface.
 - 4. Section 31 23 17 - Trenching: Excavating for utility trenches.
 - 5. Section 31 23 23 - Fill.
 - 6. Section 33 11 16 - Site Water Utility Distribution Piping.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort [12,400 ft-lbf/ft³ (600 kN-m/m³)].
 - 2. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
 - 3. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
 - 4. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- B. Local utility standards when working within 24 inches of utility lines.

1.3 QUALITY ASSURANCE

- A. Perform Work in accordance with local, State and Federal Standards.

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PART 2 PRODUCTS - Not Used.

PART 3 EXECUTION

3.1 PREPARATION

- A. Call Local Utility Line Information three working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum.
- C. Notify utility company to remove and/or relocate utilities as required.
- D. Protect utilities indicated to remain from damage.
- E. Protect plant life, lawns and other features remaining as portion of final landscaping.
- F. Protect bench marks, survey control points, existing structures, sidewalks, and paving from excavating equipment and vehicular traffic.
 - 1. Maximum Deviation from Center of Completed Compaction: 8 inches from indicated position.
 - 2. Maximum Deviation from Vertical: 4 degrees during vibrator insertion.

3.2 EXCAVATION

- A. Underpin adjacent structures which may be damaged by excavation work.
- B. Excavate subsoil to accommodate site and building improvements.
- C. Compact disturbed load bearing soil in direct contact with foundations to original bearing capacity; perform compaction in accordance with Section 31 23 23.
- D. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- E. Trim excavation. Remove loose matter.
- F. Remove lumped subsoil, boulders, and rock.
- G. Notify designer of unexpected subsurface conditions.
- H. Correct areas over excavated with structural fill as directed by Designer.
- I. Remove excess and unsuitable material from site.
- J. Stockpile subsoil in area designated and protect from erosion.

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- K. Repair or replace items indicated to remain damaged by excavation.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements, 01 73 00 – Execution, and 01 77 00 - Closeout Procedures: Field inspecting, testing, adjusting, and balancing.
- B. Request visual inspection of bearing surfaces by Designer and appropriate regulatory agency before installing subsequent work.

3.4 PROTECTION

- A. Prevent displacement or loose soil from falling into excavation; maintain soil stability.
- B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.
- C. Protect structures, utilities and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.

END OF SECTION

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SECTION 31 23 17 - TRENCHING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Excavating trenches for utilities from 5 feet outside building to utility service
 - 2. Compacted fill from top of utility bedding to subgrade elevations.
 - 3. Backfilling and compaction.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-In-Place Concrete: Concrete materials.
 - 2. Section 31 05 13 - Soils for Earthwork: Soils for fill.
 - 3. Section 31 05 16 - Aggregates for Earthwork: Aggregates for fill.
 - 4. Section 31 22 13 - Rough Grading: Topsoil and subsoil removal from site surface.
 - 5. Section 31 23 16 - Excavation: General building excavation.
 - 6. Section 31 23 23 - Fill: General backfilling.
 - 7. Section 32 91 19 - Landscape Grading: Filling of topsoil over backfilled trenches to finish grade elevation.
 - 8. Section 33 11 16 - Site Water Utility Distribution Piping:
 - 9. Section 33 31 00 - Sanitary Utility Sewerage Piping:
 - 10. Section 33 41 00 - Storm Utility Drainage Piping:

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International:
 - 1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort [12,400 ft-lbf/ft³ (600 kN-m/m³)].
 - 3. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
 - 4. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort [(6,000 ft-lbf/ft³ (2,700 kN-m/m³))].
 - 5. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
 - 6. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - 7. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

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1.3 DEFINITIONS

- A. Utility: Any buried pipe, duct, conduit, or cable.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with local, State and Federal Standards.

1.5 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.6 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 PRODUCTS

2.1 FILL MATERIALS

- A. Subsoil Fill: Type as specified in Section 31 05 13.
- B. Structural Fill: Type as specified in Section 31 05 13 and 31 05 16.
- C. Granular Fill: Type as specified in Section 31 05 16.

2.2 ACCESSORIES

- A. Geotextile Fabric: Non-biodegradable Other types and manufactures will also be considered.
 - 1. Alkzo Nobel Geosynthetic Co
 - 2. Huesker, Inc.
 - 3. TC Mirafi
 - 4. Tenax Corp.
 - 5. Tensar Earth Technologies, Inc.

PART 3 EXECUTION

3.1 LINES AND GRADES

- A. Excavate trenches to indicated slopes, lines, depths, and invert elevations as indicated on Drawings.
 - 1. Designer reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.

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- B. Pipe Bedding: Excavate trench bottoms. Unless otherwise indicated, provide bedding in accordance with the following:
 - 1. Vitrified Clay Pipe (VCP) Class D Bedding
 - 2. PVC Pipe (Gravity Piping)
Crushed Stone Encasement
 - 3. Ductile Iron Pipe Class D Bedding
 - 4. PVC Pipe (Water mains & Sewage Force Mains) Class D Bedding
 - 5. Reinforced Concrete Pipe Class C Bedding
 - 6. High Density Polyethylene (HDPE) pipe Class B Bedding

3.2 APPROVAL OF SUBGRADE

- A. Notify THE OWNER'S REPRESENTATIVE when excavations have reached required subgrade.
- B. When THE OWNER'S REPRESENTATIVE determines that unforeseen unsatisfactory soil is present, continue excavation and replace with select material as directed.
 - 1. Unforeseen additional excavation and replacement material will be paid according to the Contract provisions for changes in Work.
- C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the THE OWNER'S REPRESENTATIVE.

3.3 PREPARATION

- A. Call Local Utility Line Information service a minimum of three working days before performing Work. See also Section EARTHWORK FOR SITE 31 20 Item 1.6 C 3.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum locations.
- C. Protect plant life, lawns, and other features remaining as portion of final landscaping.
- D. Protect bench marks, existing structures, sidewalks, paving, and all other existing features to remain from excavating equipment and vehicular traffic.
- E. Maintain and protect above and below grade utilities indicated to remain.
- F. Establish temporary traffic control when trenching is performed in public right-of-way. Relocate controls as required during progress of Work.

3.4 TRENCHING

- A. Excavate subsoil required for utilities.

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- B. Remove lumped subsoil, boulders, and rock up as required.
- C. Perform excavation within 24 inches of existing utility service in accordance with utility's requirements.
- D. Cut trenches sufficiently wide to enable installation and allow inspection. Remove water or materials that interfere with Work.
- E. Provide uniform and continuous bearing and support for bedding material and pipe utilities.
- F. When unsuitable subsurface materials are encountered at bottom of trench that would not support utility or pipe, continue excavation and fill provide stable bedding. Notify Designer prior to additional excavation.
- G. Excavate soft areas of subgrade not capable of compaction in place. Backfill with Fill Type and compact to density equal to or greater than requirements for subsequent backfill material. Notify Designer prior to excavation.
- H. Trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.
- I. Correct over excavated areas with compacted backfill at no cost to the Owner.
- J. Remove excess subsoil not intended for reuse.
- K. Stockpile subsoil in area designated and protect from erosion.

3.5 SHEETING AND SHORING

- A. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.
- B. Support trenches as required and in accordance with all applicable codes and regulations. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.
- C. Repair damage to new and existing improvements from settlement, water or earth pressure or other causes resulting from the work.

3.6 BACKFILLING

- A. Backfill trenches to contours and elevations with unfrozen fill materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- C. Place fill material in continuous layers and compact in 6-inch lifts.
- D. Employ placement method that does not disturb or damage any existing foundation perimeter drainage, utilities in trench, etc.

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- E. Maintain optimum moisture content of fill materials to attain required compaction density.

3.7 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1/4 inch from required elevations.
- C. Top Surface of General Backfilling: Plus or minus 1/2 inch from required elevations.

3.8 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending indicated bottom elevation of concrete foundation or footing to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position when acceptable to the THE OWNER'S REPRESENTATIVE.
 - 1. Fill unauthorized excavations under other construction as directed by the THE OWNER'S REPRESENTATIVE.
- B. Where indicated widths of utility trenches are exceeded, provide stronger pipe, or special installation procedures, as required by the THE OWNER'S REPRESENTATIVE.

3.8 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements, 01 73 00 – Execution, and 01 77 00 - Closeout Procedures: Field inspecting, testing, adjusting, and balancing.
- B. Perform laboratory material tests in accordance with ASTM D1557. ASTM D698. AASHTO T180.
- C. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D1556, ASTM D2167, or ASTM D2922.
 - 2. Moisture Tests: ASTM D3017.
- D. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest.

3.9 PROTECTION OF FINISHED WORK

- A. Section 01 73 00 - Execution and 01 77 00 - Closeout Procedures: Protecting finished work.
- B. Reshape and re-compact fills subjected to vehicular traffic during construction.

END OF SECTION

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SECTION 31 23 23 - FILL

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Backfilling building perimeter to subgrade elevations.
 - 2. Backfilling site structures to subgrade elevations.
 - 3. Fill under slabs-on-grade.
 - 4. Fill under paving.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-In-Place Concrete
 - 2. Section 31 05 13 - Soils for Earthwork
 - 3. Section 31 05 16 - Aggregates for Earthwork
 - 4. Section 31 22 13 - Rough Grading
 - 5. Section 31 23 16 - Excavation.
 - 6. Section 31 23 17 - Trenching
 - 7. Section 32 91 19 - Landscape Grading:
 - 8. Section 33 11 16 - Site Water Utility Distribution Piping.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International:
 - 1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort [12,400 ft-lbf/ft³ (600 kN-m/m³)].
 - 2. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
 - 3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort [6,000 ft-lbf/ft³ (2,700 kN-m/m³)].
 - 4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
 - 5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - 6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
 - 7. ASTM D4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

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PART 2 PRODUCTS

2.1 FILL MATERIALS

- A. Subsoil Fill: Type as specified in Section 31 05 13.
- B. Structural Fill: Type as specified in Section 31 05 13 and 31 05 16.
- C. Granular Fill: Type as specified in Section 31 05 16.

2.2 ACCESSORIES

- A. Geotextile Fabric: Non-biodegradable, woven. Manufacture names are for reference only.
 - 1. Alkzo Nobel Geosynthetic Co
 - 2. Huesker, Inc.
 - 3. TC Mirafi
 - 4. Tenax Corp.
 - 5. Tensar Earth Technologies, Inc.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 Sections: Coordination and project conditions.
- B. Verify subdrainage, dampproofing, or waterproofing installation has been inspected.

3.2 PREPARATION

- A. Compact subgrade to density requirements for subsequent backfill materials.
- B. Excavate areas of subgrade not capable of compaction in place. Backfill with structural fill and compact to density equal to or greater than requirements for subsequent fill material.
- C. Scarify subgrade surface to depth of 4-inches
- D. Proof roll to identify soft spots; fill and compact to density equal to or greater than requirements for subsequent fill material.

3.3 BACKFILLING

- A. Backfill areas to contours and elevations with unfrozen materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.
- C. Place material in continuous 6-inch layers.

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- D. Employ placement method that does not disturb or damage other work.
- E. Maintain optimum moisture content of backfill materials to attain required compaction density.
- F. Backfill simultaneously on each side of unsupported foundation walls until supports are in place.
- G. Slope grade away from building minimum 2 percent slope for minimum distance of 10 ft, unless noted otherwise.
- H. Make gradual grade changes. Blend slope into level areas.
- I. Survey locations of underground utilities for record documents.
- J. Remove surplus backfill materials from site.
- K. Leave fill material stockpile areas free of excess fill materials.

3.4 FILL

- A. Preparation: Remove vegetation, topsoil, debris, wet, and unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placing fills.
 - 1. Plow strip, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing surface.
- B. When subgrade or existing ground surface to receive fill has a density less than that required for fill, break up ground surface to depth required, pulverize, moisture-condition or aerate soil and recompact to required density.
- C. Place fill material in layers to required elevations for each occurrence listed below.
 - 1. Under grass, use satisfactory excavated or borrow soil material.
 - 2. Under walks and pavements, use NCDOT Class II material.
 - 3. Under steps and ramps, use NCDOT Class VI material.

3.5 MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.
 - 1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace, or scarify and air-dry satisfactory soil material that is too wet to compact to specified density.
 - a. Stockpile or spread and dry removed wet satisfactory soil material.

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3.6 COMPACTION

- A. Place backfill and fill materials in layers not more than 6 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill materials evenly on all sides of structures to required elevations. Place backfill and fill uniformly along the full length of each structure.
- C. Percentage of Maximum Dry Density Requirements: Compact soil to not less than the following percentages of maximum dry density according to ASTM D 1557:
 - 1. Under structures, building slabs, steps, and pavements, compact the top 12 inches below subgrade at 100 percent maximum dry density and each layer of backfill or fill material below the top 12 inches at 98 percent maximum dry density.
 - 2. Under walkways, compact the top 6 inches below subgrade and each layer of backfill or fill material at 95 percent maximum dry density.
 - 3. Under lawn or unpaved areas, compact the top 6 inches below subgrade and each layer of backfill or fill material at 95 percent maximum dry density.

3.7 GRADING

- A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between existing adjacent grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to conform to required surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding

3.8 SUBGRADE, BASES, AND SHOULDERS

- A. Subgrade, Bases, and Shoulders shall be placed in accordance with NCDOT Standard Specifications Sections 500 and 560.

3.9 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Top Surface of Backfilling Within Building Areas: Plus or minus ¼ inch from required elevations.
- C. Top Surface of Backfilling Under Paved Areas: Plus or minus 1/2 inch from required elevations.
- D. Top Surface of General Backfilling: Plus or minus 1/2 inch from required elevations.

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3.10 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements, 01 73 00 – Execution, and 01 77 00 - Closeout Procedures: Field inspecting, testing, adjusting, and balancing.
- B. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D1556, ASTM D2167, or ASTM D2922.
 - 2. Moisture Tests: ASTM D3017.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.
- D. Proof roll compacted fill surfaces under slabs-on-grade, pavers and paving.

3.11 PROTECTION OF FINISHED WORK

- A. Section 01 73 00 - Execution and 01 77 00 - Closeout Procedures: Protecting finished work.
- B. Reshape and re-compact fills subjected to vehicular traffic.

3.12 SCHEDULE

- A. Fill Under Landscaped Areas:
 - 1. Compact uniformly to 95 percent of maximum density.
- B. Fill Under Asphalt and Concrete Paving:
 - 1. Compact subsoil to 98 percent of its maximum dry density.
- C. Structural Fill:
 - 1. Compact uniformly to minimum 98 percent of maximum density.
- D. Previous Structural Fill:
 - 1. Compact uniformly to minimum 98 percent of maximum density.
- E. Subsoil Fill:
 - 1. Compact uniformly to minimum 98 percent of maximum density.
- F. Topsoil Fill:
 - 1. 4-inch thick.
 - 2. Compact uniformly to minimum 98 percent of maximum density.

END OF SECTION

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SECTION 31 25 13 - EROSION CONTROLS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Diversion Channels.
 - 2. Rock Energy Dissipator.
 - 3. Paved Energy Dissipator.
 - 4. Rock Basin.
 - 5. Rock Barriers.
 - 6. Sediment Ponds.
 - 7. Sediment Traps.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-In-Place Concrete.
 - 2. Section 31 05 13 - Soils for Earthwork.
 - 3. Section 31 05 16 - Aggregates for Earthwork.
 - 4. Section 31 10 00 - Site Clearing.
 - 5. Section 31 23 16 - Excavation.
 - 6. Section 31 23 23 - Fill.
 - 7. Section 32 91 19 - Landscape Grading.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T88 - Standard Specification for Particle Size Analysis of Soils.
 - 2. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. American Concrete Institute:
 - 1. ACI 301 - Specifications for Structural Concrete.
- C. ASTM International:
 - 1. ASTM C127 - Standard Test Method for Specific Gravity and Absorption of Coarse Aggregate.
 - 2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort [12,400 ft-lbf/ft³ (600 kN-m/m³)].
 - 3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort [6,000 ft-lbf/ft³ (2,700 kN-m/m³)].
 - 4. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - 5. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

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- D. Precast/Prestressed Concrete Institute:
 - 1. PCI MNL-116S - Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Product Data: Submit data on erosion control fabric.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 73 00 - Execution and 01 77 00 - Closeout Procedures: Requirements for submittals.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with requirements of Section 31 05 13, Section 31 05 16, Section 31 10 00, Section 31 23 16, Section 31 23 23, Section 32 13 13, Section 32 91 19, Section 03 30 00, Section 04 05 03, Section 05 12 00, and Section 05 50 00..
- B. Perform work in accordance with local, NCDENR and Federal standards.

1.6 PRE-INSTALLATION MEETINGS

- A. Division 01 Sections: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not place grout when air temperature is below freezing.
- C. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

PART 2 PRODUCTS

2.1 ROCK AND GEOTEXTILE MATERIALS

- A. Furnish materials in accordance with NCDOT Roads and Structures Standards manual.

2.2 CONCRETE MATERIALS AND REINFORCEMENT

- A. As specified in Section 03 30 00.

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- B. Fine and Coarse Aggregates: Section 03 30 00.
- C. Water: Clean and not detrimental to concrete.
- D. Aggregate, Sand, Water, Admixtures - Precast: Determined by precast fabricator, as appropriate to design requirements and PCI MNL-116S.

2.3 BLOCK, STONE, AGGREGATE, AND SOIL MATERIALS

- A. Coarse Aggregate: Type as specified in Section 31 05 16.
- B. Soil Backfill: Soil Type as specified in 31 05 13. Subsoil with no rocks over 6 inches in diameter, frozen earth or foreign matter.

2.4 PLANTING MATERIALS

- A. Seeding and Soil Supplements: Type as specified in Section 32 90 00.
- B. Mulch: Straw type.

2.5 SOURCE QUALITY CONTROL (AND TESTS)

- A. Section 01 40 00 - Quality Requirements: Testing, inspection and analysis requirements.
- B. Perform tests on cement, aggregates, and mixes to ensure conformance with specified requirements.
- C. Test samples in accordance with ACI 301.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 Sections: Verification of existing conditions before starting work.
- B. Verify compacted site is acceptable and ready to support devices and imposed loads.
- C. Verify gradients and elevations of base or foundation for other work are correct.

3.2 DIVERSION CHANNELS

- A. Windrow excavated material on low side of channel.
- B. Compact to 95 percent maximum density.
- C. On entire channel area, apply soil supplements and sow seed as specified in Section 32 90 00.

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- D. Mulch seeded areas with hay as specified in Section 32 90 00.
- E. Install Work in accordance with local and NCDENR standards

3.3 ROCK ENERGY DISSIPATOR

- A. Excavate to indicate depth of rock lining or nominal placement thickness as follows. Remove loose, unsuitable material below bottom of rock lining, then replace with suitable material. Thoroughly compact and finish entire foundation area to firm, even surface.
- B. Lay and overlay geotextile fabric over substrate. Lay fabric parallel to flow from upstream to downstream. Overlap edges upstream over downstream and upslope over downslope. Provide a minimum overlap of 3 feet. Offset adjacent roll ends a minimum of 5 feet when lapped. Cover fabric as soon as possible and in no case leave fabric exposed more than 4 weeks.
- C. Carefully place rock on geotextile fabric to produce an even distribution of pieces, with minimum of voids and without tearing geotextile.
- D. Unless indicated otherwise, place full course thickness in one operation to prevent segregation and to avoid displacement of underlying material. Arrange individual rocks for uniform distribution.
 - 1. Saturate rock with water. Fill voids between pieces with grout, for at least top 6 inches. Sweep surface with stiff broom to remove excess grout.
 - 2. Moist cure grouted rock for at least 3 days after grouting, using water saturated burlap in accordance with Section 03 30 00.
- E. Install Work in accordance with local and NCDENR standards.

3.4 ROCK BASIN

- A. Construct generally in accordance with rock energy dissipater requirements to indicated shape and depth. Rock courses may be placed in several operations.

3.5 ROCK DAM

- A. Clear and grub storage area and embankment foundation area site as specified in Section 31 10 00.
- B. Excavate key trench for full length of dam. Excavate emergency spillway in natural ground.
- C. Install pipe spillway, with anti-seep collar attached, at location indicated.
- D. Place forms, and reinforcing for concrete footing at bottom of riser pipe [with trash rack and anti-vortex device], as specified in Section 03 10 00, and Section 03 20 00. Construction of embankment and trench prior to placing pipe is not required.

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- E. Mix, place, finish, and cure concrete, as specified in Section 03 30 00.
- F. Do not use coarse aggregate as backfill material around pipe. Backfill pipe with suitable embankment material to prevent dam leakage along pipe.
- G. Construct rock basin at outlet end of pipe, as specified in this Section. Place embankment material, as specified in Section 31 23 23. When required, obtain borrow excavation for formation of embankment, as specified in Section 31 23 23.
- H. On entire sedimentation pond area, apply soil supplements and sow seed as specified in 32 90 00.
- I. Mulch seeded areas with hay as specified in Section 32 90 00.
- J. Install Work in accordance with local and NCDENR standards.

3.6 SEDIMENT TRAPS

- A. Clear site, as specified in Section 31 10 00.
- B. Construct trap by excavating and forming embankments as specified in Section 31 23 16, and Section 31 23 23.
- C. Place coarse aggregate or rock at outlet as indicated on Drawings.
- D. Place geotextile fabric, as specified for rock energy dissipater.
- E. When required, obtain borrow excavation for formation of embankment, as specified in Section 31 23 16.
- F. On entire sediment trap area, apply soil supplements and sow seed as specified in Section 32 90 00.
- G. Mulch seeded areas with hay as specified in Section 32 90 00.
- H. Install Work in accordance with local and NCDENR standards.

3.7 SITE STABILIZATION

- A. Incorporate erosion control devices indicated on the Drawings into the Project at the earliest practicable time.
- B. Construct, stabilize and activate erosion controls before site disturbance within tributary areas of those controls.
- C. Stockpile and waste pile heights shall not exceed 35 feet. Slope stockpile sides at 2: 1 or flatter.
- D. Stabilize any disturbed area of affected erosion control devices on which activity has ceased and which will remain exposed for more than 20 days.

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1. During non-germinating periods, apply mulch at recommended rates.
 2. Stabilize disturbed areas which are not at finished grade and which will be disturbed within one year in accordance with Section 32 90 00.
 3. Stabilize disturbed areas which are either at finished grade or will not be disturbed within one year in accordance with Section 32 90 00 permanent seeding specifications.
- E. Stabilize diversion channels, sediment traps, and stockpiles immediately.

3.8 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements, 01 73 00 – Execution, and 01 77 00 - Closeout Procedures: Field inspecting, testing, adjusting, and balancing.
- B. Inspect erosion control devices on a weekly basis and after each runoff event. Make necessary repairs to ensure erosion and sediment controls are in good working order.
- C. When work does not meet specified requirements, remove Work and replace.

3.9 CLEANING

- A. Section 01 73 00 – Execution and 01 77 00 - Closeout Procedures: Requirements for cleaning.
- B. When sediment accumulation in sedimentation structures has reached a point one-third depth of sediment structure or device, remove and dispose of sediment.
- C. Do not damage structure or device during cleaning operations.
- D. Do not permit sediment to erode into construction or site areas or natural waterways.
- E. Clean channels when depth of sediment reaches approximately one half channel depth.

3.10 PROTECTION

- A. Section 01 73 00 - Execution and 01 77 00 - Closeout Procedures: Requirements for protecting finished work.
- B. Immediately after placement, protect paving from premature drying, excessive hot or cold temperatures, and mechanical injury.
- C. Do not permit construction traffic over asphalt paving for 7 days minimum after finishing and until 75 percent design strength of concrete has been achieved.
- D. Protect paving from elements, flowing water, or other disturbance until curing is completed.

END OF SECTION

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SECTION 32 11 23

AGGREGATE BASE COURSES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Aggregate subbase.
 - 2. Aggregate base course.
- B. Related Sections:
 - 1. Section 31 22 13 - Rough Grading: Preparation of site for base course.
 - 2. Section 31 23 17 - Trenching: Compacted fill under base course.
 - 3. Section 31 23 23 - Fill: Compacted fill under base course.
 - 4. Section 32 12 16 - Asphalt Paving: [Binder and] finish asphalt courses.
 - 5. Section 32 13 13 - Concrete Paving: Finish concrete surface course.
 - 6. Section 32 91 19 - Landscape Grading:

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications.
 - 2. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International:
 - 1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - 2. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
 - 3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
 - 5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - 6. ASTM D2940 - Standard Specification for Graded Aggregate Material For Bases or Subbases for Highways or Airports.
 - 7. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

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1.4 QUALITY ASSURANCE

- A. Furnish each aggregate material from single source throughout the Work.
- B. Perform Work in accordance with NCDOT Roads and Structures Standards

PART 2 PRODUCTS

2.1 AGGREGATE MATERIALS

- A. Subbase Aggregate: ASTM D2940; graded type.

Sieve Size	Percent Passing
2 inches	100
No. 4	30 to 60
No. 200	0 to 12

- B. Base Aggregate: ASTM D2940; graded type.

Sieve Size	Percent Passing
2 inches	100
1-1/2 inches	95 to 100
3/4 inches	70 to 92
3/8 inches	50 to 70
No. 4	35 to 55
No. 30	12 to 25
No. 200	0 to 8

***** [OR] *****

2.2 AGGREGATE MATERIALS

- A. Coarse Aggregate: Fill Type as specified in Section 31 05 16.

2.3 ACCESSORIES

- A. Geotextile Fabric: AASHTO M288; non-woven, polypropylene.

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PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 Sections: Verification of existing conditions before starting work.
- B. Verify compacted substrate is dry [and ready to support paving and imposed loads].
 - 1. Proof roll substrate with a minimum two perpendicular passes to identify soft spots.
 - 2. Remove soft substrate and replace with compacted fill as specified in Section 31 23 23.
- C. Verify substrate has been inspected, gradients and elevations are correct.

3.2 PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.
- B. Do not place fill on soft, muddy, or frozen surfaces.

3.3 AGGREGATE PLACEMENT

- A. Spread aggregate over prepared substrate to total compacted thickness as indicated on Drawings.
- B. Roller compact aggregate to 100 percent maximum density.
- C. Level and contour surfaces to elevations, profiles, and gradients indicated.
- D. Add small quantities of fine aggregate to coarse aggregate when required to assist compaction.
- E. Maintain optimum moisture content of fill materials to attain specified compaction density.
- F. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.4 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Maximum Variation from Flat Surface: 1/4-inch measured with 10 foot straight edge.
- C. Maximum Variation from Thickness: 1/4inch.
- D. Maximum Variation from Elevation: 1/2 - inch.

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3.5 FIELD QUALITY CONTROL

- A. Testing Agency Services: Allow testing agency to inspect and test each subgrade and each fill or backfill layer. Do not proceed until test results for previously completed work verify compliance with requirements.
 - 1. Perform field in-place density tests according to ASTM D 1556 (sand cone method), ASTM D 2167 (rubber balloon method), or ASTM D 2937 (drive cylinder method), as applicable.
 - a. Field in-place density tests may also be performed by the nuclear method according to ASTM D 2922, provided that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D 1556. With each density calibration check, check the calibration curves furnished with the moisture gages according to ASTM D 3017.
 - b. When field in-place density tests are performed using nuclear methods, make calibration checks of both density and moisture gages at beginning of work, on each different type of material encountered, and at intervals as directed by the owner's representative.
 - 2. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, perform at least one field in-place density test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
- B. When testing agency reports that subgrades, fills, or backfills are below specified density, scarify and moisten or aerate, or remove and replace soil to the depth required, recompact and retest until required density is obtained.

3.6 SCHEDULES

- A. Asphalt Paving
 - 1. Compact placed aggregate materials uniformly to achieve 100 maximum density
- B. Concrete Paving
 - 1. Compact placed aggregate materials uniformly to achieve 100 maximum density.

END OF SECTION

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SECTION 32 12 16

ASPHALT PAVING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Asphalt materials.
 - 2. Aggregate materials.
 - 3. Aggregate subbase.
 - 4. Asphalt paving base course, binder course, and wearing course.
 - 5. Asphalt paving overlay for existing paving.
 - 6. Surface slurry.
- B. Related Sections:
 - 1. Section 09 91 00 - Painting
 - 2. Section 31 22 13 - Rough Grading
 - 3. Section 31 23 23 - Fill
 - 4. Section 32 11 23 - Aggregate Base Courses
 - 5. Section 32 17 23 - Pavement Markings

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO M17 - Standard Specification for Mineral Filler for Bituminous Paving Mixtures.
 - 2. AASHTO M29 - Standard Specification for Fine Aggregate for Bituminous Paving Mixtures.
 - 3. AASHTO M140 - Standard Specification for Emulsified Asphalt.
 - 4. AASHTO M208 - Standard Specification for Cationic Emulsified Asphalt.
 - 5. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications.
 - 6. AASHTO M324 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
 - 7. AASHTO MP1a - Standard Specification for Performance-Graded Asphalt Binder.
- B. Asphalt Institute:
 - 1. AI MS-2 - Mix Design Methods for Asphalt Concrete and Other Hot- Mix Types.
 - 2. AI MS-19 - Basic Asphalt Emulsion Manual.
 - 3. AI SP-2 - Superpave Mix Design.
- C. ASTM International:
 - 1. ASTM D242 - Standard Specification for Mineral Filler For Bituminous Paving Mixtures.

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2. ASTM D692 - Standard Specification for Coarse Aggregate for Bituminous Paving Mixtures.
3. ASTM D977 - Standard Specification for Emulsified Asphalt.
4. ASTM D1073 - Standard Specification for Fine Aggregate for Bituminous Paving Mixtures.
5. ASTM D1188 - Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens.
6. ASTM D2027 - Standard Specification for Cutback Asphalt (Medium-Curing Type).
7. ASTM D2726 - Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures.
8. ASTM D2950 - Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods.
9. ASTM D3381 - Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction.
10. ASTM D3515 - Standard Specification for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
11. ASTM D3549 - Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens.
12. ASTM D3910 - Standard Practices for Design, Testing, and Construction of Slurry Seal.
13. ASTM D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
 1. Submit product information for asphalt and aggregate materials.
 2. Submit mix design with laboratory test results supporting design.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with NCDOT Roads and Structures Standards.
- B. Obtain materials from same source throughout.

1.5 QUALIFICATIONS

- A. Installer: The paving installer shall be properly licensed to perform the work and have a minimum of 8 years of successful experience in paving of public projects to include roadways and parking facilities.

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1.6 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not place asphalt mixture when ambient air or base surface temperature is less than 40 degrees F, or surface is wet or frozen.

PART 2 PRODUCTS

2.1 ASPHALT MATERIALS

- A. Asphalt Binder: AASHTO M320 AASHTO MP1a; performance grade PG 58-28 PG 64-22.
- B. Asphalt Binder: In accordance with NCDOT Roads and Structures Standards.
- C. Tack Coat: ASTM D977 AASHTO M140; diluted emulsified asphalt, setting type.
- D. Tack Coat: In accordance with NCDOT Roads and Structures Standards Section 605.
- E. Asphalt Surface Course: Conform Material to NCDOT Section 645.

2.2 AGGREGATE MATERIALS

- A. Coarse Aggregate: In accordance with Section 31 05 16.
- B. Fine Aggregate: In accordance with Section 31 05 16.

2.3 ACCESSORIES

- A. Geotextile Fabric: AASHTO M288; non-woven, polypropylene.
- B. Sealant: ASTM D6690 AASHTO M324 Type I Type II or Type III Type IV; hot applied type.

2.4 MIXES

- A. Use dry material to avoid foaming. Mix uniformly.
- B. Asphalt Paving Mixtures: ASTM D3515; designed in accordance with AI MS2
- C. Asphalt Paving Mixtures: Designed in accordance with NCDOT Roads and Structures Standards

2.5 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Testing, inspection and analysis requirements.

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- B. Submit proposed mix design of each class of mix for review prior to beginning of Work.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 Sections: Verification of existing conditions before starting work.
- B. Verify utilities indicated under paving are installed with excavations and trenches backfilled and compacted.
- C. Verify compacted subbase is dry and ready to support paving and imposed loads.
 - 1. Proof roll subbase with a minimum two perpendicular passes to identify soft spots.
 - 2. Remove soft subbase and replace with compacted fill as specified in Section 31 23 23.
- D. Verify gradients and elevations of base are correct.
- E. Pre-installation Conference: No pavement shall be placed without prior inspection of the subgrade by the owner's representative. The contractor shall schedule and conduct a conference at the project site to review methods and procedures related to the contemplated asphalt paving including, but not limited to, the following:
 - 1. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
 - 2. Review condition of subgrade.
 - 3. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
 - 4. Review and finalize construction schedule for paving and related work. Verify availability of materials, paving Installer's personnel, and equipment required to execute the Work without delays.
 - 5. Review inspection and testing requirements, governing regulations, and proposed installation procedures.
 - 6. Review forecasted weather conditions and procedures for coping with unfavorable conditions.
- G. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials, 50 deg F for water-based materials, and not exceeding 95 deg F.

3.2 SUBBASE

- A. Aggregate Subbase: Install as specified in Section 32 11 23.
- B. Prepare subbase in accordance with NCDOT Roads and Structures Standards.

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3.3 EXISTING WORK

- A. Saw cut and notch existing paving [as indicted on Drawings].
- B. Clean existing paving to remove foreign material, excess joint sealant and crack filler from paving surface.
- C. Repair surface defects in existing paving to provide uniform surface to receive new paving.

3.4 TACK COAT

- A. Apply tack coat in accordance with NCDOT Roads and Structures Standards.
- B. Apply tack coat on asphalt and concrete surfaces over subgrade surface at uniform rate.

3.5 SINGLE COURSE ASPHALT PAVING

- A. Install Work in accordance with NCDOT Roads and Structures Standards.
- B. Place asphalt within 24 hours of applying primer or tack coat.
- C. Place asphalt wearing course to thickness identified in schedule at end of section
- D. Compact paving by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.
- E. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

3.6 DOUBLE COURSE ASPHALT PAVING

- A. Place asphalt binder course within 24 hours of applying primer or tack coat.
- B. Place binder course to thickness identified in schedule at end of section.
- C. Place wearing course within 24 hours of placing and compacting binder course. When binder course is placed more than 24 hours before placing wearing course, clean surface and apply tack coat before placing wearing course.
- D. Place wearing course to ¼ inch compacted thickness identified schedule at end of section.
- E. Compact each course by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.
- F. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

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3.7 ASPHALT PAVING OVERLAY (if required)

- A. Apply tack coat to existing paving surface at rate recommended by geotextile fabric manufacturer.
- B. Place wearing course to thickness identified in schedule at end of section.
- C. Compact overlay by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.
- D. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.
- E. Roll paving to achieve uniform surface.

3.8 ERECTION TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Flatness: Maximum variation of ¼- inch measured with 10 foot straight edge.
- C. Scheduled Compacted Thickness: Within ¼-inch.

3.9 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements, 01 73 00 – Execution, and 01 77 00 - Closeout Procedures: Field inspecting, testing, adjusting, and balancing.
- B. Installer Qualifications: Engage an experienced installer who has completed hot-mix asphalt paving similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- C. Manufacturer Qualifications: Engage a firm experienced in manufacturing hot-mix asphalt similar to that indicated for this Project and with a record of successful in-service performance.
- D. Testing Agency: Sampling and testing shall be performed as directed by the owner's representative by an independent testing laboratory selected by the owner's representative and paid for by the owner. In the event that sampling and testing reveal unsatisfactory work, the costs of additional sampling and testing shall be borne by the contractor.
- E. Regulatory Requirements: Conform to applicable standards of the NCDOT and The County of Harnett for asphalt paving work on public property.
- F. Asphalt-Paving Publication: Comply with AI's "The Asphalt Handbook," except where more stringent requirements are indicated.
- G. Asphalt Paving Mix Temperature: Measure temperature at time of placement.

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- H. Asphalt Paving Thickness: ASTM D3549; test one core sample from every 1000 square yards compacted paving.
- I. Asphalt Paving Density: ASTM D2950 nuclear method; test one location for every 1000 square yards compacted paving.

3.10 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if substrate is wet or excessively damp or if the following conditions are not met:
 - 1. Tack Coats: Minimum surface temperature of 60 deg F.
 - 2. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

3.11 PROTECTION OF FINISHED WORK

- A. Section 01 73 00 - Execution and 01 77 00 Closeout Procedures: Requirements for protecting finished Work.
- B. Immediately after placement, protect paving from mechanical injury for 24 hours or until surface temperature is less than 140 degrees F.

3.12 SCHEDULES

- A. Asphalt Paving – Light Duty: Compacted Subgrade, 6 inches Compacted ABC, 2 inches Bituminous Surface Course.
- B. Asphalt Paving – Medium Duty: Compacted Subgrade, 8 inches Compacted ABC, 1½ inches Binder Course, 1½ inches Bituminous Surface Course.
- C. Asphalt Paving – Heavy Duty: Compacted Subgrade, 8 inches Compacted ABC, 2 inches Binder Course, 2 inches Bituminous Surface Course.

END OF SECTION

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SECTION 32 13 13

CONCRETE PAVING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Concrete paving for:
 - a. Concrete sidewalks.
 - b. Concrete stair steps.
 - c. Concrete curbs and gutters
 - d. Concrete median barriers.
 - e. Concrete pads.
- B. Related Sections:
 - 1. Section 07 92 00 - Joint Protection
 - 2. Section 09 91 00 - Painting and Coating
 - 3. Section 31 22 13 - Rough Grading
 - 4. Section 31 23 23 - Fill:
 - 5. Section 32 11 23 - Aggregate Base Courses
 - 6. Section 32 12 16 - Asphalt Paving
 - 7. Section 32 91 19 - Landscape Grading

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO M324 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
- B. American Concrete Institute:
 - 1. ACI 301 - Specifications for Structural Concrete.
 - 2. ACI 304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete.
- C. ASTM International:
 - 1. ASTM A184/A184M - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
 - 2. ASTM A185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
 - 3. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
 - 4. ASTM A497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
 - 5. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - 6. ASTM A706/A706M - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.

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7. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
8. ASTM A775/A775M - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
9. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement.
10. ASTM A934/A934M - Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.
11. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
12. ASTM C33 - Standard Specification for Concrete Aggregates.
13. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
14. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
15. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
16. ASTM C150 - Standard Specification for Portland Cement.
17. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
18. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
19. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
20. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
21. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
22. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
23. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
24. ASTM C979 - Standard Specification for Pigments for Integrally Colored Concrete.
25. ASTM C989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
26. ASTM C1017/C1017M - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
27. ASTM C1064/C1064M - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
28. ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete and Shotcrete.
29. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
30. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
31. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
32. ASTM D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.

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1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
 - 1. Submit data on concrete materials, joint filler, admixtures and curing compounds.
- C. Design Data:
 - 1. Submit concrete mix design for each concrete strength. Submit separate mix designs when admixtures are required for the following:
 - a. Hot and cold weather concrete work.
 - 2. Identify mix ingredients and proportions, including admixtures.
 - 3. Identify chloride content of admixtures and whether or not chloride was added during manufacture.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301 and requirements of Section 03 30 00.
- B. Perform Work in accordance with building codes, local and State standards.
- C. Obtain cementitious materials from same source throughout.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum of 3 years documented experience.

1.6 MOCKUP (If required)

- A. Section 01 40 00 - Quality Requirements: Requirements for mockup.
- B. Construct mockup, 5 x 5 feet, including paving, joints, surface texture, and exposed aggregate.
- C. Locate where directed by Architect/Engineer.
- D. Incorporate accepted mockup as part of Work if allowed by Architect/Engineer.

1.7 PRE-INSTALLATION MEETINGS

- A. Division 01 Sections: Pre-installation meeting.

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- B. Convene minimum one week prior to commencing work of this section.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.

PART 2 PRODUCTS

2.1 FORM MATERIALS

- A. Plywood, metal, metal-framed plywood, or other acceptable panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces. Use flexible or curved forms for curves of a 100-foot or less radius.
- B. Joint Filler: ASTM D1751; Asphalt impregnated fiberboard or felt, ¼ inch thick.
- C. Form Release Agent: Provide commercial formulation form-release agent with a maximum of 350 g/L volatile organic compounds (VOCs) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.2 REINFORCING

- A. Deformed Reinforcing: ASTM A615/A615M steel bars unfinished unless specifically directed to use coated bars.
- B. Deformed Bar Mats: ASTM A184/A184M; fabricated from ASTM A615/A615M steel bars, unfinished unless specifically directed to use coated mats.
- C. Welded Plain Wire Fabric: ASTM A185; in flat sheets or coiled rolls; unfinished unless specifically directed to use coated fabric.
- D. Dowels: ASTM A615/A615M; plain steel bars; cut to length square ends with burrs removed; unfinished unless specifically directed to use coated dowels.
- E. Tie Wire: Minimum 16 gage annealed type, epoxy coated.
- F. Epoxy Coating Patching Material: Type as recommended by coating manufacturer.

2.3 CONCRETE MATERIALS

- A. Cement: ASTM C150, Type I – Normal.
- B. Fine and Coarse Aggregates: ASTM C33, Class 4.

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1. Coarse Aggregate Maximum Size: $\frac{3}{4}$ inches.
 2. Do not use fine or coarse aggregates that contain substances that cause spalling.
- C. Exposed Aggregate: Gravel washed natural mineral aggregate; furnished from single source.
1. Color and stone size as selected by owner.
- D. Concrete Reinforcing Fibers: ASTM C1116, high strength industrial-grade fibers specifically engineered for secondary reinforcement of concrete. Tensile strength 130, 15 ksi; $\frac{3}{4}$ inch long fibers, 34 million/lb fiber count.
- E. Water: ASTM C94/C94M; potable, without deleterious amounts of chloride ions.
- F. Air Entrainment: ASTM C260.
- G. Chemical Admixture: ASTM C494/C494M, Type A - Water Reducing. Type D - Water Reducing and Retarding; Type E - Water Reducing and Accelerating.
- H. Color Pigment: ASTM C979; mineral oxides, alkali and fade resistant.
1. Color: As selected.

2.4 ACCESSORIES

- A. Curing Compound: ASTM C309, Type 2, Class B, wax free.
- B. Membrane Curing Compound: ASTM C1315.
- C. Liquid Surface Sealer
- D. Joint Sealers: Type 1 rated at 50% extension at 0 degrees F for moderate climates.
- E. Joint Sealers: ASTM D6690 AASHTO M324, Type I hot applied type.

2.5 CONCRETE MIX - BY PERFORMANCE CRITERIA

- A. Mix concrete in accordance with ACI 304. Deliver concrete in accordance with ASTM C94/C94M.
- B. Provide concrete to the following criteria:
1. Compressive Strength: Minimum 3,000 psi at 28 days or as specifically specified based on the work and application.
 2. Slump: 3 inches.
 3. Air Entrainment: 6.0 percent for $\frac{3}{4}$ inch maximum aggregate.
- C. Use accelerating admixtures in cold weather only when approved by the Architect/Engineer in writing. Use of admixtures will not relax cold weather placement requirements.
- D. Use calcium chloride only when approved by the Architect/Engineer in writing.

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- E. Use set retarding admixtures during hot weather only when approved by the Architect/Engineer in writing.

2.6 FABRICATION

- A. Fabricate reinforcing in accordance with CRSI Manual of Practice and local requirements.
- B. Form standard hooks for 180 degree bends.

2.7 SHOP FINISHING - REINFORCING

- A. If required, Galvanized Finish for Steel Bars: ASTM A767/A767M, Class [I] [II], hot dip galvanized after fabrication.
- B. If required, Epoxy Coated Finish for Steel Bars: [ASTM A775/A775M] [ASTM A934/A934M].
- C. If required, Epoxy Coated Finish for Steel Wire: ASTM A884/A884M; Class A using [ASTM A775/A775M] [ASTM A934/A934M].

2.8 SOURCE QUALITY CONTROL AND TESTS

- A. Submit proposed mix design [of each class of concrete] to appointed firm for review prior to commencement of Work.
- B. Tests on cement, aggregates, and mixes will be performed to ensure conformance with specified requirements.
- C. Test samples in accordance with [ASTM C94/C94M] [ACI 301.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify compacted subgrade and subbase is dry and ready to support concrete components and imposed loads. Do not begin concrete work until such conditions have been corrected and are ready to receive paving.
 - 1. Proof roll prepared subbase surface to check for unstable areas and verify need for additional compaction. Do not begin paving work until such conditions have been corrected and are receive to receive paving.
 - 2. Remove soft subbase and replace with compacted fill as specified in Section 31 23 23.

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- C. Verify gradients and elevations of base are correct.

3.2 SUBBASE, BASE COURSE

- A. Subbase and Base Course: Install as specified in Section 32 11 23.

3.3 PREPARATION

- A. Moisten substrate to minimize absorption of water from fresh concrete.
- B. Coat surfaces of manhole, valve caps, and catch basin frames with oil to prevent bond with concrete paving.
- C. Notify Architect/Engineer minimum 48 hours prior to commencement of concreting operations.

3.4 FORMING

- A. Place and secure forms and screeds to correct location, dimension, profile, and gradient. Install forms to allow continuous progress of work and so that forms can remain in place at least 24 hours after concrete placement.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- C. Remove loose material from compacted subbase surface immediately before placing concrete.

3.5 REINFORCING

- A. Place reinforcing as indicated on Drawings.
- B. Place reinforcing to achieve paving and curb alignment as detailed.
- C. If required, repair damaged coatings to match shop finish.

3.6 PLACING CONCRETE

- A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in.
- B. Remove snow, ice, or frost from subbase surface and reinforcing before placing concrete. Do not place concrete on surfaces that are frozen.
- C. Moisten subbase to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.
- D. Comply with requirements and with ACI 304R for measuring, mixing, transporting, and placing concrete.

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- E. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- F. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- G. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete complying with ACI 309R.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocating reinforcing, dowels, and joint devices.
- H. Screed paved surfaces with a straightedge and strike off. Use bull floats or darbies to form a smooth surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces prior to beginning finishing operations.
- I. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete.
- J. Cold-Weather Placement: Comply with provisions of ACI 306R and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.
- K. Hot-Weather Placement: Place concrete complying with ACI 305R and as specified when hot weather conditions exist.
 - 1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg F (32 deg C). Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.

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3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.5 CONCRETE FINISHING

- A. Float Finish: Begin floating when bleed water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Finish surfaces to true planes within a tolerance of 1/4 inch in 10 feet as determined by a 10-foot-long straightedge placed anywhere on the surface in any direction. Cut down high spots and fill low spots. Refloat surface immediately to a uniform granular texture.
 1. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across concrete surface perpendicular to line of traffic to provide a uniform fine line texture finish.
- B. Final Tooling: Tool edges of paving and joints formed in fresh concrete with a jointing tool to the following radius. Repeat tooling of edges and joints after applying surface finishes. Eliminate tool marks on concrete surfaces.
 1. Radius: 3/8 inch.

3.6 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with the recommendations of ACI 306R for cold weather protection and ACI 305R for hot weather protection during curing.
- B. Evaporation Control: In hot, dry, and windy weather, protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply according to manufacturer's instructions after screeding and bull floating, but before floating.
- C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- D. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
 1. Moisture Curing: Keep surfaces continuously moist for not less than 7 days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with a 12-inch lap over adjacent absorptive covers.

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2. **Moisture-Retaining-Cover Curing:** Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. **Curing Compound:** Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.7 JOINTS

- A. **General:** Construct contraction, construction, and isolation joints true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to the centerline, unless indicated otherwise.
 1. When joining existing paving, place transverse joints to align with previously placed joints, unless indicated otherwise.
- B. **Contraction Joints:** Provide weakened-plane contraction joints, sectioning concrete into areas as shown on Drawings. Construct contraction joints for a depth equal to at least 1/4 of the concrete thickness, as follows:
 1. **Tooled Joints:** Form contraction joints in fresh concrete by grooving and finishing each edge of joint with a radiused jointer tool.
 2. Contraction joints shall be spaced at 10 foot intervals for curb and gutter construction, unless otherwise approved by the owner's representative.
 3. Contraction joints shall be spaced at 5 foot intervals for sidewalk construction, unless otherwise approved by the owner's representative.
- C. **Construction Joints:** Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than 1/2 hour, unless paving terminates at isolation joints.
 1. Provide preformed galvanized steel or plastic keyway-section forms or bulkhead forms with keys, unless indicated otherwise. Embed keys at least 1-1/2 inches into concrete.
 2. Continue reinforcement across construction joints unless indicated otherwise. Do not continue reinforcement through sides of strip paving unless indicated.
 3. Provide tie bars at sides of paving strips where indicated.
 4. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.
- D. **Isolation Joints:** Form isolation joints of preformed joint filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
 1. Locate expansion joints at intervals of 30 feet, unless indicated otherwise.

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2. Extend joint fillers full width and depth of joint, not less than 1/2 inch or more than 1 inch below finished surface where joint sealant is indicated. Place top of joint filler flush with finished concrete surface when no joint sealant is required.
3. Furnish joint fillers in one-piece lengths for full width being placed wherever possible. Where more than one length is required, lace or clip joint filler sections together.
4. Protect top edge of joint filler during concrete placement with a metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

3.8 EXPOSED AGGREGATE

- A. Apply surface retarder where exposed aggregate finish is required.
- B. Wash exposed aggregate surface with clean water and scrub with stiff bristle brush acid etch solution] exposing aggregate.

3.9 FINISHING

- A. Broom finish all surfaces unless otherwise specified.
- B. Inclined Vehicular Ramps: Broomed perpendicular to slope.

3.10 CURING AND PROTECTION

- A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

3.11 ERECTION TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Maximum Variation of Surface Flatness: 1/4 inch in 10ft.
- C. Maximum Variation From True Position: 1/4 inch.

3.12 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements 01 73 00 – Execution, and 01 77 00 - Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Perform field inspection and testing in accordance with ASTM C94/C94M.
- C. Inspect reinforcing placement for size, spacing, location, support.
- D. Testing firm will take cylinders and perform slump and air entrainment tests in accordance with ACI 301.
- E. Strength Test Samples:
 1. Sampling Procedures: ASTM C172.

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2. Cylinder Molding and Curing Procedures: ASTM C31/C31M, cylinder specimens, standard cured or field cured as required.
 3. Strength Test: ASTM 31; one set of four standard cylinders for each compressive-strength test, unless directed otherwise. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.
 4. Make one additional cylinder during cold weather concreting, and field cure.
- F. Field Testing:
1. Slump Test Method: ASTM C143/C143M.
 2. Air Content Test Method: ASTM C231.
 3. Temperature Test Method: ASTM C1064/C1064M.
 4. Measure slump and temperature for each compressive strength concrete sample.
 5. Measure air content in air entrained concrete for each compressive strength concrete sample.
 6. When frequency of testing will provide fewer than five strength tests for a given class of concrete, conduct testing from at least five randomly selected batches of from each batch if fewer than five are used.
- G. Cylinder Compressive Strength Testing:
1. Test Method: ASTM C39.
 2. Test Acceptance: one set for each day's pour of each concrete class exceeding 5 cu. Yd. but less than 25 cu. Yd., plus one set for each additional 50 cu. Yd.
 3. Test one cylinder at 7 days.
 4. Test two cylinders at 28 days.
 5. Retain one cylinder for in reserve for testing when requested by Architect/Engineer.
 6. Dispose remaining cylinders when testing is not required.
- H. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

3.13 PROTECTION

- A. Immediately after placement, protect paving from premature drying, excessive hot or cold temperatures, and mechanical injury.
- B. Do not permit pedestrian and vehicular traffic over paving for 7 days minimum after finishing until 75 percent design strength of concrete has been achieved.

3.14 SCHEDULES

- A. Concrete Sidewalks, Curb and Gutters: 3,000 psi 28 day concrete with thickness and finish as specified.
- B. Parking Area Paving and Slabs: 4,000 psi 28 day concrete with thickness and finish as specified

END OF SECTION

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SECTION 32 17 23 - PAVEMENT MARKINGS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Traffic lines and markings.
 - 2. Legends.
 - 3. Paint.
 - 4. Glass beads.
- B. Related Sections:
 - 1. Section 32 12 16 - Asphalt Paving.
 - 2. Section 32 13 13 - Concrete Paving.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO M247 - Standard Specification for Glass Beads Used in Traffic Paint.
- B. ASTM International:
 - 1. ASTM D34 - Standard Guide for Chemical Analysis of White Pigments.
 - 2. ASTM D126 - Standard Test Methods for Analysis of Yellow, Orange, and Green Pigments Containing Lead Chromate and Chromium Oxide Green.
 - 3. ASTM D562 - Standard Test Method for Consistency of Paints Using the Stormer Viscometer.
 - 4. ASTM D711 - Standard Test Method for No-Pick-Up Time of Traffic Paint.
 - 5. ASTM D713 - Standard Practice for Conducting Road Service Tests on Fluid Traffic Marking Materials.
 - 6. ASTM D969 - Standard Test Method for Laboratory Determination of Degree of Bleeding of Traffic Paint.
 - 7. ASTM D1301 - Standard Test Methods for Chemical Analysis of White Lead Pigments.
 - 8. ASTM D1394 - Standard Test Methods for Chemical Analysis of White Titanium Pigments.
 - 9. ASTM D1475 - Standard test Method for Density of Liquid Coatings, Inks, and Related Products.
 - 10. ASTM D1640 - Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature.
 - 11. ASTM D2202 - Standard Test Method for Slump of Sealants.
 - 12. ASTM D2371 - Standard Test Method for Pigment Content of Solvent-Reducible Paints.
 - 13. ASTM D2621 - Standard Test Method for Infrared Identification of Vehicle Solids From Solvent-Reducible Paints.
 - 14. ASTM D2743 - Standard Practices for Uniformity of Traffic Paint Vehicle Solids by Spectroscopy and Gas Chromatography.

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1.3 PERFORMANCE REQUIREMENTS

- A. Paint Adhesion: Adhere to road surface forming smooth continuous film one minute after application.
- B. Paint Drying: Tack free by touch so as not to require coning or other traffic control devices to prevent transfer by vehicle tires within two minutes after application.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit paint formulation for each type of paint.
- C. Manufacturer's Installation Instructions: Submit instructions for application temperatures, eradication requirements, application rate, line thickness, type of glass beads, bead embedment and bead application rate, and any other data on proper installation.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with NCDOT Road and Structures Standards.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Applicator: Company specializing in performing work of this section [with minimum 3 years] documented experience approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Invert containers several days prior to use when paint has been stored more than 2 months. Minimize exposure to air when transferring paint. Seal drums and tanks when not in use.
- C. Glass Beads. Store glass beads in cool, dry place. Protect from contamination by foreign substances.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

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- B. Do not apply materials when surface and ambient temperatures are outside temperature ranges required by paint product manufacturer.
- C. Do not apply exterior coatings during rain or snow when relative humidity is outside humidity ranges, or moisture content of surfaces exceed those required by paint product manufacturer.
- D. Do not apply paint when temperatures are expected to fall below 50 degrees F for 24 hours after application.
- E. Volatile Organic Content (VOC). Do not exceed State or Environmental Protection Agency maximum VOC on traffic paint.

1.9 WARRANTY

- A. Section 01 73 00 - Execution and 01 77 00 - Closeout Procedures: Requirements for warranties.
- B. Furnish three year manufacturer's warranty for traffic paints.

1.10 MAINTENANCE SERVICE

- A. Section 01 73 00 - Execution and 01 77 00 - Closeout Procedures: Requirements for maintenance service.
- B. Furnish service and maintenance of traffic paints for three years from Date of Substantial Completion.

PART 2 PRODUCTS

2.1 PAINTED PAVEMENT MARKINGS

- A. Manufacturers: This list is a general representation of paint manufactures and shall not be construed to be all inclusive.
 - 1. Pervo Paint Company] Model
 - 2. Pathmark Traffic Products] Model
 - 3. Safety Coatings Inc.] Model
 - 4. Franklin Paint Company] Model
 - 5. EZ-Liner Industries
 - 6. Substitutions: Section 01 60 00 - Product Requirements Not Permitted.
 - 7. Paint: Ready mixed, conventional and fast dry waterborne traffic paints, lead-free, non-toxic, NASSHTO Test Deck, minimum retroreflectance of 100 mcads, durability rating of 6 or more after in place for 9 months;
- B. Glass Beads: AASHTO M247, Type 1, coated to enhance embedment and adherence with paint.

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2.2 EQUIPMENT

- A. Continuous Longitudinal Line Application Machine: Use application equipment with following capabilities.
 - 1. Dual nozzle paint gun to simultaneously apply parallel lines of indicated width in solid or broken patterns or various combinations of those patterns.
 - 2. Pressurized bead-gun to automatically dispense glass beads onto painted surface, at required application rate.
 - 3. Measuring device to automatically and continuously measure length of each line placed, to nearest foot.
 - 4. Device to heat paint for fast dry applications.
- B. Other Equipment:
 - 1. For application of crosswalks, intersections, stop lines, legends and other miscellaneous items by walk behind stripers, hand spray or stencil trucks, apply with equipment meeting requirements of this section. Do not use hand brushes or rollers. Optionally apply glass beads by hand.

2.3 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Testing, inspection and analysis requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 Sections: Verification of existing conditions before starting work.
- B. Do not apply paint to concrete surfaces until concrete has cured for 28 days.

3.2 PREPARATION

- A. Maintenance and Protection of Traffic:
 - 1. Prevent interference with marking operations and to prevent traffic on newly applied markings before markings dry.
 - 2. Maintain travel lanes between 7: 00 AM to 9: 00 AM, and between 4: 00 PM and 6: 00 PM.
 - 3. Maintain access to existing buildings and other properties requiring access.
- B. Surface Preparation.
 - 1. Clean and dry paved surface prior to painting.
 - 2. Blow or sweep surface free of dirt, debris, oil, grease or gasoline.
 - 3. Spot location of final pavement markings as specified and as indicated on Drawings by applying pavement spots 25 feet on center.
 - 4. Notify Designer after placing pavement spots a minimum 3 days prior to applying traffic lines.

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3.3 EXISTING WORK

- A. Remove existing markings in an acceptable manner. Do not remove existing pavement markings by painting over with blank paint. Remove by methods that will cause least damage to pavement structure or pavement surface. Satisfactorily repair any pavement or surface damage caused by removal methods.
- B. Clean and repair existing [remaining] [or] [reinstalled] lines and legends.

3.4 APPLICATION

- A. Agitate paint for 1-15 minutes prior to application to ensure even distribution of paint pigment.
- B. Dispense paint to wet-film thickness of 15 mils, except dispense edge markings to wet-film thickness of 12 mils.
- C. Apply glass beads at rate of 6 pounds per gallon of paint.
- D. Apply markings to indicated dimensions at indicated locations.
- E. Prevent splattering and over spray when applying markings.
- F. Unless material is track free at end of paint application convoy, use traffic cones to protect markings from traffic until track free. When vehicle crosses a marking and tracks it or when splattering or over spray occurs, eradicate affected marking and resultant tracking and apply new markings.
- G. Collect and legally dispose of residues from painting operations.
- H. Install Work in accordance with NCDOT Roads and Structures Standards

3.5 APPLICATION

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Maximum Variation from Wet Film Thickness: 1 mil.
- C. Maximum Variation from Wet Paint Line Width: Plus or minus 1/8 inch.
- D. Maximum Variation from Specified Application Temperature: Plus or minus 5 degrees F

3.6 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements Section 01 73 00 - Execution and 01 77 00 - Closeout Procedures: Field inspecting, testing, adjusting, and balancing.
- B. Inspect for incorrect location, insufficient thickness, line width, coverage, retention, uncured or discolored material, and insufficient bonding.
- C. Repair lines and markings, which after application and curing do not meet following criteria:
 - 1. Incorrect Location: Remove and replace incorrectly placed patterns.
 - 2. Insufficient Thickness, Line Width, Paint Coverage, Glass Bead Coverage or Retention: Prepare defective material by acceptably grinding or blast cleaning to

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remove substantial amount of beads and to roughen marking surface. Remove loose particles and debris. Apply new markings on cleaned surface in accordance with this Section.

3. Uncured or Discolored Material, Insufficient Bonding: Remove defective markings in accordance with this Section and clean pavement surface one foot beyond affected area. Apply new markings on cleaned surface in accordance with this Section.
- D. Replace defective pavement markings as specified throughout 1 year warranted period.
- E. Prepare list of defective areas and areas requiring additional inspection and evaluation to decide where material may need replaced. Provide traffic control as necessary if markings require more detailed evaluation.
- F. Replace failed or defective markings in entire section of defective markings within 30 days after notification when any of the following exists during warranty period:
 1. Average retro-reflectivity within any 528 foot section is less than 1225 mcd/m²/1x for white pavement markings and 100 mcd/m²/1x for yellow pavement markings.
 2. Marking is discolored or exhibits pigment loss, and is determined to be unacceptable by three member team based on visual comparison with beaded color plates.
 3. More than 15 percent of area of continuous line, or more than 15 percent of combined area of skip lines, within any 528 foot section of roadway is missing.
- G. Replace pavement marking material under warranty using original or better type material. Continue warranty to end of original 1year period even when replacement materials have been installed as specified.
- H. When eradication of existing paint lines is necessary, eradicate by shot blast or water blast method. Do not gouge or groove pavement more than 1/16 inch during removal. Limit area of removal to area of marking plus 1 inch on all sides. Prevent damage to transverse and longitudinal joint sealers, and repair any damage according to requirements in Section 32 13 13 or Section 32 12 16.

3.7 PROTECTION OF FINISHED WORK

- A. Section 01 73 00 - Execution and 01 77 00 - Closeout Procedures: Requirements for protecting finished Work.
- B. Protect painted pavement markings from vehicular and pedestrian traffic until paint is dry and track free. Follow manufacturer's recommendations or use minimum of 30 minutes. Consider barrier cones as satisfactory protection for materials requiring more than 2 minutes dry time.

END OF SECTION

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SECTION 32 90 00 - LANDSCAPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including the General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. This Section includes the following items:
 - 1. Installing temporary and permanent landscape groundcover.
 - 2. Plantings including trees and shrubs.

1.2 SUBMITTALS

- A. Certification of grass seed from seed vendor for each seed mixture.
- B. Product certificates.

1.3 QUALITY ASSURANCE

- A. Maintain and establish lawns by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations to produce a uniformly smooth lawn for not less than the following:
 - 1. Permanent groundcover: 60 days after date of Substantial Completion. Thereafter, maintain at 3 month intervals minimum during the one year warranty period on or about the 15 of the month to maintain growth.
 - 2. Erosion Control Temporary Seeding – Install as required to minimize erosion. Minimum 15 days after a land disturbing activity in accordance with The North Carolina Department of Environment & Natural Resources (NCDENR).
- B. Plants (Shrubs and Trees)
 - 1. All plants shall be true to species and variety specified.
 - 2. Plants shall be provided by a nursery.
 - 3. Plants shall be sound, healthy with vigorous well-branched growth. Plants shall be free of disease and insect infestation.
 - 4. Tree trunks shall be straight of multi-stemmed depending on the variety.
 - 5. Plants shall be void of damage including the root ball or container.
- C. Delivery
 - 1. All plants shall be transported and handled with care.
 - 2. Plants shall be properly stored on site prior to installation including watering and out of excessive heat.
- D. Minimum Coverage and Plant Growth
 - 1. Seeded groundcover areas shall be 80% covered three months after planting and 100% covered six months after planting.
 - 2. Sodded lawns shall be 100% covered after installing void of dead areas.

1.4 PROJECT CONDITIONS

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- A. Utilities: Determine location of above grade and underground utilities and perform work in a manner which will avoid damage. Hand excavate as required. Maintain grade stakes until removal is mutually agreed upon by concerned parties.
- B. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Engineer before planting.
- C. Contractor shall seed all areas disturbed by the construction phase.
 - 1. Installation of groundcovers and plantings shall be done when temperatures are above freezing and the ground is thawed.

PART 2 PRODUCTS

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with the Association of Official Seed Analysts' "Rules for Testing Seeds" for purity and germination tolerances.
 - 1. Seed Mixture: Provide seed of grass species and varieties, proportions by weight, and minimum percentages of purity, germination, and maximum percentage of weed seed as indicated.
- B. Topsoil: ASTM D 5268, pH range of 5.5 to 7, 4 percent organic material minimum, free of stones 1 inch (25 mm) or larger in any dimension, and other extraneous materials harmful to plant growth.
 - 1. Topsoil Source: Reuse surface soil stockpiled on the site. Verify suitability of surface soil to produce topsoil meeting requirements and amend when necessary. Supplement with imported topsoil when quantities are insufficient. Clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.
- C. Lime: ASTM C 602, Class T, agricultural limestone, applied at the rate of 2 tons/acre.
- D. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea-form, phosphorous, and potassium in the following composition:
 - 1. Composition: 1 lb per 1000 sq. ft. (0.5 kg per 100 sq. m) of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
- E. Bermuda Sod – Shall be free of weeds and foreign grasses. Must have dense growth with no void areas, no visible sign of disease or insect infestation. Thickness of soil shall not exceed ¾ inch.

PART 3 EXECUTION

- A. Lawn Planting Preparation: Loosen subgrade to a minimum depth of 4 inches (100 mm). Remove stones larger than 1-1/2 inches (38 mm) in any dimension and sticks, roots, rubbish, and other extraneous materials.

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1. Spread planting soil mixture to 4-inch depth to meet thickness, grades, and elevations shown, after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen.
2. Place approximately 1/2 the thickness of planting soil mixture required. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil mixture.
- B. Moisten prepared lawn areas before planting when soil is dry and allow surface to dry before planting.
- C. Seeding Lawns: Sow seed with a spreader or a seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h). Evenly distribute seed by sowing equal quantities in 2 directions at right angles to each other. Rake seed lightly into top 1/8 inch (3 mm) of topsoil, roll lightly, and water with fine spray.
 1. Seeding Rate: to 4 lb per 1000 sq. ft. (1.5 to 2 kg per 100 sq. m).
 2. Protect seeded areas with slopes less than 1:6 against erosion by spreading straw mulch after completion of seeding operations and anchor by crimping into topsoil. Spread uniformly at a minimum rate of 2 tons per acre (45 kg per 100 sq. m).
 3. Sow seed at the following rates:
 - a. Planting Date from Mar. 1 - Aug. 31: Mixture: 1/2 hulled Common Bermuda and 1/2 Fescue, Ky-31.
 - b. Planting Date from Sep. 1 - Feb. 28: Mixture of 2/3 Common Bermuda and 1/3 Rye Grain.
- D. Disposal: Remove trash, and debris, and legally dispose of it off the Owner's property. Remove surplus soil including excess subsoil and distribute within approved areas.
- E. Plantings
 1. Pit for balled planting shall be three (3) times the root ball diameter. The sides of the hole shall be scarified. The planting shall match the root ball depth. Container plants shall be handled in a similar manner.
 2. Plants shall be planted straight and plum per the planting detail.
 3. All void areas shall be thoroughly filled with a topsoil
 4. A continuous soil saucer shall be formed around each planting on each side of the slope to act as a watering basin. The area shall be repaid as necessary to maintain moisture.
- F. Watering
 1. Thoroughly water each plant immediately following installation. Apply water as needed through the maintenance cycle.
- G. Mulch
 1. After planting place mulch materials to a 4'inch depth. Mulch shall be pulled back from trunk approximately 6".

END OF SECTION

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SECTION 32 91 19 - LANDSCAPE GRADING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Final grade topsoil for finish landscaping.
- B. Related Sections:
 - 1. Section 31 22 13 - Rough Grading
 - 2. Section 31 23 17 - Trenching
 - 3. Section 31 23 23 - Fill
 - 4. Section 32 12 16 – Asphalt Paving

1.2 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures
- B. Materials Source: Submit name and location of imported materials source.

1.3 QUALITY ASSURANCE

- A. Furnish each topsoil material from single source throughout the Work.
- B. Perform Work in accordance with contract requirements and North Carolina DOT Roads and Standard Manual.

PART 2 PRODUCTS

2.1 MATERIAL

- A. Topsoil: ASTM D 5268, pH range of 5.5 to 7, 4 percent organic material minimum, free of stones 1 inch (25 mm) or larger in any dimension, and other extraneous materials harmful to plant growth.
 - 1. Topsoil Source: Reuse surface soil stockpiled on the site. Verify suitability of surface soil to produce topsoil meeting requirements and amend when necessary. Supplement with imported topsoil when quantities are insufficient. Clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 Sections: Verification of existing conditions before starting work.
- B. Verify building and trench backfilling have been inspected.
- C. Verify substrate base has been contoured and compacted.

3.2 PREPARATION

- A. Protect landscaping and other features remaining as final Work.
- B. Protect all new and existing site improvements as required.

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3.3 SUBSTRATE PREPARATION

- A. Eliminate uneven areas and low spots.
- B. Remove debris, roots, branches and native stones, in excess of (1) one inch in size. Remove contaminated subsoil.
- C. Remove all construction gravel.
- D. Scarify surface to depth of (6) six inches where topsoil is scheduled. Scarify in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

3.4 PLACING TOPSOIL

- A. Place topsoil in areas where seeding, sodding, planting, is required to minimum depth of (4) four inches. See specific depths under 3.7 SCHEDULES. Place topsoil during dry weather.
- B. Work approximately $\frac{1}{2}$ of the required depth into top of loosened subgrade to create a transition layer and then place remainder of planting soil mixture.
- C. Fine grade topsoil in a smooth even plane to eliminate rough or low areas. Maintain profiles and contour of subgrade.
- D. Remove roots, weeds, rocks, and foreign material while spreading.
- E. Manually spread topsoil close to plant material, building, and other site improvements to prevent damage.
- F. Lightly compact and role placed topsoil.
- G. Remove surplus subsoil and topsoil from site.
- H. Leave any stockpile areas that is scheduled to remain in a uniform manner and site clean and rake, ready to receive landscaping.

3.5 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Top of Topsoil: Plus or minus (1/2) one half inch.

3.6 PROTECTION OF INSTALLED WORK

- A. Section 01 73 00 - Execution: Requirements for protecting finished Work.
- B. Prohibit construction traffic over topsoil.

3.7 SCHEDULES

- A. Compacted topsoil thicknesses:
 - 1. Seeded Grass: (4) 4- inches.
 - 2. Sod: (4) four inches.
 - 3. Shrub Beds: (18) eighteen inches.
 - 4. General Planting Landscape Beds: (8) eight inches.

END OF SECTION

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SECTION 33 41 00 - STORM UTILITY DRAINAGE PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Storm drainage piping.
 - 2. Accessories.
 - 3. Underground pipe markers.
 - 4. Catch basins and plant area drains.
 - 5. Cleanouts.
 - 6. Bedding and cover materials.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-In-Place Concrete:
 - 2. Section 04 05 03 - Masonry Mortaring and Grouting: Mortar and grout.
 - 3. Section 31 05 13 - Soils for Earthwork: Soils for backfill in trenches.
 - 4. Section 31 05 16 - Aggregates for Earthwork: Aggregate for backfill in trenches.
 - 5. Section 31 23 16 - Excavation: Product and execution requirements for excavation and backfill required by this section.
 - 6. Section 31 23 17 - Trenching: Execution requirements for trenching required by this section.
 - 7. Section 31 23 23 - Fill: Requirements for backfill to be placed by this section.
- C. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- D. ASTM International:
 - 1. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
 - 2. ASTM C14 - Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
 - 3. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
 - 4. ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
 - 5. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
 - 6. ASTM C924 - Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method.
 - 7. ASTM C969 - Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.
 - 8. ASTM C1103 - Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.
 - 9. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).

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10. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft³ (2,700 kN-m/m³)).
11. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
12. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
13. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
14. ASTM D2729 - Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
15. ASTM D2751 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.
16. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
17. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
18. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
19. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
20. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

1.2 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures: Requirements for submittals. Submit shop drawings for precast concrete manholes and other structures. Include frames, covers, and grates.
- B. Manufacturer's Installation Instructions: Submit special procedures required to install Products specified.
- C. Shop drawings for cast-in-place concrete or field-erected masonry manholes and other structures. Include frames, covers, and grates.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Section 01 73 00 - Execution and 01 77 00 - Closeout Procedures: Requirements for submittals.
- B. Project Record Documents:
 1. Accurately record actual locations of pipe runs, connections, catch basins, cleanouts, and invert elevations.
 2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

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1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with local, State and Federal Standards
- B. Maintain one copy of design plans and construction manual on site.

1.5 PRE-INSTALLATION MEETINGS

- A. Division 01 Sections: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.6 COORDINATION

- A. Division 01 Sections: Coordination and project conditions.
- B. Coordinate the Work with termination of storm sewer connection outside building with building contractor.

PART 2 PRODUCTS

2.1 PIPES AND FITTINGS

- A. Reinforced-Concrete Culvert Pipe: NCDOT Section 1032-9(B), ASTM C 76, Class III Wall B.
 - 1. Shall have section joints designed for cold applied sealing compound conforming to the latest FED. SPEC. SS-S-00210-A. Sealing compound shall be RAM-NEK Flexible Plastic Gaskets as manufactured by K.T. Snyder Company, Inc. or approved equal.
 - 2. Minimum diameter is 15-inch unless specifically noted otherwise on plans.
- B. HDPE Pipe and Fittings:
 - 1. Use pipe manufactured by ADS, Hancor or approved equal.
 - 2. Connections shall be a gasketed integral bell type. Zip ties and collar connections shall not be allowed.
 - 3. Pipe must meet ASTM D 3350 'Standard Specification for Polyethylene Plastics Pipe and Fittings Materials'
- C. Plastic Pipe: ASTM D2729, polyvinyl chloride (PVC) material; inside nominal diameter of 8-inches or less, bell and spigot solvent sealed ends. SDR 35
 - 1. Fittings: PVC.
 - 2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

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- D. Plastic Pipe: ASTM D3034, Type PSM, Poly (Vinyl Chloride) (PVC) material; inside nominal diameter of greater than 8-inches inches, bell and spigot style rubber ring sealed gasket joint. SDR 35
 - 3. Fittings: PVC.
 - 4. Joints: ASTM F477, elastomeric gaskets.

2.2 MANHOLES

- A. Storm Drainage Manholes: Conform to NCDOT Section 840.
- B. Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated.
 - 1. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent floatation.
 - 2. Base Section: 6-inch minimum thickness for floor slab and 5-inch minimum thickness for walls and base riser section, and having a separate base slab or base section with integral floor.
 - 3. Riser Sections:
 - a. 5-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.
 - b. 6-inch minimum thickness, 60-inch diameter, and lengths to provide depth indicated
 - c. Minimum manhole diameter is 48-inch. Manhole diameters are determined by diameter of entering pipes and angles between all pipes connected.
 - 4. Top Section: Eccentric cone type, unless concentric cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
 - 5. Gaskets: AASHTO M-198, Type B, Flexible Plastic Gasket
 - 6. Grade Rings: Include 2 or 3 reinforced-concrete rings, of 6- to 9-inch total thickness, that match a 24-inch-diameter frame and cover.
 - 7. Steps: Individual steps of rubber- or plastic-encased steel reinforcing bar as manufactured by MA Industries (Model PSI-PF). Include a width that allows a worker to place both feet on one step and is designed to prevent lateral slippage off the step. Cast steps or anchor ladder into base, riser, and top sections sidewalls at 12- to 16-inch intervals. Omit steps for manholes less than 60 inches deep.
 - 8. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.
 - 9. Preformed flow channels shall not be acceptable.
- C. Manhole Frames and Covers: ASTM A 48-83, Class 30, heavy-duty cast iron as manufactured by Vulcan Foundry, Inc. Model V-1284-3. Include indented top design with lettering, equivalent to the following, cast into cover:
 - 1. Storm Drainage Piping Systems: STORM SEWER.

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2.3 CATCH BASINS

- A. Precast Concrete Catch Basins: Conform to NCDOT Section 840. Dimensions shall be as indicated on the Drawings.
 - 1. Steps: Individual steps of rubber- or plastic-encased steel reinforcing bar as manufactured by MA Industries (Model PSI-PF). Include a width that allows a worker to place both feet on one step and is designed to prevent lateral slippage off the step. Cast steps or anchor ladder into base, riser, and top sections sidewalls at 12- to 16-inch intervals. Omit steps for catch basins less than 60 inches deep.
 - 2. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.
- B. Brick Catch Basins: Brick and mortar, of depth, shape, and dimensions indicated.
 - 1. Base, Channel, and Bench: Concrete.
 - 2. Wall: ASTM C 32, Grade MS, manhole brick; 8-inch minimum thickness with tapered top for a 24-inch frame and cover.
 - a. Option: ASTM C 139, concrete masonry units may be used instead of brick.
 - 3. Mortar: ASTM C 270, Type S, using ASTM C 150, Type II, portland cement.
 - 4. Steps: Individual steps of rubber- or plastic-encased steel reinforcing bar as manufactured by MA Industries (Model PSI-PF). Include a width that allows a worker to place both feet on one step and is designed to prevent lateral slippage off the step. Cast steps or anchor ladder into base, riser, and top sections sidewalls at 12- to 16-inch intervals. Omit steps for catch basins less than 60 inches deep.
- C. Cast-in-Place Concrete Catch Basins: Construct of reinforced-concrete, designed according to ASTM C 857 for structural loading. Include depth, shape, dimensions, and appurtenances indicated.
 - 1. Bottom, Walls, and Top: Reinforced concrete.
 - 2. Channels and Benches: Concrete.
 - 3. Steps: Individual steps of rubber- or plastic-encased steel reinforcing bar as manufactured by MA Industries (Model PSI-PF). Include a width that allows a worker to place both feet on one step and is designed to prevent lateral slippage off the step. Cast steps or anchor ladder into base, riser, and top sections sidewalls at 12- to 16-inch intervals. Omit steps for catch basins less than 60 inches deep.
- D. Frames and Grates: ASTM A 536, Grade 60-40-18, heavy-duty ductile iron. Include 24-by-24-inch minimum flat grate with small square or short-slotted drainage openings.
- E. Frames and Grates: ASTM A 48, Class 30 iron. Include 24-by-24-inch minimum flat grate with small square or short-slotted drainage openings as indicated.

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2.4 STORM-WATER INLETS

- A. Curb inlets: Made with vertical curb opening, of materials and dimensions according to NCDOT Roadway standards.
- B. Frames and Grates: Heavy-duty frames and grates according to NCDOT standards.

2.5 OUTFALLS

- A. Construct headwall, apron, and tapered sides of cast-in-place, reinforced concrete.
- B. Riprap: Broken stone, irregular size and shape, of NCDOT Class indicated. Where no Class is indicated, use Class A.
- C. Energy Dissipators: Construction as indicated, from materials indicated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 Sections: Verification of existing conditions before starting work.
- B. Verify excavation base is ready to receive work and excavations, dimensions, and elevations are as indicated on drawings.

3.2 PREPARATION

- A. Hand trim excavations to required elevations. Correct over excavation with
- B. Remove large stones or other hard matter which could damage piping or impede consistent backfilling or compaction.

3.3 BEDDING

- A. Excavate pipe trench in accordance with Section 31 23 17 for work of this Section. Hand trim excavation for accurate placement of pipe to elevations indicated.
- B. Maintain optimum moisture content of any bedding material to attain required compaction density.

3.4 INSTALLATION - PIPE

- A. Install pipe, fittings, and accessories in accordance with ASTM D2321. Seal joints watertight.
- B. Lay pipe to slope gradients noted on drawings.
- C. Refer to Section 31 23 23 for backfilling and compacting requirements. Do not displace or damage pipe when compacting.

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- D. Connect to building storm sewer outlets, municipal storm sewer system, and other structures as appropriate.
- E. Install trace wire continuous over top of pipe.
- F. Install site storm drainage system piping as shown on drawings. Connect to building storm outlets.
- G. Existing Conditions: Drawings indicate the general location and arrangement of existing underground utilities based upon best available data. Contractor shall be responsible for verifying all existing conditions, and shall notify the THE OWNER'S REPRESENTATIVE of any discrepancies between field conditions and those indicated on the drawings.
- H. Install piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's recommendations for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.
- I. Use proper size increasers, reducers, and couplings, where different sizes or materials of pipes and fittings are connected. Reduction of the size of piping in the direction of flow is prohibited.
- J. Install gravity-flow-systems piping at constant slope between points and elevations indicated.
- K. General: Join and install pipe and fittings according to the following:
 - 1. Polyvinyl Chloride (PVC) Plastic Pipe and Fittings: As follows:
 - a. Join solvent-cement-joint pipe and fittings with solvent cement according to ASTM D 2855 and ASTM F 402.
 - b. Join pipe and gasketed fittings with elastomeric seals according to ASTM D 2321.
 - 2. Concrete Pipe and Fittings: Install according to ACPA "Concrete Pipe Handbook."
- L. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and fit both systems' materials and dimensions and as approved by the Designer.

3.5 MANHOLE INSTALLATION

- A. General: Install manholes, complete with accessories, as indicated.
- B. Form continuous concrete channels and benches between inlets and outlet.
- C. Set tops of frames and covers in suitable mortar surrounded by a concrete collar to a grade one-fourth inch (1/4") above finished surface where manholes occur in pavements. Set tops 3 inches above finished surface elsewhere, except where otherwise indicated.

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- D. Place precast concrete manhole sections as indicated.
 - 1. Provide rubber joint gasket complying with ASTM C 443, at joints of sections.
 - 2. Apply bituminous mastic coating at joints of sections.

3.6 CATCH BASIN INSTALLATION

- A. Construct catch basins to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.

3.7 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318, ACI 350R, and as indicated.

3.8 FIELD QUALITY CONTROL

- A. Clear interior of piping and structures of dirt and superfluous material as the work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.
 - 1. In large, accessible piping, brushes and brooms may be used for cleaning.
 - 2. Place plug in end of incomplete piping at end of day and whenever work stops.
 - 3. Flush piping between manholes and other structures, if required by authorities having jurisdiction, to remove collected debris.
- B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of the Project.
 - 1. Submit separate reports for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visual between structures.
 - b. Crushed, broken, cracked, or otherwise damaged piping.
 - c. Infiltration: Water leakage into piping.
 - d. Exfiltration: Water leakage from or around piping.
 - 3. Replace defective piping using new materials and repeat inspections until defects are within allowances specified.
 - 4. Reinspect and repeat procedure until results are satisfactory.
- C. Test new piping systems and parts of existing systems that have been altered, extended, or repaired for leaks and defects. The maximum length of a line tested shall not exceed 1,000 feet.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to the above referenced standards.
 - 3. Schedule tests, and their inspections by the Owner's Representative, with at least 24 hours' advance notice.

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4. Submit separate reports for each test.

3.9 PROTECTION OF FINISHED WORK

- A. Section 01 73 00 - Execution and 01 77 00 - Closeout Procedures: Protecting finished Work. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.
 1. Take care not to damage or displace installed pipe and joints during construction of pipe supports, backfilling, testing, and other operations.
 2. Repair or replace pipe that is damaged or displaced from construction operations.

END OF SECTION

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SECTION 32 84 00 - IRRIGATION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes piping, valves, sprinklers, lawn sprinkler specialties, accessories, controls, and wiring.
- B. Related Sections: The following Section contain requirements that relate to this Section:
 - 1. Section 31 05 13 – Soils for Earthwork: Soils for backfill in trenches
 - 2. Section 31 05 16 – Aggregates for Earthwork: Aggregate for backfill.
 - 3. Section 32 90 00 - Landscaping

1.2 DEFINITIONS

- A. Pipe sizes used in this Section are nominal pipe size (NPS) in inches. Equivalent SI (metric) sizes are indicated in millimeters (mm) in parentheses.
- B. Supply Piping: Piping from water source to connection to irrigation system pressure piping. Piping is under same pressure as water supply. Piping in this category is not included in these Sections.
- C. Circuit Piping: Downstream from control valves to sprinklers, specialties, and drain valves. Piping is under pressure during flow.
- D. Drain Piping: Downstream from circuit piping drain valves. Piping is not under pressure.
- E. Pressure Piping: Downstream from point of connection to water distribution piping to and including control valves. Piping is under water distribution system pressure. Piping in this category includes pressure regulators, and backflow preventers, when used.
- F. Control Valve: Manual or automatic (electrically operated) valve for control water flow to irrigation system zone.
- G. Drain Valve: Manual or automatic (pressure operated) drain valve for draining of irrigation system circuit piping.
- H. The following are industry abbreviations for plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. NP: Nylon plastic.
 - 3. PE: Polyethylene plastic.
 - 4. PP: Polypropylene plastic.
 - 5. PTFE: Polytetrafluoroethylene plastic.
 - 6. PVC: Polyvinyl chloride plastic.

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1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. Minimum Water Coverage: 100 percent of turf and planting areas.
- B. Location of Sprinklers and Specialties: Design location is approximate. Make minor adjustments may be made to in the location of the equipment to ensure proper coverage.
- C. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and specialties, unless otherwise indicated:
 - 1. Pressure Piping: 150 psig (1035 kPa).
 - 2. Circuit Piping: 100 psig (690 kPa).
 - 3. Drain Piping: 100 psig (690 kPa).

1.4 SUBMITTALS

- A. Product Data: Include pressure rating, rated capacity, settings, and electrical data of selected models for the following:
 - 1. Pressure regulators.
 - 2. Water hammer arresters.
 - 3. Valves. Include aboveground and underground; general-duty, manual and automatic control, and quick-coupler types.
 - 4. Valve boxes.
 - 5. Sprinklers.
 - 6. Specialties. Include emitters, drip tubes, and other devices.
 - 7. Controllers. Include wiring diagrams.
 - 8. Wiring
 - 9. Area drains.
- B. Shop Drawings: Shop drawing showing irrigation system, including plan layout and locations, types, sizes, capacities, and flow characteristics of irrigation system components. Include water meters, backflow preventers, valves, piping, sprinklers and devices, accessories, controls, and wiring. Show areas of sprinkler spray and overspray.
- C. Coordination Drawings: Show piping and major system components. Indicate interface and spatial relationship between piping, system components, adjacent utilities, and proximate structures.
- D. Test Reports: As specified in "Field Quality Control" Article in Part 3.
- E. Maintenance Data: To include in an operation and maintenance manual specified in Division 1. Include data for the following:
 - 1. Backflow preventers
 - 2. Pressure regulators.
 - 3. Automatic control valves.
 - 4. Sprinklers.
 - 5. Specialties.
 - 6. Controllers.

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1.5 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of lawn sprinkler piping components and are based on specific types and models indicated. Other manufacturers' products with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."
- B. Comply with requirements of utility supplying water and authorities having jurisdiction for preventing backflow and back siphonage.
- C. Comply with ASTM F 645, "Guide for Selection, Design, and Installation of Thermoplastic Water Pressure Piping Systems."
- D. Comply with NFPA 70, "National Electrical Code," and Local and State Codes for electrical connections between wiring and electrically operated devices.
- E. Listing/Approval Stamp, Label, or Other Marking: On equipment, specialties, and accessories made to specified standards.
 - 1. The Terms "Listed" and "Labeled": As defined in "National Electrical Code," Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves according to the following:
 - 1. Ensure that valves are dry and internally protected against rust and corrosion.
 - 2. Protect valves against damage to threaded ends and flange faces.
 - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves according to the following:
 - 1. Do not remove end protectors unless necessary for inspection; then, reinstall for storage.
 - 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- D. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- E. Protect flanges, fittings, and specialties from moisture and dirt.
- F. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.7 PROJECT CONDITIONS

- A. Verify existing utility locations and that irrigation system piping may be installed in compliance with original design and referenced standards.

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1.8 SEQUENCING AND SCHEDULING

- A. Maintain uninterrupted water service to building during normal working hours. Arrange for temporary water shutoff with Owner.
- B. Coordinate irrigation systems work with other disciplines, as required.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal.
 - 1. Backflow Preventers:
 - a. Ames co., Inc.
 - b. Buckner, Inc.
 - c. Cash by A.W. Cash Valve Mfg. Corp.
 - d. Cla-Val Co.
 - e. Conbraco Industries, Inc.
 - f. Febco
 - g. Hersey Products, Inc., Grinnell Corp.
 - h. Rain Bird Sprinkler Mfg. Corp.
 - i. Sparco, Inc.
 - j. Watts Regulator co.
 - k. Wilkins Regulator div., Zurn Industries, Inc.
 - 2. Gate Valves for Underground Installation:
 - a. American Darling Valve Div., American Case Iron Pipe Co.
 - b. Clow Valve Co., McWane, Inc.
 - c. Kennedy Valve Div., MCWane, Inc.
 - d. Stock ham Valves & Fittings, Inc.
 - e. Waterous Co.
 - 3. Valves for Aboveground and Pit Installation:
 - a. Grinnell Supply Sales Co., Grinnell Corp.
 - b. Jomar International, LTD.
 - c. Kitz Corp. of America
 - d. Lunkenheimer Co.
 - e. Milwaukee Valve Co., Inc.
 - f. Nibco, Inc.
 - g. Hammond Valve Div., Prairie Manufacturing Corp.
 - h. Red-White Valve Corp.
 - i. Stockham Valves & Fittings, Inc.
 - j. Walworth Co.

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- k. Watts Regulator Co.
- l. Wm. Powell Co.
- 4. Corporation Stops and Valves for Underground Installation:
 - a. Ford Meter Box Co., Inc.
 - b. Hays Div., Romac Industries
 - c. A.Y. McDonald Mfg. Co.
 - d. Mueller Co., Grinnell Corp.
- 5. Automatic Control Valves:
 - a. Buckner, Inc.
 - b. Ceres Products Corp.
 - c. Champion Irrigation Products.
 - d. Hasslinger Manufacturing Corp.
 - e. Hunter Industries.
 - f. Imperial Underground Sprinkler Co.
 - g. Netafim Irrigation, Inc.
 - h. Rain Bird Sprinkler Mfg. Corp.
 - i. Superior Controls Co., Inc.
 - j. Telsco Industries; Weather-Matic Sprinkler Div.
 - k. Toro Co.; Irrigation Div.
- 6. Automatic Control Valves:
 - a. Buckner, Inc.
 - b. Champion Irrigation Products.
 - c. Hardie: James Hardie Irrigation, Inc.; Landscape Div.
 - d. Hit Products Corp.
 - e. Imperial Underground Sprinkler Co.
 - f. Lawnlife by Ceres Products Corp.
 - g. Nelson: L.R. Nelson Corp.
 - h. Rain Bird Sprinkler Mfg. Corp.
 - i. Richdel by James Hardie Irrigation, Inc., landscape Div.
 - j. Superior Controls Co., Inc.
 - k. Toro Co.; Irrigation Div.
 - l. Valcon by Automatic Irrigation Equipment co
 - m. Weather-matic Sprinkler Div., Telsco Industries.
- 7. Control-Valve Boxes:
 - a. Ametek by Plymouth Products Div., AMETEK
 - b. Applied Engineering Products.
 - c. Brooks Products, Inc., Polyplastics Div.
 - d. Carson Industries, Inc.
 - e. DFW/HPI by Hefco Plastics, Inc.
 - f. National Diversified Sales, Inc.
 - g. Pepco Water Conservation Products, Inc.
 - h. Quazite Div., Morrison Molded Fiber glass Co.
- 8. Quick Couplers:
 - a. Buckner, Inc.
 - b. Champion Irrigation Products.

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- c. Lawnlife by Ceres Products Corp.
 - d. Nelson: L.R. Nelson Corp.
 - e. Rain Bird Sprinkler Mfg. Corp.
 - f. Toro Co.; Irrigation Div.
 - g. Weather-matic Sprinkler Div., Telsco Industries.
9. Sprinklers:
- a. Buckner, Inc.
 - b. Champion Irrigation Products.
 - c. Hardie: James Hardie Irrigation, Inc.; Landscape Div.
 - d. Hit Products Corp.
 - e. Hunter Industries.
 - f. Lawnlife by Ceres Products Corp.
 - g. Nelson: L.R. Nelson Corp.
 - h. Rain Bird Sprinkler Mfg. Corp.
 - i. Richdel by James Hardie Irrigation, Inc. Landscape Div.
 - j. Senninger Irrigation, Inc.
 - k. Toro Co.; Irrigation Div.
 - l. Weather-Matic Sprinkler Div., Telsco Industries.
10. Pressure Regulators:
- a. Bermad, Inc.
 - b. Cashco, Inc.
 - c. Cla-Val Co.
 - d. Conbraco Industries, Inc.
 - e. FLOMATIC Corp.
 - f. GA Industries, Inc.
 - g. Honeywell Braukmann.
 - h. IMI Cash Valve, Inc.
 - i. Watts Industries, Inc.; Water Products Div.
 - j. Zurn Industries, Inc.; Wilkins Div.
11. Emitter and Drip-Tube Specialties:
- a. Agrifim Irrigation Products, Inc.
 - b. Buckner, Inc.
 - c. Hardie: James Hardie Irrigation, Inc.; Landscape Div.
 - d. Hit Products Corp.
 - e. Olson Irrigation Systems.
 - f. Pepco Water Conservation Products, Inc.
 - g. Rain Bird Sprinkler Mfg. Corp.
 - h. Raindrip, Inc.
 - i. Salco Products, Inc.
 - j. Tornado by Plastro Irrigation, Inc.
 - k. Toro Co.; Irrigation Div.
 - l. Weather-matic Springkler Div., Telsco Industries
12. Controllers:
- a. Buckner, Inc.
 - b. Champion Irrigation Products.
 - c. Dayni controls Manufacturing Co.

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- d. Hardie: James Hardie Irrigation, Inc.; Landscape Div.
 - e. Hydro-Electronics, Inc.
 - f. Irritrol by James Hardie Irrigation, Inc., Landscaper Div.
 - g. Nelson: L.R. Nelson Corp.
 - h. Oasis by Hit Products Corp.
 - i. Rain Bird Sprinkler Mfg. Corp.
 - j. Richdel by James Hardie Irrigation, Inc., Landscape Div.
 - k. Superior Controls Co., Inc.
 - l. Toro Co.; Irrigation Div.
 - m. Valcon by Automatic Irrigation Equipment Co.
 - n. WaterSaver by EMC/Hirsch, Inc.
 - o. Weather-matic Sprinkler Div., Telsco Industries
13. Backflow Preventers
- a. Ames Co., Inc.
 - b. Buckner, Inc.
 - c. Cash by A.W. Cash Valve MFG. Corp.
 - d. Cla-Val Co.
 - e. Conbraco Industries, Inc.
 - f. Febco.
 - g. Hersey Products, Inc., Grinnell Corp.
 - h. Rain Bird Sprinkler Mfg. Corp.
 - i. Sparco, Inc.
 - j. Watts Regulator co.
 - k. Wilkins regulator Div., Zurn Industries, Inc.
14. Pressure Regulators
- a. Bermad
 - b. A.W. Cash Valve Mfg. Corp.
 - c. Cla-Val Co.
 - d. Conbraco Industries, Inc.
 - e. G.A. Industries, Inc.
 - f. Honeywell Braukmann.
 - g. O.C. Keckley Co.
 - h. Spence Engineering Co., Inc.
 - i. Watts regulator co.
 - j. Wilkins Regulator Div., Zurn Industries, Inc.

2.2 PIPES

- A. PVC Pipe: ASTM D 1785, PVC 1120 compound, Schedules 80 250 psig (1725 kPa) minimum pressure rating for 8-inch (200-mm) and smaller sizes, with plain and threaded ends.
- B. PVC Pressure-Rated Pipe: ASTM D 2241; PVC 1120 compound; SDRs 21, 200 psig (1380 kPa) minimum pressure rating, with plain ends.

2.3 PIPE FITTINGS

- A. Polyvinyl Chloride (PVC) Plastic Pipe Fittings: ASTM D 2467, Schedule 80, socket-type.

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2.4 JOINING MATERIALS

- A. Solvent Cement: ASTM F 656 primer and ASTM D 2564 solvent cement in color other than orange.

2.5 BACKFLOW PREVENTERS

- A. Description: ASSE Standard backflow preventers, of size indicated for maximum flow rate and maximum pressure loss indicated.
1. Working Pressure” 150 psig (1035 kPa) minimum except where otherwise indicated.
 2. 2-inches (DN 50) and Smaller: Bronze body with threaded ends.
 3. 2 ½ -inches (DN 65) and Larger: Bronze, cast-iron steel, or stainless steel body with flanged ends.
 - a. Interior Protective Coating: AWWA C550, epoxy coating for backflow preventers with cast-iron or steel body.
 4. Interior components: Corrosion-resistant materials.
 5. Strainer supplied with and compatible for size and capacity with unity, on inlet, where strainer is indicated.
- B. Hose connection Vacuum Breakers: ASSE 1011, nickel-plated, with nonremovable and manual drain features, and ASME B1.20.7 garden-hose threads on outlet. Units attached to rough-bronze hose connections may be rough bronze.
- C. Reduced-Pressure-Principle Backflow Preventer: ASSE 1013, with (OS&Y) gate valves on inlet and outlet and strainer on inlet. Include test cocks and pressure-differential relief valve with ASME A112.1.2 air-gap fitting located between 2 positive-seating check valves for continuous pressure application.
1. Pressure Loss: 15 psig (103 kPa) maximum, through middle third of flow range.
 2. Gate valves supplied with and comparable for size and testing of unit on inlet and outlet. Valves 2-inches (DN 50) and smaller may be ball valves if these are unit manufacturer’s standard valve for this application
 3. Test Kit: Unit manufacturer supplied, complete calibrated backflow preventer testing equipment kit with carrying case.
- D. Double-Check Backflow Prevention Assemblies: ASSE 1015, with shutoff valves on inlet and outlet and strainer on inlet. Include test cocks with 2 positive-seating check valves for continuous pressure application.
1. Pressure Loss: 12 psig (83 kPa) maximum, through middle third of flow range.
 2. Gate valves supplied with and compatible for size and testing of unit on inlet and outlet. Valves 2-inches (DN 50) and smaller may be ball valves if these are unit manufacturer’s standard valve for this application.
 3. Test Kit: Unit manufacturer supplied, complete calibrated backflow preventer testing equipment kit with carrying case.
- E. Antisiphon, Pressure-Type Vacuum Breakers: ASSE 1020, with valves, spring-loaded check valve, and spring-loaded floating disc. Included test cocks and atmospheric vent for continuous pressure application
1. Pressure Loss: 6 psig (41 kPa) maximum, through middle third of flow range.

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2. Gate valves supplied with and compatible for size and testing of unit on inlet and outlet. Valves 2-inches (DN 50) and smaller may be ball valves if these are unity manufacture's standard valve for this application.
3. Test Kit: Unit manufacturer supplied, complete calibrated backflow preventer testing equipment kit with carrying case.

2.6 PRESSURE REGULATORS

- A. Description: ASSE 1003, single-seated, direct-operated type water pressure regulators, rated for initial working pressure of 150 psig minimum, with size, flow rate, and inlet and outlet pressures indicated. Include integral factory-installed or separate field-installed y-pattern strainer that is compatible with unit for size and capacity.
1. 2-inches (DN 50) and Smaller: Bronze body with threaded ends.
 2. 2 ½-inch (DN 65) and Larger: Bronze of cast-iron body with flanged ends.
 - a. Interior Protective Coating: AWWA C550, epoxy coating, for regulators with a cast-iron body.
 - b. Interior components: Corrosion resistant materials.

2.7 VALVES

- A. Nonrising Stem Gate Valves 3-inches (DN 80) or Larger: AWWA C500, cast-iron double disc, bronze disc, and seat rings or AWWA C509, resilient seated; bronze stem, cast-iron, or ductile-iron body and bonnet, stem nut, 200-psig (1380-kPa) working pressure; and ends that fit PVC pipe. Include elastomeric gaskets.
- B. Cast-Iron, Nonrising-Stem Gate Valves, 2 ½-inches (DN 65) and Larger: MSS SP-70, Type I, solid wedge disc; nonrising stem and flanged ends. Include all bronze trim; Class 125, ASTM A 126, cast-iron body; and handwheel:
- C. Bronze, Nonrising-Stem Gate Valves, 2 ½-inches (DN 50) and Smaller: MSS SP-80, Type 1, solid wedge; nonrising, copper-silicon-alloy stem; Class 125 body and screw bonnet of ASTM B 62 cast bronze, with threaded or solder-joint ends. Include polytetrafluorethylene (PTFE)-impregnated packing, brass packing gland, and malleable-iron handwheel: MSS SP-80, Type 1, solid wedge; nonrising, copper-silicon-alloy stem; Class 125, body and screw bonnet
- D. Valve Boxes: Cast iron with top section and cover with lettering "WATER," bottom section with base to fit over valve, 5-inch- (127-mm) in diameter, and adjustable cast-iron extension of length required for depth of bury of valve.
1. Provide 1 steel tee-handle, shutoff rod with pointed end, stem of length to operate valve, and end fitting valve operating nut.
 2. Provide 1 steel tee-handle shutoff rod with each service box. Include tee-handle, shutoff rod with one pointed end, stem of length to operate curb stop, and slotted end fitting curb stop head.

2.8 CONTROL VALVES

- A. Description: Manufacturer's standard control valves for circuits, of type and size indicated and as follows:
1. Provide cast-bronze bodies, unless otherwise indicated.

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2. Automatic Control Valves: Diaphragm-type, normally closed, with manual flow adjustment, and operated by 24-volt ac solenoid.
 3. Quick-Couplers: Factory-fabricated, bronze or brass, two-piece assembly. Include coupler water-seal valve; removable upper body with spring-loaded or weighted, rubber-covered cap; hose swivel with ASME B1.20.7, 3/4-11.5NH threads for garden hose on outlet; and operating key.
 - a. Locking Top Option: Include vandal-resistant, locking feature with two matching keys.
- B. Control-Valve Boxes: PE, ABS, fiberglass, polymer concrete, or precast concrete box and cover, designed for installing flush with grade. Size as required for application.

2.9 SPRINKLERS

- A. Description: Manufacturer's standard sprinklers designed for uniform coverage over entire spray area shown on drawings, at available water pressure.
1. Components: Brass or plastic housing and stainless steel corrosion-resistant interior parts.
 2. Pop-up, Rotary, Spray Sprinklers: Gear drive, full-circle and adjustable part-circle types.

2.10 WATER HAMMER ARRESTERS

- A. ASME A112.26.1M, ASSE 1010, or PDI WH-201 water hammer arrester. Include bellows or piston-type pressurized cushioning chamber and sizes complying with ASME A112.26.1M and PDI WH-201 Sizes A to F.

2.11 PRESSURE GAGES

- A. ASME B40.1 pressure gage. Include 4-1/2-inch- (115-mm-) diameter dial, dial range of two times system operating pressure, and bottom outlet.

2.12 AUTOMATIC CONTROL SYSTEM

- A. Exterior Control Enclosures: Weatherproof enclosure with locking cover and two matching keys; Enclosure construction complies with NFPA 70 and NEMA 250, Type 4, and includes provision for grounding.
1. Material: Enameled-steel, sheet metal or molded plastic.
 2. Mounting: Surface type for wall mounting to wall or post.
- B. Interior Control Enclosures: Drip proof construction with locking cover and two matching keys. Enclosure construction complies with NFPA 70 and NEMA 250, Type 12.
1. Material: Enameled-steel, sheet metal or molded plastic.
 2. Mounting: Surface type for wall mounting.
- C. Transformer: Internal; and suitable for converting 120-V, ac building power to 24-V, ac power.
- D. Controller Stations for Automatic Control Valves: Each station is variable from approximately 5 to 60 minutes. Include switch for manual or automatic operation of each station.
- E. Timing Device: Adjustable, 24-hour, 14-day clock to operate any daytime of day. Include provision for the following settings:
1. Setting to skip operation any day in timer period.

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2. Setting for operation every other day.
3. Settings for operation 2 or more times daily.
4. Provide Nickel-Cadmium Battery and Trickle Charge to automatically power timing device during power outages.

F. Wiring: UL 493, Type UF, solid-copper-conductor, insulated cable, suitable for direct burial. All wiring shall adhere to Local, State and Federal Codes.

1. Feeder-Circuit Cables: Type UF, No. 12 AWG minimum, between building and controllers.
2. Low-Voltage, Branch-Circuit Cables: No. 14 AWG minimum, between controllers and automatic control valves. jacket color is other than feeder-circuit-cable jacket color.
3. Splicing Materials: Pressure-sensitive, thermoplastic tape; waterproof sealing packets; or other waterproof connectors.

2.12 IDENTIFICATION

- A. Refer to Division 2 Section 02200 "Excavation, Filling & Grading" for underground warning-tape materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Confirm available water supply water pressure and flow characteristics.

3.2 PREPARATION

- A. Set stakes to identify proposed lawn sprinkler locations. Obtain designers approval before excavation.

3.3 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Division 31 "Earthwork".
- B. Underground location tape installation is specified in Division 31 "Earthwork".

3.4 PAVING WORK (NOT REQUIRED)

- A. Cutting and patching of asphalt paving is specified in Division 32 "Exterior Improvements".
- B. Install piping in sleeves where crossing sidewalks, roadways and parking lots.
1. Install piping sleeves by boring or jacking under existing site features, where possible.

3.5 PIPING APPLICATIONS

- A. Refer to Part 2 of this Section for detailed specifications for pipe and fittings products listed below. Use pipe, tube, fittings, and joining methods according to the following applications. Piping in pits and aboveground may be joined with flanges instead of joints indicated.

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B. Pressure Piping Aboveground: Use the following:

1. 4-Inch NPS (DN100) and Smaller: ASTM D 1785, Schedule 80 polyvinyl chloride (PVC) plastic pipe; ASTM D 2467 Schedule 80 PVC socket fittings, and solvent-cemented joints.
2. 5-Inch NPS (DN125) and Larger: ASTM D 1785, Schedule 80 polyvinyl chloride (PVC) plastic pipe; ASTM D 2467 Schedule 80 PVC socket fittings, and solvent-cemented joints.

C. Pressure Piping Underground: Use the following:

1. 3-Inch NPS (DN80) and Smaller: ASTM D 1785, Schedule 80 polyvinyl chloride (PVC) plastic pipe; ASTM D 2467 Schedule 80 PVC socket fittings, and solvent-cemented joints.
2. 4-Inch NPS (DN100) and Larger: ASTM D 1785, Schedule 80 polyvinyl chloride (PVC) plastic pipe; ASTM D 2467 Schedule 80 PVC socket fittings, and solvent-cemented joints.

D. Circuit Piping: Use the following:

1. All Sizes: ASTM D 1785, Schedule 80 polyvinyl chloride (PVC) plastic pipe; ASTM D 2467 Schedule 80 PVC socket fittings, and solvent-cemented joints.
2. All Sizes: ASTM D 2241, ADR 17 or 21 polyvinyl chloride (PVC) plastic pipe; ASTM D 2446 Schedule 40 PVC socket fittings, and solvent-cemented joints.

E. Branches and Offsets at Sprinklers and Devices: ASTM 1785, Schedule 80, polyvinyl chloride (PVC) plastic pipe with threaded ends; ASTM D 2464, Schedule 80, PVC plastic, threaded fittings; and threaded joints.

1. Option: Plastic piping made for this application may be used instead of pipe and fittings specified.

F. Drain Piping: ASTM D 2241. SDR 21 or 26 polyvinyl chloride (PVC) plastic pipe; ASTM D 2466 Schedule 40 PVC socket fittings; and solvent-cemented joints.

G. Sleeves: ASTM D 1785, Schedule 80 polyvinyl (PVC) plastic pipe; ASTM D 2467, Schedule 80 PVC socket fittings, and solvent-cemented joints.

3.6 JOINT CONSTRUCTION

A. Polyvinyl Chloride (PVC) Piping Solvent-Cemented Joints: Construct joints according to ASTM D 2672 and ASTM D 2855.

1. Handling of solvent Cements, Primers, and Cleaners: Comply with procedures in ASTM F 402 for safe handling when joining plastic pipe and fittings with solvent cements.

B. Dissimilar Materials Piping Joints: Construct joints using adapters that are compatible with both piping materials, outside diameters, and system working pressure. Refer to “Piping Systems – Common requirements” item for joining dissimilar metal piping.

3.7 PIPING SYSTEMS – COMMON REQUIREMENTS

A. General Locations and Arrangements: Drawings indicate general location and arrangement of piping systems, which were used to size pipe and calculate friction loss, and other design considerations. Install piping as indicated, unless deviations are approved on Coordination Drawings.

B. Install piping at uniform slope of 6-inches per 100 feet (1:200) minimum, down toward drain points.

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- C. Install components having pressure rating equal to or greater than system operating pressure.
- D. Install piping free of sags and bends.
- E. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- F. Install fittings for changes in direction and branch connections.
- G. Piping Connections: Except as otherwise indicated make piping connections as specified below.
 - 1. Install unions in piping 2-inches (DN 50) and smaller, adjacent to each valve and at final connections to each piece of equipment having 2-inch (DN50) or smaller threaded pipe connection.
 - 2. Install unions in piping 2 ½ inches (DN 65) and or larger, adjacent to each valve and at final connections to each piece of equipment having 2-inch (DN50) or smaller threaded pipe connection.
 - 3. Install dielectric fittings to connect piping of dissimilar metals.

3.8 PIPING INSTALLATION

- A. Install underground polyvinyl chloride (PVC) plastic pipe according to ASTM D 2774.
- B. Lay piping on solid sub-base, uniformly sloped without humps or depressions.
 - 1. Install polyvinyl chloride (PVC) plastic piping in dry weather when temperature is above 40 deg F (4.4 deg C). Allow joints to cure at least 24 hours at temperature above 40 deg F (4.4 deg C) before testing, unless otherwise recommended by manufacturer.
- C. Minimum Cover: Provide following minimum cover over top of buried piping:
 - 1. Pressure Piping: Greater depth of minimum of 36-inches below finished grade, or not less than 18-inches below average local frost depth.
 - 2. Circuit Piping: 12-inches (300 mm)
 - 3. Drain Piping: 12-inches (300 mm)
 - 4. Sleeves: 24-inches (600 mm)
- D. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed, by tunneling, boring, or jacking.

3.9 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Buried Valves 2-inches (DN 50) and Smaller: Bronze-body, curb stop, with tee head, service box and shutoff rod.
 - 2. Pit and Aboveground Installation, Valves 2 ½-inches (DN 65) and Larger: MSS, nonrising stem, gate valves.
 - 3. Pit and Aboveground Installation, Valves 2-inches (DN 50) and Smaller: MSS nonrising stem gate valves.

3.10 VALVE INSTALLATION

- A. Valves: Install underground valves in valve boxes or pits.

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1. Install valves and polyvinyl chloride (PVC) pipe with restrained, gasketed joints or thrust blocking.
- B. Curb Stops: Install in service box with top flush with grade.
- C. Control Valves: Install in valve control valve boxes, arranged for easy adjustment and removal. Install union on downstream side.
- D. Drain Valves: Install in control-valve box.

3.11 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to plumbing code and health department authorities with jurisdiction.
- B. Install pressure-type vacuum breakers minimum of 12-inches (300 mm) above downstream piping system.
- C. Do not install bypass around backflow preventer.
- D. Do not install backflow preventers with drains or vents in pits or areas subject to flooding.
- E. Support backflow preventers, valves, and piping on 3000-psi (20.7-Mpa) minimum, portland-cement-mixed concrete piers.

3.12 PRESSURE REGULATOR INSTALLATION

- A. Install pressure regulators with shutoff valve and strainer on inlet and pressure gage on outlet. Install shutoff valve on outlet and valved bypass where indicated.

3.13 SPRINKLER INSTALLATION

- A. Sprinklers: Flush circuit piping with full head of water and install sprinklers after hydrostatic test is completed.
- B. Install lawn sprinklers at manufacturer's recommended heights.
- C. Locate part-circle sprinklers to maintain a minimum distance of 4-inches from walls and 2 inches from other boundaries, unless otherwise indicated.

3.14 AUTOMATIC CONTROL SYSTEM INSTALLATION

- A. Install controllers according to manufacturer's written instructions and as indicated.
- B. Install freestanding controllers on 4" x 4" non-arsenic treated wood post. Where dimensions are not indicated, furnish bases not less than 12-inches by 12-inches thick, and not less than 6-inches greater in each direction than overall dimensions of controller.
- C. Install control wiring in same trench with piping.

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3.15 CONNECTIONS

- A. Connect piping to valves, sprinklers, and specialties.
- B. Connect water supplies to irrigation systems. Include backflow preventers on potable water supplies.
- C. Electrical Connections: Connect to power source, controllers, and automatic control valves.
- D. Minimum requirements for electrical installations are specified in Division 16.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- E. Ground systems according to Division 16 Section "Grounding".

3.16 FIELD QUALITY CONTROL

- A. Testing: Hydrostatically test piping and valves before backfilling trenches. Piping may be tested in sections to expedite work.
 - 1. Cap and test piping with static water pressure of 50 psig (345 kPa) above system operating pressure and without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects in system that shall be repaired by contractor.
 - 2. Repair leaks and defects with new materials and retest system or portion thereof until satisfactory results are obtained.

3.17 CLEANING AND ADJUSTING

- A. Flush dirt and debris from piping before installing sprinklers and other devices.
- B. Adjust automatic control valves to provide flow rate of rated operating pressure required for each sprinkler circuit.
- C. Carefully adjust irrigation system sprinklers so they will be flush with, or not more than 1/2 inch (13 mm) above, finish grade.
- D. Adjust settings of controllers and automatic control valves.

3.18 COMMISSIONING

- A. Starting Procedures: Follow manufacturer's written procedures. If no procedures are prescribed by manufacturers, proceed as follows:
 - 1. Verify that specialty valves and their accessories are installed and operate correctly.
 - 2. Verify that specified tests of piping are complete.
 - 3. Check that sprinklers and devices are correct type.
 - 4. Check that damaged sprinklers and devices are replaced with new materials.
 - 5. Check that potable-water supply connections have backflow preventers.
 - 6. Energize circuits to electrical equipment and devices.

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7. Adjust operating controls.
- B. Operational Testing: Perform operation testing after hydrostatic testing is completed, backfill is in place, and sprinklers are adjusted to final position.

3.19 DEMONSTRATION

- A. Demonstrate to Designer that system meets coverage requirements and that automatic controls function properly.
- B. Demonstrate to Owner's maintenance personnel operation of equipment, sprinklers, specialties, and accessories. Review maintenance information.
- C. Provide seven days' advance written notice of demonstration.

END OF SECTION



FAYETTEVILLE REGIONAL AIRPORT (FAY)

Airline Terminal Improvements

Specifications for the Design, Manufacture
and Construction of the
Inbound Baggage Handling Claim Device Replacement at the
Fayetteville Regional Airport

15 July 2019

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SECTION PARTS

PART I - GENERAL SPECIFICATIONS

PART II - PRODUCT SPECIFICATIONS

PART III - EXECUTION SPECIFICATIONS

PART IV – QUALITY CONTROL SPECIFICATIONS

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SECTION 34 77 16 BAGGAGE HANDLING SYSTEM

PART I - GENERAL SPECIFICATIONS

1.01 RELATED DOCUMENTS.

A. General

1. These written Specifications, in conjunction with the accompanying Contract Drawings, constitute the Contract Documents for the Project. If there are any discrepancies between these written Specifications and the Contract Drawings, the more stringent requirement shall apply as interpreted by the Owner or their representative.
2. As indicated throughout these contract documents (drawings and specifications) the BHS scope of work consists of the replacement of the two (2) existing inbound claim devices with like equipment. Implement and demonstrate to the Owner and their representatives the installed BHS.
3. These Contract Documents are confidential and are not to be distributed or copied, in part or in whole, without the written consent of an authorized representative of the Owner.
4. These Contract Documents are confidential and are not to be distributed or copied, in part or in whole, without the written consent of an authorized representative of the Owner or BNP Associates, Inc.

B. Drawings

1. Specification Drawings (Ref. Drawing B0.001 for listing), Architectural Drawings, Communications/Network Layout Drawings, Fire Protection System Drawings, MEP (Mechanical, Electrical and Plumbing) Drawings, Structural Drawings, Overall Program Phasing Plans, Addendum, Contract Provisions, Special Provisions and Supplementary Provisions apply to the work of this Section.
2. Define the facility modifications that will be performed to accommodate the Baggage Handling System alterations. These drawings shall be used for bidding purposes and preparation of design/engineering documents.
3. It shall be the BHS Contractor's responsibility to request and obtain architectural drawings, MEP (Mechanical, Electrical and Plumbing) drawings, Structural drawings and Project Phasing Plans applicable to the BHS from the Owner or their representative.

C. Special Related Documents

1. Contact the appropriate firm or supplier to request the necessary documents that would be required for coordination, testing, interface and reference purposes.

1.02 SUMMARY

A. General

1. This Baggage Handling System Specification is divided into four (4) parts as follows:

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- a. Part I specifies general administrative and procedural requirements for a BHS installation as specified herein and in the accompanying drawings.
 - b. Part II specifies product information including approved equipment requirements.
 - c. Part III specifies execution requirements for the BHS installation, modifications, demolition that are required.
 - d. Part IV specifies quality control requirements
 2. The BHS Specification and accompanying Contract Drawings are intended to outline the work define functional requirements and establish minimum standards of quality for the Project. Meet all local, state and federal laws, codes and safety standards and assures a safe and efficient system for all personnel who operate, maintain or have access to the completed baggage handling system.
 3. The laws of the City of Fayetteville, the State of North Carolina, and the United States of America (USA) shall apply and govern the Contract.
 4. Unless otherwise specified, all references to sums of money shall be in United States Dollars (USD), the currency of the United States of America (USA).
- B. Scope of Work
1. Provide the design, engineering, fabrication, transportation to/from the site, installation, temporary BHS conditions, removal, salvage, demolition, refurbishment, modifications, testing and turning over in working order the BHS, in compliance with these written Specifications and the accompanying drawings.
 2. Provide a complete, operable, maintainable and safe system on a "turnkey basis", including all supports, header steel (unless otherwise specified), hangers, anchors, framing, trim, electrical power to the BHS systems from the sources indicated on the Control Drawings (such as but not limited to disconnect, wiring, and conduits), motors, motor starters, disconnects, controls, push buttons, conduit, wiring, cabinets, catwalks, ladders, stairs, crossovers and all other components, whether specifically shown and described, or implied in the plans and specifications or wherever required to effectively accomplish the intended functions of the BHS. In all cases where a device or part of the equipment is herein referred to in the singular number, it is intended that such reference shall apply to as many such devices as are required to satisfactorily complete the installation.
 3. Provide all labor, materials, and equipment required for implementing the BHS as defined by these specifications, including but not limited to installation, all required acceptance testing, all necessary wiring between BHS components, necessary protection of conveyor equipment that is under construction, materials, new conveyor equipment with all related components, provision of new BHS PLCs, PLC Networks, and other applicable components/devices.
 4. Coordinate the site planning, the BHS Phased-in Implementation, required BHS testing for all of the conveyor lines as they relate to this Project.

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5. Submit implementation schedules and associated phasing plan documentation with the operating and maintenance documentation to the Owner or their representative, including required manuals, equipment parts lists and shop drawings - all in strict accordance with the specifications and applicable drawings, and subject to the terms and conditions of the Contract.
6. Provide all hardware, software, and construction supervision to ensure that the BHS equipment operates on a fully integrated “Turnkey” basis.
7. The Contract Drawings are intended to generally outline the conveyor system configuration and function desired. Pertinent building dimensions are noted along with some specified conveyor dimensions and elevations. An attempt has been made to present approximate conveyor length and rights-of-way, but these shall necessarily be determined by review and inspection of building construction drawings and verified by actual field measurements by the BHS Contractor prior to preparing shop and erection drawings. An attempt has also been made to present the number, size and locations of the BHS Motor Control Panels (MCPs); verify the final number of panels with related cabinet sizes and locations based on their electrical shop drawings within 30 days of contract award.
8. Preserve all mechanical and electrical right of ways for all deferred equipment depicted on the Contract Drawings.
9. Identify all building interface requirements necessary to install the BHS over and above those shown on the contract drawings in the bid documents. Verify as-built conditions and notify the Owner or their representative of conflicts. Any additional building modifications or alterations not so identified in the contract bid shall be borne by the BHS Contractor.
10. Coordinate the BHS maintenance catwalk design with the sprinkler system design, to permit the installation of the sprinkler pipes below the proposed catwalks or areas where they are projecting below adjacent conveyors. The coordination between the sprinkler system design and the BHS equipment/catwalks shall ensure the sprinkler pipes do not interfere with the BHS operation or related maintenance access.
11. The construction of all the new equipment shall be in accordance with all codes and standards and local laws and regulations, applicable to the design and construction of this type of equipment, which are generally accepted and used as good practice throughout the industry, i.e., NFPA, Underwriters Laboratories, OSHA, SAE publications, National Electrical Code (NEC), American National Standards. Design all parts and sub- assemblies in accordance with good commercial practice and assure safe, efficient and practical design in keeping with requirements peculiar to this type of system. All equipment shall be in imperial dimensions.
12. Submit to the Owner or their representative any request for information, clarification of specification, and variance from the specifications as a Request For Information (RFI).

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13. Obtain and pay for all permits, inspection fees, and certificates relative to all phases of BHS construction.
14. Be responsible for all employee badges as required by the Airport Authority for this project. The Owner shall not provide escort services for employees on the ATO and AOA side of the facility.
15. Submit all structural attachment detail/computations and electrical drawings signed and sealed by a Professional Engineer licensed in the jurisdiction where this project is located.
16. Provide any and all temporary power and lighting that may be required for and during the course of the installation and testing of the BHS.
17. Cooperate and coordinate with the Owner and their Architect for the location of all Mechanical, Plumbing, Electrical, Right-of-Ways and access/egress between the BHS and the building.
18. Cooperate with the Architect and other contractors for coordination of the building fire zones to confirm the number and location of the BHS associated fire/security doors and number of conveyors, which require emergency power.
19. Develop detailed sequencing plans for each subsystem designated for modification after discussions and coordination with the Construction Manager to determine the availability of the respective Baggage Handling System Areas. Sequencing shall follow the phasing plans. The BHS Contractor at no additional cost shall perform these tasks.
20. After installation of the BHS, demonstrate its operating capability. Accomplish prior to the start of the Systems Acceptance Testing all “debugging” and internal testing. In addition, carry out a “dry test run” of all Acceptance Tests prior to conducting such tests with the Owner or their representative to ensure that tests conducted with the Owner or their representative are successful. Submit to the Owner on a daily basis any and all records of internal testing and debugging (with corrective action) performed prior to Acceptance Testing.
21. Coordinate and adequately protect the conveyor equipment from the Mechanical, Electrical and Plumbing (MEP) modifications, as well as other related building service modifications and alterations. Ensure that adequate protection is provided around the conveyor segments (new and existing/modified) wherever the Facility and Utility modifications are occurring. Ensure that the construction of the expansion around the conveyors and the protection that shall be provided around the conveyor segments allows for the uninterrupted and continued operation of the baggage handling systems in all cases.
22. Coordinate with all relative on-site disciplines/contractors, for all required interfaces to the BHS. Submit to the Owner or their representative on daily basis any and all records of internal testing and debugging (with corrective action) performed prior to Acceptance Testing.

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23. Upon completion of the BHS installation, all related programming and internal testing/debugging, demonstrate the system's operating capability to the Owner and his representatives for acceptance to confirm compliance with the specified requirements. Provide all labor and test material as specified elsewhere in this document, including service technicians and test material handlers for the BHS Acceptance Testing. Prepare BHS Test Plans in compliance with the specified requirements of Part 3, Section 3.15.

C. System Description

1. The Baggage Handling System (BHS) to be provided is illustrated on the accompanying Drawing Package (Ref. Drawing Number B0.001 for a complete listing of drawings).
2. Current Terminal Equipment and Operations
 - a. The existing Inbound Baggage Handling System at the Fayetteville Regional Airport consist of two (2) flat plate inbound claim devices located in the South East Terminal lobby.
 - b. The BHS contractor is responsible for the demolition of all existing Inbound Claim device equipment, doors and MCP's.

D. New System Requirements

1. Provision of the new two (2) flat plate claim devices and associated fire/security doors.
2. New control systems shall be provided, including MCPs, PLCs and panel views as required, to accommodate the specified functionality.
3. Provide additional components, equipment and systems as required and specified to fulfill the scope of work as described herein.
4. Fire/Security Doors
 - a. Provide, install and integrate all BHS fire/security doors as illustrated on the contract drawings. Also, provide and install all draft curtains at the new fire/security door locations.
5. Impact Protection
 - a. Provide and install new impact protection as illustrated in the contract drawings.

E. BHS Allowances

1. Provide a line item cost for recommended spare parts allowance.

1.03 DEFINITIONS

A. Abbreviations

1. ACS shall mean Access Control System
2. ANS shall mean American National Standards
3. ANSI shall mean American National Standards Institute

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4. ASCII shall mean American Standard Code for Information Interchange
5. AOA shall mean Airport Operations Area
6. ATO shall mean Airline Ticket Office
7. BHS shall mean Baggage Handling System
8. BNP shall mean BNP Associates, Inc., the Baggage Handling System Consultant/Engineer.
9. CEMA shall mean Conveyor Equipment Manufacturers Association
10. CM shall mean Construction Manager
11. COF shall mean Coefficient of Friction
12. Cold Back-up shall mean that redundancy is based on the removal of a failed primary component (e.g. PLC) and subsequent replacement with a fully programmed component (PLC).
13. DCH shall mean Data Communication Highway. Communication line between PLCs, peripheral devices and computer systems.
14. EIA shall mean Electronic Industry Association
15. EPROM shall mean Erasable Programmable Read Only Memory
16. FAA shall mean Federal Aviation Administration
17. FAT shall mean Factory Acceptance Test
18. FAY – Fayetteville Regional Airport
19. FLA shall mean Full Load Ampacity or Full Load Amperes
20. FPM shall mean Feet Per Minute
21. GC shall mean General Contractor - a firm or person other than the BHS Contractor who shall enter or has entered into a Contract with the Owner and who shall be identified by the Construction Manager for work at the Airport relating to this contract
22. GSE shall mean Ground Service Equipment
23. HDD shall mean Hard Disk Drive
24. HMI shall mean Human Machine Interface.
25. HVAC shall mean Heating, Ventilating and Air Conditioning
26. IATA shall mean International Airline Transportation Association
27. ID shall mean Identification
28. IEC shall mean International Electromechanical Commission
29. I/O Module shall mean Input/output Module
30. LAN shall mean Local Area Network

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- 31. LCD shall mean Liquid Crystal Display
- 32. LED shall mean Light Emitting Diode
- 33. MCP shall mean Motor Control Panel. The MCP contains the electrical control and power circuit devices for the control of the baggage system(s).
- 34. MEP shall mean Mechanical, Electrical and Plumbing System
- 35. MTBF shall mean - Mean Time Between Failures
- 36. NEC shall mean National Electrical Code
- 37. NEMA shall mean National Electrical Manufacturers' Association
- 38. NFPA shall mean National Fire Protection Association
- 39. NIC shall mean Not In Contract
- 40. NRT shall mean Near Real Time
- 41. NTP shall mean Notice-to-Proceed.
- 42. O & M shall mean Operations and Maintenance
- 43. OEM shall mean Original Equipment Manufacturer
- 44. OSHA shall mean Occupational Safety and Health Administration
- 45. The Owner shall mean Fayetteville Regional Airport
- 46. PAX shall mean Passenger
- 47. PCI shall mean Passive Control Interface
- 48. PDP shall mean Power Distribution Panel or Point. Designated location(s) to provide power for the BHS.
- 49. PE shall mean Professional Engineer
- 50. PLC shall mean Programmable Logic Controller, a microprocessor that controls BHS operations.
- 51. PM shall mean Project or Program Manager
- 52. PSI shall mean Pounds per Square Inch
- 53. RFI shall mean Request for Information
- 54. ROW shall mean Right of Way
- 55. RT shall mean Real Time
- 56. SIDA shall mean Security Identification Area
- 57. TOB shall mean Top of Belt
- 58. UL shall mean Underwriters Laboratories
- 59. UPS shall mean Uninterrupted Power Supply

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- 60. USS shall mean Uniform Symbology Specification
- 61. User Airline shall mean those airlines that use the Baggage Handling System(s) related to this contract
- 62. VFD shall mean Variable Frequency Drive
- 63. VOM shall mean Volt Ohm Meter
- 64. WAN shall mean Wide Area Network
- 65. Warm Back-up shall mean that in the event of a primary component failure (e.g. PLC) the warm back up has to be manually switched to become the primary component.

B. Authorized Representative

- 1. The Owner may designate by written notice to BHS Contractor or by provision elsewhere in this Contract one or more persons, firms or corporation to act as its Authorized Representative in connection with the administration of this Contract. Except as otherwise provided in such written notice or elsewhere herein, such Authorized Representative shall have the authority to act for the Owner with respect to the performance of this Contract by the BHS Contractor with the objective of achieving full compliance by the BHS Contractor of the terms and provisions of the Contract.
- 2. Accept and comply with instructions from such Authorized Representative as though such instructions had been given by the Owner and the BHS Contractor shall deal directly with such Authorized Representative in all matters arising under this Contract, including but not limited to matters involving Contract interpretation, disputes and arbitration procedures. However, such Authorized Representative is authorized to act in connection with this Contract solely as the representative of the Owner and not as principal hereunder.

C. General

- 1. Baggage Handling System (BHS) shall mean all components, installation materials, interfaces and other components, all necessary hardware, software, installation coordination and construction supervision of computers/PLC, controls and control hardware and software, management and support services required to implement the work and supply a fully functioning system as described by the Contract Documents.
- 2. Baggage Handling System Contractor shall be synonymous with Equipment Contractor, Equipment Supplier, Baggage Contractor, BHS Contractor, Supplier and Contractor and shall mean the firm or company that is responsible for the design, engineering, manufacture and installation of the conveyor equipment and systems required to implement the work and supply a fully functioning system as described by the Contract Documents.
- 3. In these written Specifications and on the Contract Drawings (unless inconsistent with the content or subject matter or unless a contrary intention otherwise appears) the following clarifications/definitions shall apply:

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- a. As Built shall encompass all elements of the term As Executed.
- b. Bill of Quantities shall mean a document named therein as a Bill of Quantities issued to bidders by or on behalf of the Owner, stating quantities of work to be carried out.
- c. Completion shall mean:
 - 1.) That stage of the execution of the Work under the Contract when the Works are completed and all other things, which are required by the Contract to be performed by the Contractor before completion, have been performed and accepted.
 - 2.) Where contract or specifications provide a period of time for completion, the last day of the period. 3.) However, if the Owner grants an extension of time for completion, it means the date resulting from the extension of time.
- d. Contract means this Deed of Agreement between the Owner and the Contractor for the performance of the Works, together with all schedules, attachments, annexure and other documents incorporated into this Contract.
- e. Construction Manager shall mean a firm or person, or such other manager as may be appointed by the Owner for the purpose of managing the Contract and, in so far as it concerns the functions exercisable by the Construction Manager, includes his nominated representatives.
- f. Contract Sum means:
 - 1.) Where the Owner accepted a lump sum, the lump sum.
 - 2.) Where the Owner accepted rates, the sum ascertained by adding the products of the rates and the corresponding quantities in the Schedule of Rates.
 - 3.) Where the Owner accepted a lump sum and rates, the aggregate of the sums referred to in paragraphs 1 and 2 above.
- g. Date for Completion shall mean:
 - 1.) Where contract provides a date for completion, that date.
 - 2.) Where contract or specifications provide a period of time for completion, the last day of the period. 3.) However, if the Owner grants an extension of time for completion, it means the date resulting from the extension of time.
 - 4.) The date certified by the Owner in a Certificate of Completion to be the date upon which the Works have reached completion.
- h. Day means a calendar day.
- i. Diversion Point shall mean the point at which a bag will either be routed into the

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BHS for final sortation or routed to the next level of security screening for further processing.

- j. Other Contractor or Other shall mean a firm or person other than the BHS Contractor who shall enter or has entered into a Contract with the Owner.
- k. Schedule of Rates shall mean any schedule included in the Contract, which, in respect of any section or item of work to be carried out, shows the rate or respective rates of payment for execution of that work, and which may also include provisional items, provisional sums, quantities and prices. The schedules of rates are fixed sums for the duration of the Contract with the Owner.
- l. Site means the lands and other places made available or to be made available to the Contractor by the Owner for the purpose of the Contract.
- m. Specifications means the Specification for the Works included in the Contract and any modification of such Specification thereafter.
- n. Subsystem shall mean a set of conveyor segments and its related field elements (e.g., control stations, consoles, scanners, and the like), which is a system itself, and a part of the whole system
- o. Temporary Work shall mean any work required in the execution of the Contract but not forming part of the Works.
- p. The Contract Drawings shall mean the drawings referred to in these written Specifications or The Contract; the Owner may from time to time supply modifications/revisions of such drawings and other drawings to the Contractor for the purposes of the Contract.
- q. The Works shall mean the whole of the work to be executed in accordance with the Contract, including variations provided for by the Contract.
- r. Words importing the singular include plural and words importing the plural include the singular.
- s. Words importing persons include a partnership and a body corporate.
- t. Words importing the masculine gender include the feminine and neuter genders.
- u. Work Under the Contract shall mean any work the BHS Contractor is or may be required to execute under the Contract and includes variations, remedial work and Temporary Work.

1.04 BHS EQUIPMENT IDENTIFICATION

A. General

- 1. The item numbering system and format used for physical identification of new and modified conveyors and associated equipment and in all documentation shall be consistent with the subsystem identification detailed on the contract documents. The equipment shall be numbered in consecutive order.

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B. Equipment Identification

1. The item numbering system and format used for physical identification of conveyors and associated equipment and in all documentation shall be the same as that indicated on the Contract Drawings. The equipment in each subsystem shall be numbered in consecutive order.
2. The following is a listing of the equipment abbreviations utilized in the contract drawings:
 - a. CD means Claim Device(s) – CD1 and CD2
 - b. FS means fire/security doors – FSD1, FSD2, FSD3 and FSD4

1.05 SUBMITTALS

A. General

1. All submittals shall be in accordance with the Conditions of the Contract.
2. Submit the following documentation at the time specified during the course of the work, and in accordance with the following Submittal Deadlines.
3. Prepare all documents in the English language.

B. Bid Proposal Submissions

1. The BHS Contractor is deemed to have studied the system design and requirements presented in the drawings and specification respectively and accepted the design and requirements as suitable and appropriate to safely accomplish the functions and processes described herein. Identify in bid submission any design aspect or specification requirement that is believed to be inappropriate or inadequate and shall propose alternate solutions to alleviate the perceived problem but shall, in all cases, include in the bid submittal pricing for the base system presented in the drawings. Any alternate designs developed must meet or exceed the design criteria as listed in the specifications.
2. Include in the proposal submission the following items:
 - a. Any exceptions to these specifications or contract terms in a separate section titled "Exceptions".
 - b. Type and duration of the proposed training program if different to the minimum requirements as listed in Part III of these contract documents
 - c. Allowance to purchase items from the Estimated Spare parts list as detailed in the contract documents
 - d. Identification of any special environmental requirements more stringent than what is shown in the Specifications (if any).
 - e. Notification of any perceived safety hazard with specified design of system or its components.
 - f. Notification if an adjustment is required to the Contractor's Submittal Deadlines.

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- g. Proposed equipment of non-standard design and equipment substitutions.
- h. Define the technical support to be provided during testing, conditional acceptance phase and after Final Acceptance has been granted.
- i. Requirements for lay down areas include line item cost if off site storage facility has to be rented.
- j. Project schedule outline for the phased-in implementation of the BHS (indicate number of weeks for completion of work after NTP)
- k. Related project list references (indicate client, location of project, type of work, year performed/completed and overall cost).
- l. Provide listing of staff with resumes and qualifications that shall be working on the project. Indicate project manager's name, names and number of programmers, technicians, instructors/ training personnel, and all other required information. Include on-site and off-site participating staff and the percent of anticipated participation on this project. In addition, provide training instructors professional qualifications. The Owner reserves the right to approve or reject key personnel from the list.
- m. Provide a line item for the cost of additional on-site training hourly rate.
- n. Provide a line item cost for all BHS related acceptance testing. This should clearly identify the types and quantities of required testing material as well as manpower.
- o. Provide a line item cost for any additional on-site support should it be required after final acceptance.

C. Drawings Submitted for Review

- 1. Submit for review an electronic copy of each shop and installation drawing (e.g. PDF format submitted on CDROM, DVDROM or the established project ftp site).
- 2. The Owner or their representative shall review the drawings and return them for revision and re-submittal within 21 days, where re-submittals are required. Revise and re-submit drawings for final review by the Owner or their representative within 14 days. Any corrections or changes indicated on Shop Drawings shall not be considered as an extra work order. Do not start fabrication until receipt of the Owner or their representative's approval.
- 3. The comments from the Owner or their representative shall not be taken to imply that the arrangement has been checked in detail. The BHS Contractor shall be fully responsible for the suitability, adequacy, integrity, durability and practicality of the arrangement or assembly, components and systems as set out in the drawings, specifications and other information submitted for acceptance by the Owner or their representative including all subsequent amendments. In no case shall the Owner's or his representative's review or comments relieve the Contractor in any way of his responsibility of ensuring that the equipment supplied complies with all specification

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and functions in accord with the wording and the intent of the applicable Specifications.

4. Do not submit drawings, which are not in full compliance with the specifications unless an Engineering Change Order Request (ECR) requesting a variable from the specifications accompanies the submittal. In this case the Owner or their representative will endeavor to respond within 21 days but shall be under no obligation to do so.
5. Approved shop drawings shall be at the site at all times for use in the construction of the work. Failure to supply such drawings will be deemed sufficient cause to delay the work until such drawings are available for field use and reference.
6. Submit a drawing log that contains a complete list of all anticipated installation and shop drawings and submit an updated copy with each drawing submission.

D. Submittal Deadlines

1. Listed below are the submittals and suggested submittal dates. Any adjustments to the submittal dates to facilitate the Project Construction schedule shall be made by the BHS Contractor when developing their installation schedule.

Submittal Item	Ref. Paragraph	Deadline
Safety Program Manual	Para. 4.01E	10 days after NTP
Project Management Team	Para. 4.01F	10 days after NTP
Quality Control Manual	Para. 4.01A	20 days after NTP
Configuration Management Plan	Para. 4.01D	30 days after NTP
Detailed Master Schedule	Para. 1.05D	30 days after NTP
Phasing Schedule	Para. 1.05F	30 days after NTP
Environmental Requirements	Para. 1.05L	30 days after NTP
Catalog Cuts and Equipment Specifications	Para. 1.05H	20 days after NTP
System Power Requirements and MCP Sizes	Para. 1.05U	30 days after NTP
BHS Equipment - Combined Heat Output Figures	Para. 1.05G.2.c	90 days after NTP
Emergency Stop Zone Drawings	Para. 1.05H.4.c.6.)	60 days after NTP
Controls System Description	Para. 1.05G.5	90 days after NTP
Shop Detail Drawings	Para. 1.05G.2.c	60 days prior to fabrication
Motor Schedule	Para. 1.05G.4.b.6.)	60 days prior to fabrication
Installation Drawings	Para. 1.05G	60 days prior to fabrication
Training Program	Para. 1.05K	90 days prior to testing
Estimated Parts List	Para. 1.05T	90 days prior to testing
Functional Specification	Para. 1.05N	60 days prior to testing
Inspection and Test Program	Para. 1.05N	60 days prior to testing
Final Parts List	Para. 1.05R	30 days prior to testing

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Work Activities Bulletin	Para. 4.01K	14 days prior to each activity
Test Reports	Para. 1.05O	15 days after completion of testing
Certificate of Testing Compliance	Para. 1.05Q	
System Reliability Calculations	Para. 1.05U	30 days after completion of testing
Certificate of Installation Compliance	Para. 1.05P	15 days after completion of installation
As-Built Drawings	Para. 1.05G.2.d	30 days after acceptance of equipment

List of Lubricants	Para. 1.05M	60 days prior to start-up
O & M Manual – Draft for Owner Review	Para. 1.05I	60 days prior to start-up
Periodic Maintenance Inspection and Lubrication Chart	Para. 1.05J	60 days prior to start-up
O & M Manual – Final	Para. 1.05I	15 days prior to start-up
Semi-Monthly Report	Para. 1.05X	Last day of each month/week
Submittal Log	Para. 1.05W	With each submittal or as required by the project.

E. Detailed Master Schedule

1. Submit a detailed Master Schedule as specified below for review and approval by the Owner or their representative before commencing with any work. Display schedule in graphic form, large and spacious enough to be updated directly on the original submittal during the course of the project. Show the principal dates and commensurate activity times for each entry. Include in the schedule:
 - a. Beginning and ending of mechanical, electrical and controls/computer engineering for each subsystem or construction phase.
 - b. Drawing submittal and approval.
 - c. Long lead item order placement and expected delivery date.
 - d. Beginning and ending of fabrication per subsystem or construction phase.
 - e. On-dock plant to on-site transportation.
 - f. Beginning and ending of demolition, removal or alterations work per each subsystem or construction phase.
 - g. Beginning and ending of mechanical, electrical and controls/computer installation per subsystem or construction phase.
 - h. Factory Acceptance Test dates
 - i. Milestone dates for completion of pertinent facility interfaces (e.g., permanent system power).

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- j. Contractor's internal specification conformance acceptance test dates
 - k. Equipment item test.
 - l. Training and test plan submittals.
 - m. Submittal of operation and maintenance manuals.
 - n. Operation and maintenance training periods.
 - o. Submittal of manufacturer's recommended spare parts list.
 - p. Acceptance inspections, testing/commissioning by subsystem.
 - q. System acceptance testing by subsystem or sequence.
 - r. Operational dates by subsystem or construction phase or sequence.
 - s. Punch list rectification.
 - t. Final acceptance testing.
 - u. Submittal of As-Built documentation.
2. Maintain and update the Master Schedule monthly showing the actual progress made and any revisions in the schedules or at any time that changes in the design, construction, procurement and installation cause any major change in the overall schedule. Required reporting frequency intervals may be shorter during critical periods at the discretion of the Owner or their representative. Such additional reporting frequency shall not be grounds for additional cost claims.
3. If the monthly schedule update reflects, or the Owner or their representative determines, that the BHS Contractor is at least ten percent (10%) or fourteen (14) or more calendar days behind the original progress schedule (whichever is less) for the BHS project as a whole, a major Contract item, an item of BHS which is on the critical path, or an item of BHS not on the original critical path but that, because of the delay or anticipated delay, becomes a critical path item, then the BHS Contractor must submit its proposed recovery plan for bringing the BHS project back on schedule and for completing the BHS within the Date of Completion with the monthly/weekly schedule update.
4. Allow for the coordination and interfacing of his work in line with the construction work of the new Baggage Screening Building, and other such contractors. Such coordination and interfacing shall include for permitting the direct contractors to complete their work before proceeding to complete the balance of project under this BHS Contract. In the event of failure to allow for such coordination and interfacing, no claim whatsoever shall be entertained by the Owner or their representative for any additions, amendment, remedial or abortive works to be carried out by the BHS Contractor or the contractors to ensure satisfactory completion of the project. Obtain the overall construction program and project schedule of the Baggage Screening Building and other such direct contractors and include them into his Master Schedule.
5. The BHS Contractor may also request revisions to the Project Schedule in the event the

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BHS Contractor's planning for the work is revised. If there are desired changes in the Project Schedule to reflect revisions in the method of operating and scheduling of the work, notify the Owner or their representative in writing, stating the reason for the proposed revision.

6. Ensure there are sufficient personnel available for the purpose of coordination to ensure timely completion of the BHS and to ensure that the BHS Contractor does not hinder the work of other trades. Provide personnel with the required experience for coordination at meetings as required by the Owner or their representative so that decisions regarding coordination issues can be made during coordination meetings and the BHS Contractor

F. Construction (Phasing) Schedule

1. Construction phasing shall be in accordance with the General Construction Manager's schedule. Coordinate with the General Construction Contractor, the Owner or their representative to develop a BHS installation phasing plan
2. Submit a detailed phasing plan for each subsystem designated for modification (if existing), installation, description of the work, staffing requirements and schedule per phase. The overall plan/schedule shall be broken down by subsystem of activity (as coordinated with the project team). Clearly identify any differences between the proposed schedule and the Part III BHS Construction Phasing Sequence.

G. Shop Drawings, Installation Drawings, and As-Built Documents

1. General

- a. All drawings submitted shall become the property of the Owner.
- b. All drawing submittals shall be to scale. The scale utilized shall be clearly defined in the title block.
- c. The North arrow shall also be shown on all mechanical drawings.
- d. Drawings shall include the following items unless otherwise specified. 1.) Document Title Blocks

- a.) In addition to information normally presented in a drawing title block, each drawing title block shall provide the following specific information:

- (1.) Three letter airline code for airport designation of the project location
- (2.) Name of the Baggage Handling System
- (3.) Drawing scale
- (4.) Drawing title
- (5.) Drawing number/sheet number
- (6.) Drawing date

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(7.) Drawing revision date and revision number

(8.) NOTE: All drawing revisions shall be foot noted on the drawing face as well as in the appropriate revisions section of the title block.

e. Professional Engineer Approval Requirements

- 1.) Engage Professional Engineer(s) licensed in the State of North Carolina in the relevant disciplines, at its own cost, to design, review, verify and certify the BHS structural systems including all necessary temporary works and supports.
- 2.) Minimum requirements for Professional Engineer signed and sealed drawings and calculations to be submitted are defined below. Submit any additional signed and sealed drawings, calculations or submissions required by federal, state or local codes. As a minimum, the following drawings, calculations and submissions shall be signed and sealed:

a.) Mechanical/Structural

- (1.) All structural and seismic attachment details and design computations for the BHS and associated catwalks
- (2.) All structural support details and design computations for the BHS and associated catwalks
- (3.) Drawings and design computations of all structural attachment points to the parent building including imposed load on the building
- (4.) Drawings defining all structural supports and attachment types and locations. Generic details will not be acceptable for this purpose.
- (5.) Drawings defining all maintenance catwalks and methods of catwalks access including details of handrails, access stairs and ladders, and catwalks construction details.

b.) Detailed drawings with dimensions of all safety guards such as, but not limited, to the following:

- (1.) Conveyor underpans
- (2.) Rotating shaft guards (3.) Conveyor shrouds
- (4.) Drive v-belt / chain guards
- (5.) Metal bearing covers
- (6.) Finger guards
- (7.) Gap pans
- (8.) Drive pans
- (9.) Breakaway end cap safety guards c.) Electrical

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(10.) All new BHS PDP and motor control panel connected load calculations

c.) Provide the above mechanical/electrical PE signed and sealed drawings/calculations as listed above in part a.) and b.) in two separate submittals:

(1.) “For Construction” drawings/calculations

(2.) Final “As-Built” drawings/calculations

2. Drawing Submittal Package Requirements

a. Submit to the Owner or their representative final installation drawings defining BHS erection procedures, mechanical and electrical component layouts and the relationship of the equipment components to each other and to the facility prior to the commencement of fabrication. Employ an approved independent agency for the required inspection of all BHS related support attachments to the building structure and the review and approval of the Contractor’s PE signed and sealed structural attachment documents and point loading diagrams as they relate to the actual installation; these special inspections of BHS related structural members shall be performed in compliance with the International Building Code (IBC) 2009, Chapter 17 – Structural Tests and Special Inspections. These services shall be performed at no additional cost to the Project.

b. Submit a motor schedule listing: motor horsepower, voltage, source of feed, circuit breaker size, disconnect size, conduit and wire size and overload heater size selected to be used, prior to the installation of overload heaters on the controllers.

c. Submit to the Owner or their representative for review the BHS equipment combined heat output figures with calculations for the following areas of the facility. The information typically includes friction losses from conveyor equipment and heat outputs from the drive motors, motor control panels and computer equipment:

1.) Conveyor equipment enclosures.

d. Submit As-Built drawings as per the specified submittal schedule (plans and associated sections/elevations) indicating the location of the BHS, including all mechanical components, electrical devices, operator's control panels, MCP, switches, and other control devices. Ensure that the submitted “As-Built” documents and related information that is issued are accurate and include all BHS related Communication/Network Layout drawings. All final “As-built” drawings shall be signed and sealed by a Professional Engineer licensed in the State of North Carolina, at no additional cost to the Owner.

e. Submit final assembly drawings, shop detail drawings and any other pertinent drawing files in format as required by the Project.

f. As-Built drawings shall be submitted on CD ROM in addition to other forms of media

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described herein.

3. BHS Mechanical Drawing Submittal Requirements

a. General

- 1.) If standard parts are purchased, reproduced details and identifying part numbers shall be provided.
- 2.) Each BHS device or conveyor that appears on plan, elevation and section drawings of the BHS
shall be identified with the appropriate I.D., as established in this Specification.
- 3.) Number conveyor equipment and control devices starting at the beginning of each conveyor system or subsystem. If there are any discrepancies between the contract document-specified equipment
I.D. numbers and the actual identification of existing (to be retained) equipment, such discrepancies are to be brought to the attention of the Owner or their representative for immediate resolution.
- 4.) All plan views of the BHS system shall be based on an overlay of the building structure as is appropriate.
- 5.) All plan, elevation and section drawings of the BHS shall also show the vertical and horizontal clearances between the related system equipment and the building structure with its related interferences.

b. Provide the following types of mechanical drawings:

- 1.) General arrangements with dimensions of all new, modified, and relocated equipment (plan, elevation, details and sections, as appropriate) for all mechanical, maintenance catwalks, crossovers, ladders (coordinate with the Architect and the Owner or their representative for the final number and location of all maintenance access equipment), impact protection, electrical motor control panels, electrical equipment support, electrical control workstations and displays, servers.
- 2.) Drawings with the appropriate level of detail, as noted in the contract documents, shall be provided for any equipment designed and manufactured for this project.
- 3.) Detailed drawings are required for all BHS equipment framing, supports, hangers, and other required supports.
- 4.) Detailed drawing indicating locations and type of safety signage.

4. BHS Electrical Drawing Submittal Requirements

a. General

- 1.) Each BHS device or conveyor and related control and power devices that appear

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on any electrical drawings of the BHS shall be identified with the appropriate I.D., as established in this Specification.

b. Submit the following types of electrical drawings:

- 1.) Plan view of the BHS noting the identity and location of each control device, control station, motor, limit switches, safety disconnect switches, and the like as related to each BHS device of the system.
- 2.) Layout of MCP or any related control devices or indicating lamps.
- 3.) Submit all power requirements for the subsystems of this project as per the specified submittal schedule. Any discrepancies between the specified maximum allowable electrical loads and Contractor design loads shall be clearly identified in the review submission. The Owner shall retain the right to reject any and all requests for additional power beyond those as indicated in the Contract Documents. System power requirements shall be calculated in accordance with the recommended practice and shall include connected and demand power.
- 4.) Detailed drawing indicating locations and type of safety signage.
- 5.) Programmable Logic Controller (PLC) computer control system in block diagram format to include the data communication system showing the connections among all PLC, sortation computers and remote I/O units if utilized.
- 6.) Motor Manifest indicating type, part number of driven equipment, power in horsepower, full load amperes and speed.
- 7.) MCP general layout showing enclosure size, type, power requirements, equipment location and enclosed component general arrangement. Include a separate I/O list for each PLC or remote I/O in the panel. Identify I/O assignments with Equipment Item Numbers.
- 8.) Detailed block diagram representing internal layout of components within each motor control panel, both internal as well as external layout of components related to workstations, and the like.

c. Submit the following types of control system drawings:

- 1.) Plan view of the BHS noting the identity and location of each control device, control station, motor, limit switches, safety disconnect switches, and the like as related to each BHS device of the system.
- 2.) Plan view of the BHS noting the identity and location of each motor with power in horsepower. Identify all motors that will have a VFD, clutch/brake or brake. Annotate which motors are controlled by Variable Frequency Drives; indicate the location of the VFD (either at the motor or located in the relevant MCP).

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- 3.) Plan view of the BHS noting the identity of each conveyor with expected speed in feet per minute.
 - 4.) Plan view of the BHS noting the identity of every photocell location annotated whether a tracking or non-tracking device
 - 5.) Plan view of the BHS noting the identity of every tracking belt tachometer or shaft mounted encoder.
 - 6.) A set of drawings showing those conveyors that will stop by the activation of each specific Emergency Stop in the system as per the specified submittal schedule. The drawings should indicate (using different colors or hatches) the conveyors of the specific subsystem and any adjacent subsystems that will stop for each emergency stop or group of emergency stops as appropriate. The BHS Contractor should take into consideration the following when developing the e-stop zones:
 - a.) When splitting up e-stop zones, consideration must be given to the MCP breaks. If the downstream MCP is shut down, upstream bags that are left in the system should be able to divert prior to the equipment that is inoperable.
 - b.) 45-degree merge e-stops should be tied into the receiving or take-away conveyor.
 - d. Submit detailed shop drawings which include all interfaces between systems that are affected by the scope of work and shall include but is not limited to connection details (connector type, communication protocol) software protocol, transmission media, location of connections and any other required information. The types of interfaces include; Message Broker, fire system, EDS systems, provide an approved 11" x 17" reduced copy of the schematic wiring diagram(s) of each MCP including outline and wiring diagram of all special devices which shall be placed in the door pocket of the MCP.
5. Control System Description Submittal
- a. Submit Control System Description as specified in Part II of this specification.
- H. Catalog Cuts and Equipment Specifications
1. Submit a catalog cuts manual for all manufactured and purchased items (mechanical, electrical and computer equipment) as per the specified submittal schedule.
 2. The catalog cuts shall be contained in binders of the "presentation" type equipped with "D" rings. Additionally, the binders shall be equipped with a clear spine pocket to permit the insertion of the manual title. The catalog cut manual shall be contained within at least one volume of appropriate size and contain the following:
 - a. Record of Revisions: A "Record of Revisions" sheet shall be provided at the beginning of the catalog cut manual.

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- b. Table of Contents: A Table of Contents shall be provided at the beginning of the catalog cut manual.
- c. Index Tabs: Each catalog cut shall be identified with an index tab with permanently printed information.
- 3. The catalog cuts must be completely legible and reproducible, directly relevant to the specific items as used in the system. Each individual item shall be clearly indicated by the inclusion of a highlighted/shaded arrow immediately adjacent to the item. Where a variation occurs from the standard component or a special custom ordered part has been used as a replacement for the standard supply, additional details shall be submitted to clarify the identity of the component.
- 4. The catalog cuts shall include the following items (this list is not to be construed as being complete since it is provided only as a guide):
 - a. Speed reducers
 - b. Motors
 - c. Bearings
 - d. Pulleys and rollers
 - e. Motorized pulleys
 - f. Roller chain and sprockets
 - g. Belts and sheaves
 - h. Tamper-proof fasteners for safety guards
 - i. Wiring devices (including quick disconnect devices for removable conveyors)
 - j. Control devices
 - k. Soft starts, electronic
 - l. Electric brakes
 - m. Electric clutches
 - n. VFDs
 - o. PLC and peripherals
 - p. Power regulators
 - q. Video monitors
 - r. Flat Plate devices
- I. Operation and Maintenance Manuals
 - 1. Purpose
 - a. The prime purpose of the Operation and Maintenance (O & M) Manual is to provide

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the Owner's operational and maintenance personnel with a thorough understanding of the layout of the system, its function, special features, operational requirements, maintenance requirements, parts information, warranty information, and safety considerations and requirements for operating and maintaining the system safely and effectively.

- b. This specification is intended as a guide to indicate the basic requirements of the O&M Manuals. The Contractors standard O&M Manual shall be acceptable provided it is functionally equivalent to that specified below and the documents are suitable and usable for the intended purpose.
- c. The manual is to be divided into two main sections:
 - 1.) The Operational portion of the manual shall present the information required for personnel to be able to operate the system in a safe and efficient manner. The operational information shall be presented in easy to understand terms to ensure that personnel not familiar with the system will have a thorough understanding of the system upon reading the operational information.
 - 2.) The Maintenance portion of the manual shall present the information required for personnel to be able to maintain the system in a safe and efficient manner. The maintenance information shall be presented in easy to understand terms to ensure that personnel not familiar with the system shall have a thorough understanding of the mechanical and electrical equipment operation and maintenance requirements so that they shall be able to effectively and safely perform maintenance functions such as troubleshooting, servicing, and repairing.

2. Binder Type

- a. Binders shall be of the "presentation" type equipped with "D" rings. Additionally, the binders shall be equipped with a clear spine pocket to permit the insertion of the manual title.
- b. Binders shall be of sufficient size (number of pages) to be used by a reader with no difficulty of access. Also the documents as bound within the binder shall not be damaged by lack of free space for movement both during storage and use.
- c. Standard "letter" size format (8.5" x 11") shall be the basic size parameter for the binder selection.

3. Format

- a. The O & M Manual shall be contained within at least two (2) volumes of appropriate size. Note that additional volumes may be required to accommodate multiple operational or maintenance information chapters.
- b. The title information shall be generally as follows:
 - 1.) First Line Three letter code of the airport in which the system is located (e.g. FAY)

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- 2.) Second Line "Operations Manual" or Maintenance Manual
 - 3.) Third Line "For"
 - 4.) Fourth Line Type of system (such as Fayetteville Regional Airport Baggage Handling System)
 - 5.) Fifth Line Date of System, as based on actual beneficial use date
 - 6.) Sixth Line Project Number (to be Coordinated with the Owner or their representative)
4. Contents of Manual
- a. Record of Revisions: A "Record of Revisions" sheet shall be provided at the beginning of the O & M Manual.
 - b. Table of Contents: A Table of Contents shall be provided at the beginning of the O & M Manual.
 - c. Chapter Index Tabs: Each chapter shall be identified with an index tab with permanently printed information.
 - d. Chapter Index: Each chapter of the O & M Manual shall begin with an index for the related chapter.
5. Operational Information
- a. Chapter 1 - Glossary of Operational Terms
 - 1.) Chapter 1 shall include a glossary of operational related terms and equipment identification/designations.
 - b. Chapter 2 - System Overview
 - 1.) Chapter 2 shall include, at a minimum, the following items:
 - a.) A basic overview of the system showing overall layout and arrangement.
 - b.) Identify locations, number of and types of inputs.
 - c.) Identify locations, number of and type of sort areas (as appropriate).
 - d.) Identify system and subsystem conveyor designations.
 - e.) Processing rate of each subsystem as well as the total system-processing rate.
 - c. Chapter 3 - Baggage Weight and Size Limitations

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- 1.) Chapter 3 shall include, at a minimum, the following items:
 - a.) Normal Size Baggage
 - b.) Baggage that can be processed by system but requires special considerations/handling such as but not limited to skis, and golf bags.
 - c.) Fragile Baggage
 - d.) Oddsize Baggage
- d. Chapter 4 - Detailed Description of System Operation
 - 1.) Chapter 4 shall include, at a minimum, the following items written in a clear concise manner:
 - a.) The detailed operational description of system operation must be written to provide operational personnel a thorough understanding of how to operate the system. Operational personnel include:
 - (1.) Sky Caps
 - (2.) Passenger Service Ticket Agents
 - (3.) Service Baggage Handlers
 - (4.) TSA Agents
 - b.) The operational information shall cover system start-up, shut down, operational stop/start control stations, Jam Reset and Emergency stop operational requirements.
 - c.) The operational information shall also provide a thorough understanding of the system fault annunciation system so that faults can be recognized and appropriate action can be directed.
 - d.) The operational information shall provide an operator's troubleshooting guide for the safe and effective correction of operational problems.
 - e.) The BHS shall be equipped with sortation controllers, computers and workstations; Provide detailed information for the items noted below, affected by the specified requirements of this project (this list is not to be construed as being complete and is provided only as a guide):
 - (1.) All operator interface command entries

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- (2.) All operator-initiated reports
- (3.) All system automatically generated reports
- (4.) All system fault alarm messages and reports
- (5.) All graphic display information systems
- (6.) Placing equipment "in" or "out" of service
- (7.) Bag Status Displays
- f.) The detailing of the above information shall include (but not be limited to):
 - (1.) Thorough explanation and purpose of the command message or report.
 - (2.) Required keyboard or operator response.
 - (3.) Explanation of expected system response
- g.) The operator's information must also include procedures and recommendations for alternative modes of system operation as may be required due to various equipment or subsystem failures.

e. Chapter 5 - Operational Safety

- 1.) Chapter 5 must provide safety information related to the proper and safe operation of the specified system and its equipment from an operator's point of view and at a minimum must cover the following items (this list is not to be construed as being complete since it is provided only as a guide):
 - a.) Pre-operating procedure
 - b.) Start-up and Shut-down Procedure
 - c.) Emergency Stop and Restart Procedure
 - d.) Jam Detection, Jam Clearance and Restart Procedure
 - e.) Equipment Lockout/Tag-out Procedures (the procedure shall reflect/refer to the most current OSHA, ANSI and Local Code, Policies and Standards)

6. Maintenance Information

- 1.) Chapter 1 - Glossary of Terms and Identification
 - a.) Chapter 1 must include a glossary of all terms and equipment identification/designations associated with the specified system. Any industry vernacular, vocabulary, descriptions or definitions necessary for further communication of information shall also be provided.
- 2.) Chapter 2 - Description of System Equipment

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- a.) Chapter 2 must include, at a minimum, the following items:
 - (1.) Detailed description of the mechanical conveyor equipment used in the system including widths of conveyors, general specifications and capabilities of the system.
 - (2.) Detailed description of the electrical equipment used in the system, including the location of motor control panels (MCP(s)), PLC(s), fire/security door(s), sortation controller(s), encoding console(s), workstation(s), and bag status displays.
- 3.) Chapter 3 - Electrical Control Sequence of Operation
 - a.) Chapter 3 shall include a detailed description of the electrical control sequence of operation and the proposed locations of related field equipment/components, such as the items listed below. (this list is not to be construed as being complete since it is provided only as a guide):
 - (1.) Location and operation of Control Stations
 - (2.) Location and operation of Photocells
 - (3.) Location and operation of Limit Switches
 - (4.) Operation of MCP(s)
 - (5.) Operation of PLC(s)
 - (6.) Operation of Fire/Security Door(s)
 - a.) Operation of Sort Controllers
 - b.) Operation of Bag Status Displays
- 4.) Chapter 4 - Maintenance Safety Procedures
 - a.) Chapter 4 must provide safety information related to the proper and safe operation and maintenance of the specified system and its equipment from a maintenance point of view and at a minimum, the following items shall be covered (this list is not to be construed as being complete since it is provided only as a guide):
 - (1.) Pre-operating Procedure
 - (2.) Start-up and Shut-down Procedure
 - (3.) Emergency Stop and

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Restart

(4.) Jam Detection, Jam clearance and Restart Procedure

(5.) Equipment Lockout/Tag Out Procedure (the procedure must reflect/refer to the most current OHSA, ANSI, and local codes, policies and standards)

5.) Chapter 5 - Service, Inspection and Preventive Maintenance

a.) Chapter 5 must provide detailed information for the proper servicing of all of the system equipment and at a minimum must cover (this list is not to be construed as being complete since it is provided only as a guide):

(1.) A general explanation, regarding what the servicing requirements is for the related system equipment.

(2.) Detailed preventive maintenance program outlining required functions and frequencies for the proper preventive maintenance of the components that make up the system equipment items such as belt conveyors, power turns, flat plate devices, slope plate devices, HSPDs, pushers, servers/computers, bag status displays, DIDs, security doors, motor control panels. At a minimum, the following items shall be covered however; this list is not to be construed as being complete since it is provided only as a guide. It shall be noted that the information shall be "brand specific" for the actual equipment provided for this system only. Information for equipment types and brands not provided in this system will not be acceptable.

(3.) Inspections for:

(a.) Straight Conveyors, Power Turns, Merge Conveyors, Pushers/High Speed Paddle Diverters, and Slope Pallet Devices.

(4.) Lubrication of:

(a.) Motor Bearings, Pulley Bearings (as required), Drive Chains, Speed Reducers, and Power Turn Perimeter Chains/Guides, and all other items requiring lubrication.

(5.) Cleaning of:

(a.) Motors, Drive Chains, Speed Reducers, Photocells (and related reflectors), Motor Control Panels.

(6.) Adjustment of:

(a.) Flat Plate Devices

6.) Chapter 6 - Warranty Information and Procedures

a.) Chapter 6 shall provide detailed information regarding the specific

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Warranty Conditions that prevail on the specified system.

b.) Additionally, the detailed information regarding the system warranty must include the following:

(1.) Date of Beginning and Expiration of Warranty Period.

(2.) Specific instructions regarding the procedures for the documentation and return of items under warranty.

(3.) Provide detailed information regarding the specific warranty conditions that apply to the specified system, assemblies, components and parts

(4.) Names and telephone numbers of the "point of contact" for warranty questions and discussions. Note that the "point of contact" information shall be provided for both "normal" 0800 to 1700 Monday through Friday hours as well as "after hours". Direct communication shall be made available 24 hours/day, 7 days/week, 52 weeks/year.

7.) Chapter 7 - Troubleshooting

a.) Chapter 7 shall provide detailed information for the proper remedial and corrective action required (troubleshooting) for repair of the system equipment malfunctions.

b.) At a minimum, the following items must be included in a detailed "problem and correction" type of troubleshooting chart (this list is not to be construed as being complete since it is provided only as a guide):

(1.) All mechanical equipment

(2.) All electrical equipment

(3.) All control equipment

(4.) BHS/Airport Systems Interfaces

c.) The troubleshooting information provided in the chart is to cover an exhaustive list of possible causes of system failure or malfunction.

d.) A procedural approach should be used in the documentation to allow service personnel to resolve problems. This method shall emulate the actual problem as well as provide the related solution. Information should be provided to assist in discernment of cause and effect issue as well as find solutions through cross referencing.

e.) The information is to be arranged in a three (3) - column format with respective headings of: (1.) Trouble

(2.) Probable Cause

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(3.) Corrective Action.

- f.) Empirical Readings: This chapter shall include the Empirical Readings, as noted in "Testing and Acceptance" section of this Specification that were recorded at the time of the Conditional Acceptance Testing and Inspection of the system. This information is to be provided as a maintenance reference.

8.) Chapter 8 - Removal and Installation Procedures

- a.) Chapter 8 shall provide detailed information for the proper removal and installation of all of the system equipment components.
- b.) It must be noted that the information shall be "brand specific" for the actual equipment/components provided for this system only. Information for equipment/components types and brands not provided in this system will not be acceptable.
- c.) At a minimum, the following items shall be included in this chapter (this list is not to be construed as being complete since it is provided only as a guide):
 - (1.) Basic Considerations
 - (2.) Safety Precautions
 - (3.) Procedural Orientation
 - (4.) List of special tools, gauges and equipment required for the maintenance of the system, together with illustrations and instructions as to how they are to be used. Sources for procurement of these items shall also be provided.
 - (5.) Torque Values
 - (6.) V-Belt Tension Procedures and Values
 - (7.) Drive Chain Tension Procedures and Values
- d.) Component List (this list is not to be construed as being complete since it is provided only as a guide):
 - (1.) All the components for straight conveyors.
 - (2.) All the components for flat plate claim devices
 - (3.) All the components for MCPs

9.) Chapter 9 - Illustrated Parts Information

- a.) Chapter 9 must contain detailed illustrated parts information. The illustrated

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parts information shall be provided for all systems, assemblies, subassemblies, components and parts, including but not limited to all mechanical, electrical, workstation, computer, bag status displays, and other necessary equipment.

b.) Clear, concise exploded view isometric drawings showing the parts, the relationship of adjacent parts with one another within a given conveyor equipment assembly as well as the diagram number that shall reference the specific part on the adjacent parts information sheet.

c.) The parts information sheet shall be adjacent to the isometric drawing and shall contain:

(1.) Part reference number from isometric drawing

(2.) Part description

(3.) Part Number

(4.) Manufacturer of part

(5.) Number of parts found in the conveyor equipment isometric drawings

d.) Provide the above information in a manner so that the isometric drawing (up to 11" x 17" that can be folded up) shall be on the left-hand side of the open manual with the associated parts information sheet as the right hand page of the open manual.

e.) Include model and serial numbers for all special equipment such as power turn conveyors, HSPDs, and the like. All parts shall be referenced to a "next-higher-assembly" level within the drawing hierarchy. The system of referencing shall allow the reader to follow assembly / disassembly procedures in a methodical and orderly manner throughout the documentation.

10.) Chapter 10 - Manufacturer's Literature

a.) Chapter 10 shall provide all of the manufacturer's literature for all of the conveyor equipment mechanical, electrical and electronic components.

b.) Information shall be "brand specific" for the actual equipment/components provided for this system only. Information for equipment/components types and brands not provided in this system will not be acceptable.

c.) Unless unavailable, the actual original manufacturers literature shall be provided. At a minimum, only a first copy of a manufacturer's original literature will be accepted if the actual original manufacturer's literature cannot be provided.

d.) All such copies shall be clear and legible.

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- e.) All manufacturers' literature shall be appropriately highlighted with a legible solid black arrow for identification of the specific model or type of device used in the specified system.
- f.) All manufacturers' literature shall include information adequate for proper servicing of the item, proper operation of the item as well as all required information for the ordering of the item.
- g.) Complete list of parts manufacturers including address, telephone number and point of contact.

11.) Chapter 11 - Mechanical Drawings

- a.) Chapter 11 shall contain a complete, clear and legible 11" x 17" set of "As-Built" BHS mechanical drawings. Additionally, a PDF copy of these drawings shall also be provided on CD-ROM and inserted into a sleeve pocket within this chapter.
- b.) The 11" x 17" drawings are to be folded so that they will fit within the O & M Manual.

12.) Chapter 12 - Electrical Drawings

a.) Chapter 12 shall contain:

- (1.) A complete list and definition of the electrical symbols used in the electrical drawings.
- (2.) A complete, clear and legible 11" x 17" set of "As-Built" BHS electrical drawings. Additionally, a PDF copy of these drawings shall also be provided on CD-ROM and inserted into a sleeve pocket within this chapter. The As-built drawings shall contain as a minimum the following:
 - (a.) Detailed wiring connection drawing noting each control device, control station, motor, and all other controls devices, in block form with a detail of the actual "field wiring" numbers and configuration.
 - (b.) Detailed conduit routing diagram indicating size of conduit, size and number of conductors, junction boxes, control devices, motors, safety disconnect switches, and motor control panels.
 - (c.) Detailed block diagram representing internal layout of components within each motor control panel.
 - (d.) Schematic Wiring Diagram of each MCP, including outline and wiring diagram of all special devices. An additional approved 11" x 17" reduced copy shall be placed in the door pocket of the MCP.
- (3.) The 11" x 17" drawings are to be folded so that they will fit within the O & M Manual.

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13.) Chapter 13 - PLC Listings

a.) Chapter 13 shall include a complete, clear and legible set of "As-Built" BHS PLC listings. The listing shall include the following:

(1.) Complete set of PLC program ladder logic diagrams as well as PLC and Sortation controller listings for the related system.

(2.) A complete Sequence of Operation shall be included on the schematic diagrams or the PLC ladder logic diagrams.

(3.) PLC ladder logic diagrams shall have detailed "right hand" margin descriptors clearly identifying the function of each device and its associated contact rung locations.

(4.) Include a separate I/O list for each PLC or remote I/O in the panel. Identify I/O assignments with Equipment Item Numbers.

7. Draft O & M Manuals

a. Submit two (2) sets of a draft Operations and Maintenance Manual for review and approval to the Owner or their representative prior to Start-up of the system(s).

8. Final O & M Manuals

a. Three Sets of the Final O & M Manuals shall be presented to the Owner in accordance with the submittal schedule. Timely submittal of a system's O & M Manual is absolutely essential to the proper operation and maintenance of the BHS.

b. All six sets of the O & M Manuals must be updated by supplement to reflect any Field Changes, equipment changes due to warranty changes, and any other changes., that were made during the Warranty Period of the System, so that all sets of manuals shall reflect "As-Built" information.

c. An electronic medium copy of the O & M Manuals shall also be required on CD-ROM at no additional cost to the Owner.

J. Periodic Maintenance Inspection and Lubrication Chart

1. Provide a master chart or series of charts involving periodic maintenance of all equipment items in the system and defining, under equipment item subdivisions, the points and frequency of recommended periodic maintenance functions, including inspection, lubrication and replacement.

2. This chart need not detail the procedures involved with such periodic maintenance functions since such procedures will be found in the maintenance manual, but reference shall be made to specific sections or pages therein.

K. Training Program

1. Provide an operational and maintenance training program as specified in Part III of these Specifications.

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2. The training program shall be submitted to the Owner or their representative for review and approval prior to the start of System Testing and in accordance with the schedule of submissions.

L. Environmental Requirements

1. Submit any special environmental requirements above and beyond what is shown in these specifications that may be essential for correct equipment operation (e.g., computer hardware, scanner arrays and any other items with special requirements).

M. List of Lubricants

1. Submit a complete list of lubricants to be used on the equipment components. This list shall be standardized on one supplier in order to minimize the number of different lubricants used.

N. Inspection, Functional Specification and Testing Program

1. Submit an Inspection, Functional Specification and Testing Program for the BHS to demonstrate compliance with all specified requirements. Prepare the inspection and test plans based on the information provided in this specification.
2. The Functional Specification and Test Program shall identify and demonstrate all System Control Functions relating to the operational, functional and system performance tests. The Functional Specification/Test Plan is to list each Control Station, and Control Device, and its related Control Function that is to be demonstrated/tested. Refer to the Acceptance and Testing Section of this specification for detail test plan content requirements.
3. The testing plan shall include testing of all systems integrated with the BHS e.g. fire system, ACAMS.
4. The Inspection, Functional Specification and Testing Program shall be submitted for the Owner or their representative's review and approval prior to the start of System Testing in accordance with Schedule of Submissions.

O. Test Reports

1. Submit a report after completion of the internal testing, debugging and system tests performed prior to Acceptance Testing summarizing the detailed results of the tests, to the Owner or their representative prior to requesting final acceptance testing by the Owner or their representative.
2. In addition carry out a "dry test run" of Acceptance Tests prior to conducting such tests with the Owner or their representative to ensure that tests conducted with the Owner or their representative are successful.
3. Provide the Owner or their representative, upon request; the results of all in-plant tests, conducted on assemblies or sub-assemblies of equipment or equipment of like that are to be installed.

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P. Certification of Installation Compliance

1. Submit certificates issued by Regulating Authorities (in compliance with work permits (electrical, mechanical, welding, Fire Marshall and other Authorities)), that the equipment has been properly installed, meets all safety standards and is operating within the required accuracy.

Q. Certification of Test Compliance

1. Submit BHS Equipment Supplier's Certification that the system has been tested in compliance with the supplier's requirements for testing and has met all testing requirements.

R. Final Parts List

1. Provide a detailed listing and description of all individual system (subsystem) components with reference to layout and assembly drawings.
2. The listing of system parts shall include the following information:
 - a. Name of part
 - b. Complete description of part
 - c. Each specific location that the listed part is used in the system(s).
 - d. Total number of parts in system(s)
 - e. Manufacturer of part
 - f. Manufacturer's part number
 - g. Source of supply
 - h. Recommended quantity of spares per each item
 - i. Price per unit
 - j. Lead time or availability of part
 - k. Complete list of manufacturers, with addresses, telephone numbers and point of contact.
 - l. Manufacturer's catalog literature and specifications for all purchased parts.

S. System Power Requirements and MCP Sizes

1. Submit all the motor control panel (MCP) sizes and related power requirements for the all subsystems of this project. The power requirements shall indicate conveyor segment horsepower removed, horsepower added, and the total connected load of the new and existing modified subsystems (horsepower and full load amps).

T. Estimated Spare Parts List

1. Submit a list of estimated spare parts required for the first year of operation for the Owner or their representative's review and consideration for a budgetary allowance - include unit price per unit for the estimated spare parts list based on reasonable airline market

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rates. Spare parts may/shall be purchased for each phase prior to the commissioning of that phase. Include recommended inventory and replacement levels for each phase prior to commissioning as well as part description and identification quantities in system, delivery times, manufacturers and suppliers (their part or ordering numbers).

2. Include any special test instruments required for maintenance beyond the normal inventory of a conveyor maintenance shop. Include a device for measuring conveyor speed and shaft rotational speed, a VOM and a clamp-on hand-held Ammeter.
3. Submit a spare parts list in accordance with Schedule of Submissions.

U. System Reliability Calculations

1. Submit system reliability calculations demonstrating compliance with the “System Reliability” requirements specified herein.

V. Semi-Monthly Status Reports

1. The BHS Contractor’s Project Manager shall submit a Monthly/Weekly Status Report to the Owner or their representative, which shall include schedule updates in accordance with the provisions of the contract terms. The Owner or their representative shall have the right to change the time of submitting and the details of the report. The monthly/weekly status reports shall cover, including but not limited to, the following information:
 - a. Percentage of mechanical, electrical and controls/computer engineering completion, per subsystem.
 - b. Percentage of fabrication completed
 - c. Equipment delivery schedule (month look ahead)
 - d. Percentage of equipment installed complete:
 - 1.) Mechanical
 - 2.) Electrical
 - 3.) Controls
 - e. Updated detailed Project Schedule.
 - f. Task activities planned for the next week/month
 - g. BHS Engineering Issues.
 - h. Interface Issues including but not limited to the following:
 - 1.) Fire and Security Systems
 - 2.) PDP and MCP power supply
 - i. Right of Way Issues.

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- j. Brief description with status of accepted and proposed change orders with associated cost.
- k. Status of payments
- l. Manning by trade.
- m. Percentage of testing completed.
- n. Any other issues.

W. Submittal Log

1. Provide a log to the Owner or their representative listing all required project submittals to include, at a minimum, the following information:
 - a. Type of submittal.
 - b. Submittal revision number. (The submittal revision number shall also be clearly identified within the submitted document as well.)
 - c. The date in which the submittal is sent out for review.
 - d. Company or individual the submittal is sent to.
 - e. Date in which the submittal was returned after review has been completed.
 - f. Review status.
 - g. The log entries shall be maintained as current on no less than a weekly basis with submission to the Owner upon request.

1.06 CONTRACTOR'S QUALITY ASSURANCE GENERAL REQUIREMENTS

A. Laws, Codes, Rules and Regulations

1. Comply with applicable Local, State and Federal laws, rules and regulations pertaining to the following:
 - a. Installations, alteration, removal and demolition, including but not limited to the Federal Occupational Safety and Health Act and the Construction Safety Act.
 - b. Protection of the public during installations, alterations, including but not limited to, requirements for safety of operations, noise control, removal and disposal of waste materials, control of dust, dirt, pollutants, flammable materials, explosive materials, corrosive substances, and protection against fire.

B. BHS Contractor Qualifications

1. Authenticate a minimum of five years of demonstrable experience as a turnkey BHS Contractor with the completion of a minimum project value of \$5,000,000 (per project) that utilized high speed baggage diverters/pushers capable of operating at a minimum throughput rate of 60 bags per minute, integration with EDS devices, computerized sortation control systems controlling PLC systems, and computerized report generation for operational as well as maintenance status and graphic fault annunciation for the automated baggage system.

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C. Non-Standard Equipment

1. Any proposed equipment which is appreciably different from items previously fabricated or which has not displayed satisfactory performance in a similar environment for at least one year (for a minimum of 18 hours per day, 7 days per week), shall be so noted in the proposal.
2. Prior to the start of fabrication, a prototype of the new item shall be built and test data shall be presented showing that the item has successfully performed the equivalent of one full year of operation. The Owner or their representative shall be invited to witness the test and review the test data at no additional cost to the Owner.
3. The testing requirements and demonstration will identify such requirements as follows:
 - a. Number of hours of run time
 - b. Number of test cycles
 - c. Processing rates
 - d. Mean time between failures
 - e. Repair time, serviceability
4. The Owner or their representative must approve the design before the final design and fabrication, provided that the BHS is produced by a firm with at least 3 years of experience in manufacturing and installing such systems comparable to that required under this contract. The Owner or their representative must approve the use of firms with less than 3 years' experience.
5. In lieu of developing a prototype, arrangements may be made for the Owner or their representative to inspect an existing component in operation at an airport at no additional cost to the Owner.

1.07 PROJECT CONDITIONS

A. General

1. The Owner or their representative does not guarantee the accuracy or the completeness of the information relating to the new or existing utility services, facilities, or structures that may be shown on the drawings or encountered in the work. Any inaccuracy or omission in such information shall not relieve the responsibility to protect such existing features from damage or unscheduled interruption of operations and services.
2. Prior to commencing the work in the general vicinity of an existing system, utility service or facility, notify the Owner or their representative 72 hours in advance and obtain approval before proceeding with the work.
3. Failure to give the 72-hour notice shall be cause for the Owner or their representative to suspend the BHS Contractor's operations in the general vicinity of the System, utility service or facility.

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4. Should damage to or unscheduled interruption of airline operations, utility service or airline facility occur by accident or otherwise, the BHS Contractor shall notify the Owner or their representative and take all reasonable measures to prevent further damage or interruption of service. In such events, cooperate with the utility service, Airport Authority until such damage has been repaired and service restored to the complete satisfaction of the utility service or the Airport Authority.
5. Coordinate all building modifications performed by any trade to accommodate the installation of the BHS.

B. Installation Conditions

1. This BHS is to be installed within an existing Airport Terminal working simultaneously with other trades.
2. The BHS Contractor shall visit the site to familiarize himself with the site conditions and to understand local conditions that may affect the project before submitting his bid proposal. Where possible the BHS Contractor shall familiarize himself on the availability of temporary access, temporary lighting and power, telephone services, storage facilities, water supply, waste disposal facilities, labor supply, weather conditions, parking of vehicles, loading and unloading of materials, and equipment. In particular, he shall take into account in his bid proposal any effect that any adjacent construction, operations and maintenance works may have on the BHS installation. The BHS Contractor shall ascertain for himself and allow in his bid proposal for all necessary precaution and for any difficulties that may arise in the execution of the BHS Contract. No claims whatsoever arising out of the site constraints, difficulties of access, temporary services and facilities, labor, and any other charges will be entertained by the Owner.

C. Phasing Sequence

1. Comply with the phasing sequence specified herein, in compliance with the overall project phasing requirements.

D. Ramp Area Proximity

1. The portions of the construction/installation associated with this project shall take place immediately adjacent to an active aircraft ramp area and airline operations area.

E. Lay-down Area Restrictions

1. Lay-down and shake out areas may be limited to the confines of the immediate building. All Lay-Down areas shall be designated and approved by the Owner or their representative.
2. Refer to the Architectural Contract drawings for preliminary lay down areas that could be utilized by the BHS Contractor. Coordinate usage of lay-down areas with the General Contractor.

F. Restoration of Service Costs

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1. Incur all restoration of service costs due to the negligent or accidental damage of any airport utility service or facility. The Owner reserves the right to deduct such costs from any monies due, or which may become due, from the BHS Contractor, or its surety.

G. Right-of-Ways

1. It is acknowledged by all parties that the BHS Contractor has first priorities to the rights-of-way available and/as provided by others. Cooperate with other contractors for coordination of all building rights-of-way performed by other trades to accommodate the installation of the BHS.
2. In addition, the BHS Contractor shall preserve all rights-of-way for deferred equipment depicted on the Contract Drawings.

1.08 PROTECTION OF THE WORK

A. General

1. Make such explorations and probes as are necessary to ascertain any required protective measures before proceeding with installation. Give particular attention to equipment supports and bracing requirements so as to prevent any damage to BHS equipment.
2. Provide, erect and maintain catch platforms, dust partitions, lights, barriers, warning signs and other items as required for proper protection of operating personnel, the public, occupants of building, workmen engaged in installation and adjacent construction. Comply with the requirements and restrictions of the Contract Drawings.
3. Do not store or place materials in passageways, stairs or other means of egress. Do not close or obstruct walkways, passageways, stairways, streets, walks, terminals, runways, rights-of-way, or other occupied or used facilities without written permission from the Owner or their representative. Conduct operations with minimum traffic interference.
4. Utilize suitable coverings to protect existing work. Be responsible for any damage to the existing BHS and facilities or other contents by reason of the insufficiency of protection provided. Promptly repair damage caused to adjacent facilities and restore as new.
5. Repair any damage to work in place. This includes repair of both new and existing fireproofing materials removed to allow the installation of BHS structural attachment supports, header steel, and any other BHS equipment.

1.09 SYSTEM DESIGN AND PERFORMANCE REQUIREMENTS

A. General

1. All equipment shall be in strict accordance with the specifications described herein. It should be noted and stressed that the system shall be engineered, fabricated and installed with the objective of being of rugged, heavy duty, impact resistant equipment capable of withstanding the abuse and exposure to damage experienced in an air transportation baggage handling facility. Other key factors to be considered in the development of the system and its elements shall be simplicity, reliability, maintainability, and safety.

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2. The BHS Contractor is deemed to have studied the system design and requirements presented in the drawings and specification respectively and accepted the design and requirements as suitable and appropriate to safely accomplish the functions and processes described herein. Identify in the bid submission any design aspect or specification requirement that is believed to be inappropriate or inadequate and shall propose alternate solutions to alleviate the perceived problem but shall, in all cases, include in the bid submittal pricing for the base system presented in the drawings. Any alternate designs developed by the BHS Contractor must meet or exceed the design criteria as listed in the specifications.
3. Consideration shall be given to the design, fabrication and installation of all projections, welds, and transfer points between conveyor segments and conveyor items to eliminate damage to the various types of baggage processed.
4. The system and subsystem layout configuration and item/component functional requirements are specifically described on the contract drawings. However, alternate solutions, may be proposed on an optional bid cost basis for consideration by the Owner. Any alternate designs developed by the BHS Contractor shall meet or exceed the design criteria as listed in the specifications.

B. Material and Equipment Approvals

1. Where manufacturer's name, brand or trademark is specified, it has been selected to establish a standard of quality for the materials, components or equipment required. Materials, components or equipment of different manufacture considered to be equal to the materials, components or equipment specified will receive full consideration and shall be subject to approval by the Owner or their representative before being incorporated into the work. The contract price shall in all instances be based only upon materials, components or equipment specified. A list of material, component or equipment suppliers shall be submitted to the Owner or their representative for approval. Provide a listing of sources where any material, component or equipment, for which a substitution approval is being requested, can be obtained.
2. Furnish all engineering data, engineering/shop drawings, literature, test results, calculations, and any other requested information, for review of substituted material, components or equipment. The BHS Contractor shall pay for any redesign necessary to accommodate an "approved equal".

C. Request for Deviations from Drawings or Specifications

1. Requests for deviations from drawing or specification requirements may be approved at the discretion of the Owner or their representative to permit use of standards inherent in the equipment when it has been determined by the Owner or their representative that such deviations will in no way be detrimental to the conveyor equipment, the safety, operation and maintenance of the specified system, system design, system reliability and its associated inventory of spare parts.
2. Any materials, components or equipment submitted for substitution for this BHS shall

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be previously proven under the loads as specified in Part I of this Specification in an operational or test equivalent environment for a minimum of 1 year, 18 hours per day, 7 days per week.

D. Baggage Conveyors

1. Conveyor Loads

a. Design the conveyors and their supports using the following loading criteria:

- 1.) The live and dead static load imposed on the building (composed of the conveyor components, supports and baggage) used for designing structural elements, rollers and pulleys shall be 100 pounds per linear foot.
- 2.) All conveyor equipment shall be capable of supporting a single concentrated static load of 250 pounds.
- 3.) The live dynamic load to be utilized for sizing drives, belts, bearings, and other components, shall be 60 pounds per linear foot for load, unload and accumulating conveyors operating up to a speed of 120 feet per minute. For all other conveyors (e.g. transport, or sortation) it shall be 40 pounds per linear foot operating at a conveyor speed of 90 feet per minute and a throughput of 25 bags per minute adjusted proportional to speed and throughput. As an example, a sort line traveling at 360 feet per minute and rated at 60 bags per minute would have to be rated at 24 pounds per linear foot for load testing. The following formula shall be utilized to determine the test ballast for the purpose of load testing and preparation of related test plans during the BHS acceptance period:
$$\text{Formula: } 40 \text{ lbs per Linear Foot} \times (90 \text{ FPM} / \text{actual conveyor speed}) \times (\text{throughput rate} / 25 \text{ bags/min}) = \text{xx lbs per linear feet}$$

2. Conveyor Dimensions

- a. All equipment shall be of U.S dimensions. (Insert Metric dimensions if other than US project)
- b. Unless otherwise specified on drawings, construct conveyors to the following dimensions:

Conveyor Type	Overall Width	Between Guide Width	Belt Width
Standard Conveyor and Power Turns	42"	39"	36"

Note: 1. Standard Power Turn Inside Radius shall be 4' 0".

3. Conveyor Side Guard Heights

- a. Refer to Part II of this specification for side guard heights.

4. Conveyor Speeds

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- a. Unless otherwise specified, conveyors speeds shall be selected by the following criteria:

Type/Location	Speed (Feet/Min)
Flat Plate	90

E. Baggage Characteristics

- a. Design the BHS to convey standard airline baggage tubs and to process baggage having the following characteristics:
- b. Size of Single Piece

Conveyor Type	Length	Width	Height
Standard Conveyor Maximum	54"	33"	34"
Standard Conveyor Minimum	12"	12"	4"

- c. Weight of Single Piece

Conveyor Type	Weight
Standard Conveyor Maximum	120 lbs.
Standard Conveyor Minimum	1 lb.

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d. Shape

- 1.) At least one flat conveyable surface. Baggage meeting the above size limitation but lacking a flat conveyable surface (such as baby carriages, round duffle bags, and the like) shall be processed in standard airline tubs.
- 2.) Design system to accommodate 90% of the baggage normally encountered with or without the use of standard airline tubs, including but not limited to, golf bags.

e. Surface Material

- 1.) Complete spectrum of package materials found in air transport baggage, including paper, cardboard, cloth/canvas, plastic, leather, wood, and metals in the following conditions:
 - a.) Dry to Wet
 - b.) With/Without:
 - (1.) Paper/cloth/plastic tape/wrapping
 - (2.) Plastic/steel bands
 - (3.) Fiber cord
 - (4.) Twine
 - (5.) Wheels
 - (6.) Straps

F. Physical Constraints

1. Design the BHS to accommodate the following physical constraints imposed on the System by either operational or facility considerations:
 - a. All conveyors, supports and related components (unless shown as floor supported, within the confines of protective guard rails, or within a confined and protected space) shall have a minimum underside clearance of 8'-0" from the bottom of the support structure to the floor, unless otherwise specifically noted on the Contract Drawings.
 - b. Minimum clearance on all conveyors from the top of the conveyor belt to the underside of any obstruction shall be 36 inches, unless otherwise specifically noted on the Contract Drawings.
 - c. If any of these design criteria cannot be maintained, notify the Owner or their representative in writing for resolution.

G. Balancing

1. Dynamically balance all rollers and pulleys.

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H. Service Conditions

1. Design each element to operate satisfactorily in its respective environment as follows:

a. Mechanical - Indoor (Bagroom Environment)

- 1.) Temperature: 32° to 120° F (0° to 48°C)
- 2.) Relative Humidity: 5% to 99% Non-condensing
- 3.) Protected from direct exposure to weather

b. Electrical/Electronic Equipment Inside Control Panels

- 1.) Temperature: 32° to 140° F (0° to 60°C)
- 2.) Relative Humidity: 5% to 99% Non-condensing

c. Electrical/Electronic Equipment - Indoor (Bagroom Environment)

- 1.) Temperature: 32° to 120° F (0° to 48°C)
- 2.) Relative Humidity: 5% to 99% Non-condensing
- 3.) Protected from direct exposure to weather

d. Mechanical - Outdoor or in Unheated Enclosures

- 1.) Temperature: -20° to 120° F (-30° to 48° C)
- 2.) Relative Humidity: 5% to 100% condensing
- 3.) Covered but not protected from driving rain.

e. Electrical/Electronic Equipment - Outdoor or in Unheated Enclosures

- 1.) Temperature: -20° to 120° F (-30° to 48°C)
- 2.) Relative Humidity: 5% to 100% condensing
- 3.) Covered but not protected from driving rain.

f. Electrical Equipment Inside Computer/Control Room

- 1.) Temperature: 55° to 80° Fahrenheit (13° to 27° Celsius)
- 2.) Relative Humidity: 5% to 50% Non-condensing

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2. During construction if sealed office area is not available for the BHS related computer equipment, a filtered air environment area should be provided (by others).
3. Provide and clearly identify any special environmental requirements more stringent than what is shown in these specifications that may be essential for correct equipment operation.
4. The above listed requirements do not take into consideration separate requirements that may be required for any related non-BHS equipment that may be provided and installed by or personnel that may drive environmental requirements in various areas where BHS equipment also exists.

I. System Safety

1. Design, manufacture, supply, install and construct the BHS in accordance with all of the requirements in the Contract Documents, and shall meet or exceed all applicable laws rules, orders, regulations and codes. In this regard, the BHS Contractor shall be responsible throughout this Contract to bring to the attention of the Owner or their representative in writing any changes in such laws, rules, orders, regulations and codes and any condition(s), whether caused by its design or any BHS Contract requirements, which the BHS Contractor believes may result in or has resulted in an unsafe condition(s). Rectify at the BHS Contractor's own cost any such condition(s) resulting from its design and not directly as a result of any Contract requirement(s). Where the Owner and the BHS Contractor mutually determine that such condition(s) is directly a result of any Contract requirement(s) or any changes in laws, rules, orders, regulations and codes, then the Owner and the BHS Contractor shall seek a mutual resolution of the condition(s) to be effected by a Change to the Contract.
2. Utilize control methods and techniques, circuitry, mechanical and electrical equipment and operating/maintenance procedures to provide maximum safety for operation and maintenance personnel and to minimize potential damage to the equipment and to the baggage being processed. Incorporate fail-safe techniques to prevent the occurrence of unsafe conditions, which could result from an equipment failure or improper implementation of the operating procedures.
3. As employed herein, the failsafe principle shall be interpreted as follows: In the event an equipment failure or external influence such as improper operation, high temperature, power failure, or other adverse condition affects the proper function of a system or element involved with the safety of life or health, said system or element shall revert to a state known to be safe to all personnel interfacing with the equipment.
4. Ensure that all provided and installed equipment meets all applicable local, state and federal safety codes, including applicable OSHA standards and requirements, for baggage handling systems/conveyors and industrial machinery environments.

J. Personnel Safety

1. The operation of the system shall be convenient and safe to use, and control functions to be performed shall be simple to minimize possible errors. The BHS Contractor shall

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provide convenient means for emergency system shutdown.

2. Provide adequate means for ensuring the safety of all personnel who have access to the system in the system design.
3. Provide sufficient safety signage throughout the system.
4. Provide lockable devices such as disconnect switches and lockouts to prevent the accidental activation of those portions of the system shut down for maintenance. These devices shall be located in all areas.
5. Provide equipment and component guards on all drives for conveyors and sortation devices. House all moving parts in personnel areas with guards (such as bearings, return rollers, and return conveyor belts).
6. Provide sufficient work space in all limited access areas
7. Provide audible and visual warning signals along all areas of the system to make apparent any potential hazards to the public, operating and maintenance personnel resulting from moving or about-to-start equipment.
8. Provide protection from falling objects in work areas or aisles located beneath overhead portions of the system with gap pans or netting.
9. Locate conduits and all other electrical components where they shall not be subject to damage by maintenance or operational personnel.
10. Coordinate access provisions for operators so as to minimize obstructions. Locations of control stations and electrical boxes shall be coordinated to support unrestricted access by staff. The provisions of the conveyor supports, drive configurations, personnel guarding and side guards shall allow for maximum operator accessibility.

K. Noise Levels

1. Design, fabricate and install the BHS to limit combined equipment and controlled ambient noise levels to the following allowable maximum requirements. However, the BHS equipment shall not increase the ambient noise level by more than 15 dB (A). In any case, ambient noise levels for the BHS equipment shall not exceed OSHA standards.
2. Design, fabricate and install the BHS to limit combined equipment and controlled ambient noise levels to the following allowable maximums

Noise Level	Ambient
45 dB (A)	In adjacent or nearby office areas (measured at the center of room at a height of 5'-0" above the floor).
65 dB (A)	In public areas, or ceiling above public areas and offices (measured at a number of positions normally occupied by passengers, public and staff).
75 dB (A)	In bagroom and all other associated non-public areas or unoccupied

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	areas.

3. To accommodate noise levels of 65 dB (A) or less (in areas such as the CBRA, OSR room or public areas), the BHS Contractor shall consider the following items for conveyor segments installed in these spaces to minimize noise levels:
 - a. Use low noise PVC belting.
 - b. Use either shaft mounted drives or underslung drives with toothed belts (no chain drives).
 - c. Mount all safety guards with rubber isolation washers between fasteners and the conveyor frame.
 - d. Use bolted return rollers (i.e., no spring loaded return rollers). The use of UHMWPE polyethylene washers shall be placed between the rollers and mounting brackets to reduce side play and noise caused by side play. Provide high quality low noise bearings.
 - e. VFDs shall not be set with a maximum output frequency of greater than 72 Hz. This is to limit the amount of noise generated and difficulties stopping with output frequencies set beyond this limit. Set the VFD carrier frequency as to not increase the motor audible noise level.
 - f. Use vulcanized spliced belting in areas that require reduced noise levels. The conveyor must facilitate the replacement of a clipper lacing for repair/replacement of damaged conveyor belt.
 - g. Add a fire retardant sound damping material to the inside of under guarding to reduce sound levels.
4. Unless otherwise specified the measurements shall be taken at a maximum distance of 5 feet vertically and 5 feet horizontally from noise producing components.
5. The noise level measurement shall be accomplished utilizing an integrating sound level meter supplied by the BHS Contractor. A qualified person employed by the BHS Contractor shall accomplish measurements and evaluation. The BHS Contractor shall provide a certificate of calibration to the Owner or their representative.
6. The noise level shall be the Equivalent Continuous Sound Pressure Level measured over a period of one minute or more at each location. In addition, to the overall A-weighted noise level, the Equivalent Continuous Sound Pressure Level shall be measured for each octave frequency band from 125 Hz to 4000 Hz.
7. Conveyor noise shall not be unduly impulsive. Observing the difference, between the measured Equivalent Continuous Sound Pressure Level and the instantaneous sound pressure level, shall test the impulsiveness of the noise. A component shall be considered unduly impulsive if the differences exceed 3 dB (A).
8. Conveyor noise shall not be unduly tonal. Tonality shall be determined by observing the difference in level between any A-weighted octave band and each of its adjacent A-

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weighted octave bands. The sum of the differences shall not exceed 6 dB (A). All octave bands from 125 Hz to 4000 Hz shall comply with this requirement.

9. Every conveyor component shall be tested. The components shall be tested at full design speed under load conditions.
 10. Where conveyors are located in the ceiling spaces of non-bagroom areas, the noise measurements shall be taken after the architectural ceilings are in place.
 11. Noise level measurements shall be taken during non-operational hours to ensure passenger conversations or movements do not unduly increase the ambient noise levels in public areas.
 12. Measurements shall be taken during a time when the ambient noise levels are at least 6 dB (A) below the conveyor noise level. The ambient noise level shall be determined both before and after the measurement of the components. The ambient noise level shall be determined as follows:
 - a. The BHS equipment shall be turned off.
 - b. All other equipment (i.e., air-conditioning and heating equipment) shall be on and outside noise sources (from aircraft and mobile ground equipment) shall be as normal.
 - c. Noise level readings shall be taken throughout a zone 5 ft vertically and 5 ft horizontally from the BHS equipment using an integrated sound level meter set to the A-weighted network.
 - d. After the ambient noise level has been determined, the BHS equipment shall be turned on and the total noise level shall be measured at the same points throughout the zone that the ambient levels were measured.
 13. The BHS Contractor shall provide a written report to the Owner or their representative detailing the results of the noise level measurements.
- L. Radio Frequency Interference/ Electro Magnetic Interference (RFI/EMI)
1. Ensure by design and shielding that system equipment shall not create electromagnetic emissions, which can, in any way, cause interference with communications within the airport or between the airport and aircraft or ground support vehicles.
 2. Choose all electrical and electronic equipment (including computer and related equipment) to operate without malfunction in the presence of normal electromagnetic emissions generated by other equipment normally installed or used at the airport including but not limited to the aircraft communications bands, high-power radar systems, various electrical motors and controls, power tools, welding equipment, automotive vehicles, ground power units and air handling units. Provide isolation transformers and line suppression units, if required.
 3. Radio frequencies, if used for communications or information transmission within the

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systems, shall be applied for to the relevant Airport and Government Authorities for their designation and assignment.

M. Maintainability, Life & Reliability

1. The requirements set forth in this section are minimum requirements and do not relieve the obligation to provide a system in which all required maintenance tasks can be readily performed.
2. Design all components so they can be easily disconnected and removed from the equipment without the necessity for extensive disassembly. Design the components for removal and replacement by two (2) staff in a period not to exceed two (2) hours. Be prepared to demonstrate that any maintenance task, not so listed, can be accomplished as described above. Correct any installation, without charge, as required to accomplish this demonstration.
3. Design the system so that equipment components requiring inspection and servicing are readily accessible. Provide suitable doors for this purpose. Where necessary, provide access holes in frames or guards but keep them to a minimum number and size, and ensure that they do not create protrusions or discontinuities detrimental to the baggage being conveyed.
4. Design equipment to facilitate maintenance functions in preference to ease of fabrication.
5. Design equipment such that, whenever possible, assemblies shall not require dismantling in order to troubleshoot, repair or replace assemblies or components of assemblies involved in such servicing procedures.
6. Affix cover plate attachment hardware to, or hold captive in, the cover plate assemblies.
7. Provide all electric assemblies, panels, or boxes with the appropriate schematic, enclosed in a clear-faced envelope affixed in a location visible to personnel while servicing such items.
8. Provide one set of special test instruments and tools for each group of equipment items requiring such special test instruments and tools. These shall be provided in a metal toolbox with identification of the equipment for which the tools shall be used.
9. Provide a device for measuring conveyor speed and shaft/pulley rotational speed prior to commencement of Acceptance Testing for use by the Owner or their representative, during the Acceptance Testing period.
10. Provide fixed or mobile ladders, service platforms, lifting lugs or other applicable provisions to ensure easy access to components requiring servicing, either as shown on the specification drawings or as required to assure a safe and efficient system for all personnel who operate, maintain or have access to it.

N. Standard/Interchangeable Components

1. Minimize the number of different types and makes of components used in the BHS to

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simplify spare part inventory.

2. Design all equipment and components to definite standard dimensions, tolerances, and clearances to provide maximum inter-changeability.
3. Provide like types of equipment from the same manufacturer wherever practicable.

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O. Lifespan

1. Provide equipment components and items for a system equipment life of a minimum of 15 years and an operating duty cycle of 18 hours a day, 365 days per year. This provision is a design objective, not a warranty.
2. It is understood that PC based computer equipment may not have the identical hardware available for the full 15 year period (PLC equipment does not fall under this category), as such the BHS Contractor shall submit a list of the estimated spare parts required to maintain the PC based computer hardware for the 15 years of operation for the Owner or their representative review and consideration for a budgetary allowance - include unit price per unit for the estimated spare parts list based on reasonable airline market rates.

P. System Reliability

1. Reliability requirements of the total BHS shall be measured in terms of "System Availability" (A_s).
2. Failure
 - a. A failure is defined as any malfunction of a System component, assembly, or subassembly which stops normal operations. A failure shall be charged against only the one subsystem, which causes that failure. The following shall not be classified as failures:
 - 1.) Malfunctions caused by a failure on the Owner's part (after system acceptance) to properly maintain and operate the System in accordance with recommended procedures.
 - 2.) Malfunctions due to causes outside the System such as but not limited to sabotage or general power outage.
 - 3.) Malfunctions due to baggage jams not caused by failure of a system component, assembly or subassembly unless it is a defective part, a poor installation, or a failure of a component or subassembly to perform its intended function.
 - 4.) Incipient failures, which are detected and repaired without affecting normal operation of the System.
 - 5.) Malfunction of one of a redundant Computer/PLC pair where the repair time does not affect normal operation of the system. However, reliability of redundant computer pairs is defined elsewhere in this specification.
3. Sub-System Availability (A_s)
 - a. Sub-System Availability (A_s) shall be defined by the following equation:

$$A_s = \frac{ST - RT}{ST}$$

ST

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ST = Scheduled Operating Time: The scheduled time that the BHS is available for baggage processing (normally 18 hours per day).

RT = Repair Time: The interval of time between initiation of repairs due to a failure and return of the BHS to operation.

- b. Each subsystem of the BHS shall have an availability of not less than 0.995 (99.5%) to be calculated on a monthly basis. However, the maximum allowable downtime in a single operating day shall be no more than 15 minutes on one subsystem; additionally the accumulative downtime for all subsystems shall not exceed 20 minutes.
- c. No more than one failure per month of one of the computers, PLCs, workstations and any other control equipment within of any slave/master pair shall be acceptable.
- d. All computer and control systems (including but not limited to BHS host computers, Sortation computers, and workstations) shall have an availability of not less than 0.999 (99.9%) to be calculated on a monthly basis. However, the maximum allowable downtime in a single operating day shall be no more than 2 minutes for a single event. The maximum downtime where both slave/master pair within computers, PLCs, and workstations fails simultaneously shall be 10 minutes in a

Q. Parts Availability

- 1. Maintain, for immediate delivery, an adequate inventory of spare parts (especially long lead time items) required for routine maintenance of the system. Ensure that critical spare and replacement parts required by the system are made available for a minimum of a fifteen (15) year operational period through the availability of shop and as-built drawings and through the availability of the actual parts. Additionally, ensure the availability of custom or "special" components.
- 2. If the BHS Contractor fails to make such parts available during the fifteen (15) year operation period or should pricing become unreasonably high on a competitive basis, the Owner has the right to permit the use of the project drawings, at their discretion, for fabricating such parts, or having such parts fabricated so as to maintain the specified system.

1.10 STANDARDS AND CONSTRUCTION CODES

A. General

- 1. The design and subsequent installation shall provide adequate safety factors and shall conform to all current standards and codes of the Owner, the City of Fayetteville, NC Department of Public Works or the country of design origin, whichever is more stringent.

B. Construction Codes

- 2. In the event no specific local codes or standards can be identified, the Contractor shall comply with the most recent version, applicable provisions and recommendations of the

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following:

a. American Welding Society (AWS)

- 1.) D-1.1 Welder Qualifications
- 2.) AWS-C1 Recommended Practice for Resistance Welding in Building Construction
- 3.) AWS – A2.0 Standard Welding Symbols
- 4.) D-1-0 Standard Welding practice in building construction

b. American Gear Manufacturers Association
Standards (AGMA)

- 1.) 6009-A00 Practice for Gear Motors
- 2.) 6035-A02 Practice for Worm Gear Motors

c. American National Standards Institute (ANSI)

- 1.) A-1264.1 Safety Code for Floor and Wall Openings, railing, and Toe Boards
- 2.) B-20.1 Safety Code for Conveyors, Cableways, and Related Equipment
- 3.) B-29.10M Transmission Roller Chains and Sprocket Teeth
- 4.) C-33.1 Safety Standard for Flexible Cord and Fixture Wire
- 5.) Z535 Safety Color Code

d. National Bureau of Standards (NBS)

- 1.) Handbook H28 Screw-Thread Standards

e. National Fire Protection Association (NFPA)

- 1.) NFPA No. National Electrical Code Volume 70 National Fire Code
- 2.) NFPA No. Electrical Standard for Industrial Machinery
- 3.) NFPA No. Standard for Fire Doors and Fire Windows 80

f. NEC National Electrical Code (most current version)

g. Underwriters Laboratories (UL) Standards (Components shall be labeled appropriately)

- 1.) UL 508 Industrial Controls Equipment
- 2.) UL 508A Industrial Control Panels
- 3.) UL 508 Power Conversion Equipment

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- 4.) UL 1998 Software in Programming Components
- 5.) IEC 61508 Functional Safety Standard Electrical/Electronic/Programmable Electronic (E/E/PES) Safety Related Systems
- h. National Electrical Manufacturers Association Standards (NEMA)
 - 1.) ICS Industrial Controls and Systems
 - 2.) MG1 Motors and Gear Motors
- i. American Society for Testing Materials (ASTM)
 - 1.) A-36 Structural Steel
 - 2.) A-794 Sheets cold rolled
 - 3.) A-659 Sheets & Strip - hot rolled
 - 4.) A-307 Fasteners (Bolts)
 - 5.) A-563 Fasteners (Nuts)
 - 6.) F-844 Fasteners (Washers)
- 3. All equipment and accessory items furnished and installed under this Contract shall be governed at all times by applicable provisions of federal laws, including but not limited to the revision of the following in effect as of the Contract date:
 - a. Williams-Steiger Occupational Safety and Health Act (OSHA), of 1970, Public Law 91.596, most current version.
 - b. Occupational Safety and Health Administration (OSHA)
 - 1.) 29 CFR Part 1910 Subpart D (Walking-Working Surfaces)
 - 2.) 29 CFR Part 1910 -211 (Definitions)
 - 3.) 29 CFR Part 1910 – 212 (General Industry Standards and Requirements) for machines
 - 4.) 29 CFR Part 1917.48 (Conveyors)
 - 5.) 29 CFR Part 1926.555 (Conveyors, Construction Industry Standards)
 - 6.) 29 CFR Part 1926.1053 (Ladders)
 - c. Office of State Health Planning and Development (OSHDP)
 - d. American Society of Mechanical Engineers (ASME)

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1.) ASME B20.1 – 2006 Safety Standards for Conveyors and Related Equipment, and all Addenda up to and including ASME B20.1-2006

e. Conveyor Equipment Manufacturers

Association (CEMA) 1.) ANSI/CEMA

402-2003 Belt

Conveyors

2.) ANSI/CEMA B105.1-2003 Specifications for Welded Steel Conveyor Pulleys with Compression-type Hubs

1.11 WARRANTIES

A. General Warranty

1. Warrant any new BHS equipment for one (1) year against defective parts and labor beginning on the Final Acceptance Date as related to this Project.
2. Warrant all new BHS equipment for three (3) years against design defects beginning on the Final Acceptance Date as related to this Project.
3. Warrant all new BHS software, high level and low level controls for three (3) years against design defects beginning on the Final Acceptance Date as related to this Project.
4. Assign the Owner all warranties for all materials and equipment received from Subcontractors and Suppliers.
5. The BHS Contractor shall not warrant and shall not be liable for design or throughput capability of the relocated/refurbished equipment (e.g., existing conveyor segments upstream and downstream of the new conveyor segments associated with the modified lines).
6. Considering the construction program for this project is specified to be performed under a Sequenced Implementation Process, where existing subsystems and related conveyor equipment will either be removed from service, modified, reconfigured or tied-in with new conveyor lines that will be installed and turned over for operational use on an Activity-By-Activity basis, the warranty for the BHS shall begin as follows:
 - a. Upon the Substantial Completion Date of a given Sequence for all BHS related field components, such as motors, gearboxes, bearings, belting, field control components and MCP control components. Submit a certified warranty statement summarizing the type of warranty coverage with the warranty commencement date for that given Sequence and outlining the BHS equipment that has been substantially completed and turned over for operational use.
 - b. Upon the Final Acceptance Date as related to this project for all related BHS Computer Systems and PLC system hardware and software provisions. Submit a certified warranty statement summarizing the type of warranty coverage with the

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warranty commencement date and an outline of the BHS equipment that will be covered under the warranty.

B. Warranty Exclusion

7. This warranty shall not apply to any defects or inconsistencies, which are attributable to repair, alteration, misuse or abuses by any person other than authorized personnel or Subcontractors. Liability shall be limited to repairing or replacing defective or non-performing part(s) at no cost to the Owner.

C. Warranty Limitation

1. Liability shall be determined in the Contract Agreement and shall also include repairing or replacing defective or non-performing part or parts at no cost to the Owner.

D. Technical Support

2. Provide on-site technical support as defined by the Contract Documents and agreed upon by the Owner or the Engineer. This support shall be by personnel qualified to advise the Owner on training, provisioning, start-up and maintenance of the equipment.
3. The technical representative(s) for warranty support shall be within 6 hours travel distance of Fayetteville Regional Airport, in the City of Fayetteville, State of North Carolina, where the equipment is to be located, as required by the Owner.

E. Royalties and License Fees

1. Pay all royalties and license fees and defend all suits or claims for infringements of any prior or patent rights and save the Owner harmless from liability, expense of loss on account thereof, with respect to any processes, devices, methods, articles, inventions, things or procedures used in the project.

F. Labor Warranty

1. Warranty support shall be provided as follows:
 - a. Provide labor to accomplish any warranty repair work. In the event such labor is not provided in a timely fashion, pay the Owner to accomplish warranty labor repair with its maintenance staff.
 - b. The BHS Contractor shall provide labor for work related to design deficiencies.

G. Parts Warranty

1. Terms
 - a. Provide a parts warranty which states material and equipment furnished and installed shall be new and free from faults and defects in material, workmanship, detail or incorrect component selection; shall conform to the functional and technical requirements of this Section and Contract Drawings contained herein; shall comply with all laws, statutes, ordinances and codes applicable at the installation site; and shall be suitable for the intended purposes. Excessive wear shall be considered a defect within the provisions hereof.

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- b. Parts shall be shipped freight pre-paid to the location specified by the Owner. Failed/malfunctioned parts shall be returned to the BHS Contractor, FOB, within ten (10) days of notification of detection of such failed/malfunctioned parts.

2. Spare Parts

- a. Spare parts for each phase, shall be made available for purchase by the Owner prior to the commissioning of the subsystem. The Owner may, taking the recommendations of the BHS Contractor, purchase such spare parts as it deems necessary, and said parts, shall be stocked on the Airport property. Stock control shall be by the Owner who shall grant reasonable access to the BHS Contractor's warranty service agency during the warranty period. All items withdrawn from stock shall be replaced, regardless of whether the item was purchased by the Owner or the Owner's Maintenance Group directly from the BHS Contractor or from a third party, pursuant to warranty services, within two weeks of such withdrawal.
- b. Ending of the warranty period shall be contingent on the replacement of all stock withdrawn pursuant to warranty services whether the warranty service agency or the Owner accomplished such services. Where the BHS Contractor has cause to believe that an item or items may require stocking pursuant to the terms and conditions of warranty provisions, which item or items the Owner declines to stock, the BHS Contractor shall stock such items separately at no cost to the Owner. In no case shall the absence of appropriate spare parts in the Owner's spare parts stock be construed in any way to abridge or interfere with the responsibilities of the warranty services as defined herein.

H. Design

3. Terms

- a. Provide a Design Warranty which states that the system, materials, equipment, software and high level and low level controls furnished and installed shall be free from faults and defects in design; shall conform to the functional and technical requirements of this Section and Contract Drawings contained herein; shall comply with all laws, statutes, ordinances and codes applicable at the installation site; and shall be suitable for the intended purposes. Excessive wear shall be considered a defect within the provisions hereof.

4. Design Failure

- a. In the event a design failure occurs during the warranty period, replace all such components, assemblies or devices utilizing the design in a similar application in which the failure occurs by components, assemblies or devices redesigned to prevent such occurrences at no cost to the Owner. Submit proposed redesign drawings and re-selected component designations to the Owner for their approval. Issue a new warranty period upon the replacement of such redesigned items.
- b. Components, assemblies or devices shall be considered as design failures if any of

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the following occurs during the warranty period:

- 1.) A leakage loss of over 10% of an operating fluid in any hydraulic assembly.
- 2.) A demand for frequent, unscheduled adjustment or other maintenance action in similar devices.
- 3.) Failure of a component to perform its specified function or a failure of a component to operate at its specified rate.
- 4.) Frequent activation of overload protection elements in similar devices.
- 5.) Loosening of anchoring or attachment provisions on similar devices.
- 6.) An increasing level of noise being generated by similar devices.
- 7.) A structural failure due to BHS supports, hangers, or headers.
- 8.) Inappropriate action of control or sensor elements during operational conditions.
- 9.) Occurrence of an accident or an imminent safety hazard revealed during operational conditions.
- 10.) Uncovering of a condition of specification non-compliance or degradation of specified functional requirements during the warranty period.
- 11.) More than 2 failures on one or more components or assemblies of components of similar construction or design, used in similar devices.
- 12.) More than 2 unscheduled replacements of an expendable component in similar devices.

- c. The Owner shall act to resolve any disputes regarding the definition of a design failure in a fair and equitable manner.

5. Period and Responsibility

- a. If, within three (3) years from the date of Final Acceptance of the work, the work or the system, or any equipment, material or software is found, in any respect, not to conform to the Warranty set forth herein, within forty-eight (48) hours of notification by the Owner, initiate the following series of steps in order to correct the deficiency:
 - 1.) Determine the cause of failure.
 - 2.) Prepare drawings showing recommended design changes and submit to the Owner or their representative.
 - 3.) The Owner or their representative shall comment with a change request or approval.
 - 4.) Make design changes if requested.
 - 5.) After the Owner or their representative has approved the design, all components of the system incorporating the same design deficiency shall be modified as agreed upon by the Owner or their representative.
 - 6.) The Parts Warranty period and the Design Warranty period shall start again for

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the changed item/system on the date that the design change has been incorporated if the make, manufacture or model is replaced.

END OF PART I -

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PART II - PRODUCT SPECIFICATIONS

2.01 ACCEPTABLE MANUFACTURERS

A. BHS Contractors

1. Subject to compliance with requirements, the following firms are qualified to perform as BHS Contractors for this Project:
 - a. Automatic Systems, Inc., Kansas City, MO
 - b. Diversified Conveyors, Inc., Memphis, TN
 - c. Equipment Erectors, Inc., Somerset, NJ
 - d. Glidepath LLC, Grand Prairie, TX
 - e. Daifuku Airport Technologies, Novi, MI
 - f. Logan Teleflex, Inc., Louisville, KY
 - g. Pteris Global (USA), Inc., Littleton, CO
 - h. Siemens Airport Logistics, DFW Airport, TX
 - i. Five Star Airport Alliance, Salt Lake City, UT
 - j. Vanderlande Industries, Inc., Marietta, GA

B. BHS Equipment Subcontractors

2. Subject to compliance with requirements, the following firms are qualified to perform as component subcontractors for this project:
 - a. Diversified Conveyors, Inc., Memphis, TN
 - b. Equipment Erectors, Inc., Somerset, NJ
 - c. Glidepath LLC, Grand Prairie, TX
 - d. Daifuku Airport Technologies, Novi, MI
 - e. Pteris Global (USA), Inc., Littleton, CO
 - f. Siemens Airport Logistics, DFW Airport, TX
 - g. Five Star Airport Alliance, Salt Lake City, UT
 - h. Vanderlande Industries, Inc., Marietta, GA

C. BHS Controls Subcontractors

3. Subject to compliance with requirements, the following firms are qualified to perform as BHS controls subcontractors for this project:
 - a. Alliant Technologies, Louisville, KY
 - b. Brock Solutions, Kitchener, ON

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- c. Control Touch Systems, Louisville, KY
- d. Glidepath LLC, Grand Prairie, TX
- e. Daifuku Airport Technologies, Novi, MI
- f. Pteris Global (USA), Inc., Littleton, CO
- g. Siemens Airport Logistics, DFW Airport, TX
- h. Five Star Airport Alliance, Salt Lake City, UT
- i. MCS Automation, Farmingdale, NJ

D. BHS Equipment

- 4. In order to establish a minimum standard of quality and reliability, the following manufacturers have been listed for various components of the BHS.
- 5. This list has been presented to establish this standard and the manufactures on this list shall not be perceived or construed as favored or preferred. This list shall, in no way, preclude other manufacturers, provided that their equipment and components have been reviewed by the Owner or their representative and determined to be of equivalent or similar quality, functionality, and reliability. The Owner or their representative's decision in this regard shall be final.
 - a. For Bearings:
 - 1.) Browning (Emerson Power Technologies)
 - 2.) Dodge (Baldor Electric Company)
 - 3.) Fafnir/The Timken Company
 - 4.) Sealmaster/Morse Industrial Corp. (SF, SFT, ST, STH Goldline or Sealmaster Material Handling (MH) Series)
 - 5.) SKF Bearing Services Company
 - b. For Brakes:
 - 1.) Dodge ("D" Type) (Baldor Electric Company)
 - 2.) Stearns Electric (Rexnord Industries)
 - 3.) Warner Electric (Failsafe)
 - c. For Motorized Pulleys:
 - 1.) Rulmeca (Formerly Joki)
 - 2.) Van der Graaf (model UMV)
 - d. For Flat Plate Make-Up/Claim Devices:
 - 1.) Beumer Glidepath (Glidepath Design) Small Projects
 - 2.) Daifuku (Webb Design)
 - 3.) Diversified Conveyors

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- 4.) Five Star Airport Alliance
- 5.) Pteris Global (USA), Inc.
- 6.) Siemens Airport Logistics
- 7.) Vanderlande Industries, Inc.
- e. For Control/Communication Products:
 - 1.) Motor Starters:
 - a.) Allen-Bradley
 - b.) Cutler Hammer
 - c.) Square D (Type S)
 - d.) Telemecanique (TeSYS U-Line Series)
 - 2.) Programmable Logic Controllers (PLCs):
 - a.) Allen-Bradley
 - b.) Siemens
 - c.) Telemecanique-Modicon and Quantum series
 - 3.) Photoelectric Controls:
 - a.) Allen Bradley
 - b.) Banner Engineering Corp
 - c.) Cutler Hammer
 - 4.) Variable Frequency Drives (VFD):
 - a.) ABB (Model ACS 350)
 - b.) Allen Bradley/Rockwell Automation
 - c.) SEW Eurodrive
 - d.) Telemecanique (Altivar Series)
- f. For Motor Control Panels (MCP Cabinets):
 - 1.) EMF Company, Inc
 - 2.) Hoffman Engineering Co.
- g. For Motors:
 - 1.) Baldor

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- 2.) LeRoy Somers (Part of Emerson Motor Technologies)
- 3.) Reliance Electric (Part of Baldor Electric Company)
- 4.) SEW Eurodrive
- 5.) U.S. Motors (Part of Emerson Motor Technologies)
- h. For Reducers (shaft mounted):
 - 1.) Browning (Part of Emerson Power Transmission)
 - 2.) Dodge ("TXT" ABHS Series) (Part of Baldor Electric Company)
 - 3.) Link Belt, Inc.
 - 4.) SEW Eurodrive
 - 5.) Sumitomo
- i. For Reducers (foot-mounted or base-plate mounted):
 - 1.) Link Belt, Inc
 - 2.) Reliance Electric (In-Line, helical gear type) (Part of Baldor Electric Company)
 - 3.) SEW Eurodrive
 - 4.) Sumitomo
 - 5.) Emerson Power Transmission
- j. For Signaling Devices (audible alarms):
 - 1.) Allen Bradley
 - 2.) Edwards Co. Signaling Products Div.
 - 3.) Federal Signal Corporation
 - 4.) Mallory Company
- k. For Signaling Devices (visual alarms):
 - 1.) Allen Bradley
 - 2.) Cooper Crouse-Hinds
 - 3.) Federal Signal Corporation
- l. For Uninterrupted Power Supply (UPS):
 - 1.) APC
 - 2.) Eaton Powerware

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- 3.) Leibert (Part of Emerson Network Power)
- m. For Draft Curtains:
 - 1.) TRAX Industrial Products
- n. For Powered Fire/Security Doors:
 - 1.) Raynor
 - 2.) The Cookson Company
 - 3.) Vigneaux Corporation
- o. For Soft Start Devices:
 - 1.) Allen-Bradley
 - 2.) Nordic
 - 3.) Reuland Electric
- p. For Power Regulators:
 - 1.) Sola/Hevi-Duty Electric

2.02 MATERIALS

A. General

- 1. All welding and qualification of welders shall comply with AWS D1.1.
- 2. All fasteners shall be zinc-plated, cadmium plated or stainless steel. All fasteners shall be locked with lock nuts or lock washers.
- 3. Use of alternate materials
 - a. Whenever an article or any class of articles, devices or material are specified by the trade name or by the name of any particular patentee, manufacturer, or dealer, or by reference to the catalog of any such patentee, manufacturer or dealer, it shall be taken to mean and specify the articles, devices or materials specified and none other.
 - b. If the BHS Contractor desires to use any articles or materials which he believes are equal in quality, finish and durability, and equally as suitable for the purpose for which intended as the particular articles, devices or materials specified, he shall indicate his desire to the Owner or their representative in writing.
 - c. The articles, devices and materials specified shall not be changed except with the written consent of the Owner or their representative, and the BHS Contractor shall not contract, purchase or cause to be delivered any substitute articles, devices or materials prior to obtaining such consent.

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B. Material

4. Structural Steel: ASTM A-36
5. Stainless Steel (Trim): AISC Type 304 with #4 Brush Finish
6. Plywood (FR-S Rated Fire retardant): Interior Type A requirements in AWPA Standard C-27.
7. Lumber (FR-S Rated Fire retardant): Interior Type A requirements in AWPA Standard C-20
8. Rubber/Neoprene: ASTM D-2000

2.03 FABRICATION

A. General

1. Fabricate equipment-using steel clean and free from rust, rust pits, kinks and sharp bends. Use forming methods that will not fracture or otherwise damage the metal. Remove burrs, sharp edges, and sharp corners. Smooth all joints and round all corners. Align joints in components to ensure smooth conveyance of baggage.
2. Holes in metal side guards for photocell beams are to be "punched", not burned, and tapered from the inside (wide) to the outside (narrow).
3. When two sections of conveyor bed meet, these joints shall be chamfered to ensure that there is no step-up condition between bed sections.

B. Pulleys

1. General

- a. All shafts shall be designed to CEMA standard No. 402-1992 and all subsequent revisions. Shafts are to be AISI 1018 steel, polished and ground and within tolerances for the associated bearings.
- b. All pulleys are to be dynamically balanced. Rollers of eccentric material, such as standard pipe, are to be dynamically balanced.

c. Run-out:

- 1.) The maximum shaft run-out of all assembled pulleys, shafts and bearings under a no-load condition, measured from the centerline of the bearing to the end of the related shaft furthestmost from the conveyor, shall not exceed .0075" per inch.
- 2.) The maximum run-out of any pulley shell shall not exceed .060".

d. Machining:

1.) Swaged:

- a.) Pulleys shall be 10-gauge (minimum) thickness with 3/8" (minimum) thick end plates.
- b.) End pulleys are to be swaged between centers to create a trapezoidal face

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with a taper from the pulley end to a minimum 25% of the pulley length thereby having 50% of the pulley flat in the center.

2.) Machined:

a.) If end pulleys are machined (not swaged) using Schedule 40 pipe, center plates must be made

from 1/2" thick steel plate and shall have bored centers to facilitate a slip fit on the shaft.

b.) Pulleys are to be turned between centers to create the crown or trapezoidal. Pulleys shall be crowned from each outer end to within 1/2" of the centerline leaving 1" straight but turned true to standard thickness required for each pulley application. When welding is involved, turn the assembly after welding to true the weldment and create the crown/trapezoidal.

c.) The recommended minimum wall thickness after crowning or trapezoidal shall be as follows:

Pulley Diameter	Minimum Wall Thickness
8-5/8"	5/32"
12-3/4"	7/32"
16"	11/32"
18"	11/32"

e. Hub plates shall be made from 3/8" (minimum) thick steel plate turned and bored to fit on the shaft or have a taper locking hub arrangement welded in the end plate.

f. All pulleys shall be manufactured for high-speed application.

g. All bearings shall be supplied pre-lubricated and sealed for life with plugs inserted into the grease fitting bore. Bearings are to be secured to their respective shafts with an approved form (as specified in the submittal procedure) of eccentric or squeeze locking type collar arrangement.

2. Powered Pulleys

a. Drive pulleys

1.) All drive pulleys for intermediate-type drives shall be lagged with vulcanized lagging of 70 Durometer rating with a minimum thickness of 3/8". Lagging material on individual pulleys shall be compatible with the type of belting used on the associated conveyor. Examples of lagging material are as follows:

a.) Minimum 70 durometer carboxiled nitrile

b.) Minimum 70 durometer thermo-set urethane

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- 2.) Powered pulleys shall be steel, crown faced, flat faced, or trapezoidal (per the belting manufacturer's recommendation), shall be equipped with taper-lock type hubs with 1-7/16" minimum diameter shafts mounted in eccentric locking-type or squeeze locking type precision and ground flange-type ball-bearing units.
 - 3.) The minimum acceptable belt wrap on drive pulleys shall be 210°.
 - 4.) Drive pulleys for end-type drives must be lagged with a minimum 3/8" thick vulcanized lagging of 70 durometer, again using lagging material compatible with the type of belting used on the associated conveyor. In addition, powered pulleys shall be 6" with taper lock hubs with 1-7/16" minimum diameter 1018 TGP (turned, ground and polished) steel shafts mounted in eccentric locking type precision and ground flange ball bearing units.
 - 5.) Drive pulley and shaft sizes shall be determined by maximum belt pull. The following are provided as examples:
 - a.) Light-Duty: 250 lb. maximum belt pull. Consists of a 6-3/4" minimum diameter drive pulley with a 1-7/16" minimum diameter shaft. Bearings mounted with two bolts can be used with light duty applications.
 - b.) Normal-Duty: 500 lb. maximum belt pull. Consists of an 8-3/4" minimum diameter drive pulley with a 1-11/16" minimum diameter shaft. Roller chain, if used, shall not be less than RC - 60. Bearings mounted with two bolts can be used with normal duty applications.
 - c.) Intermediate-Duty: 1000 lb. maximum belt pull. Consists of a 10-3/4" minimum diameter drive pulley with a 1-15/16" minimum diameter shaft. Roller chain, if used, shall not be less than RC - 60. Bearings mounted with four bolts are to be used with intermediate duty applications.
 - d.) Heavy-duty: 1,500 lb. maximum belt pull. Consists of a 12-3/4" minimum diameter drive pulley with a 2-7/16" minimum diameter shaft. Roller chain, if used, shall not be less than RC - 80. Bearings mounted with four bolts are to be used with heavy-duty applications.
- b. Motorized Pulleys
- 1.) The reduction gears and motors associated with power driven pulleys shall be mounted in an oil bath for lubrication and heat dissipation. The design of the pulley shall permit the lubrication oil level to be checked without dismounting or removing the drum motor from the conveyor frame. The lubricant shall be rated for 10,000 hours of life. Gears shall be hardened and ground steel alloy.
 - 2.) In addition, drums shall be machine crowned and lagged to facilitate belt tracking. Lagging material on individual motorized pulleys shall be compatible with the type of belting used on the associated conveyor.

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- 3.) Power: The power supply shall be connected directly to the starter without the use of slip rings and brushes. The terminal board housing (if used) must be capable of being rotated 180° to facilitate the direction of cable inlet.

C. Drive Assemblies

1. Submit to the Owner or their representative for approval a schedule of all drive assemblies showing configuration of motor and reducer assembly. The selection of the drive assembly shall be based on efficiency, low noise, sized for the application, achieves long service life and has low maintenance.
2. End-type drive units may be used for conveyors 25' or less in length, with intermediate drives used for conveyors over 25' long.
3. The configuration of the drive assembly motors and reducers shall be based on a direct shaft mounted speed reducer and gear box design to simplify the installation, and maintenance of the equipment, noise levels, and spare parts considerations. The selection of the drive assembly shall be based on efficiency, low noise, sized for the application, achieves long service life and has low maintenance.
4. The use of a non-direct shaft mounted speed reducer and gear box design shall only be permitted in select locations upon the review and approval of the Owner. All non-direct shaft mounted assemblies should be identified on the shop drawing submittals.
5. For non-reversing conveyors, the drive assembly shall be located towards the head end of the conveyor.
6. For reversing conveyors, the drive assembly shall be located as close to the midpoint of the conveyor as possible.
7. Motors:
 - a. The conveyors shall be driven by AC induction motors (except where motorized pulleys are used). The motors shall conform to AIEE, NEC and NEMA standards. These motors shall be equipped with two-groove minimum, taper-lock type hubs, and "A" or 3VX -belt sheaves.
 - b. Motors shall be sized for maximum load and belt speed requirements under continuous operation (minimum of 1 HP unless approved by the Owner or their representative) and, where applicable, shall be capable of withstanding shock caused by frequent starting and stopping under full load conditions. Motor FLA will be measured with full load during load tests and any motor that draws more than the name plate FLA (after start up in rush current has flattened) must be replaced with a motor of appropriate size that will result in no more than the max name plate FLA during load test.
 - c. Motors shall also be of the constant speed (nominally 1800 RPM), continuous service, and ball-bearing type with a minimum of class "F" insulation. For 2hp motors and smaller class "B" insulation shall apply.

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- d. If overrun is critical to system control operation (i.e., wherever baggage tracking is required), motors shall be equipped with automatically applied brakes to prevent overrun after the motors are de-energized.
- e. With the exception of "High-Slip" design motors, for applications that require dual drives, and motors that are controlled by "VFDs", all of the BHS motors shall be copper-wound NEMA Design "B" open drip proof or TEFC with Class F insulation, utilize a "T-frame" base, and shall be provided with overload protection in the motor control panel. These motors shall have a minimum of 1.15-service factor. High-Slip Motors are required by specification where the use of dual drives is used. These motors shall be copper-wound NEMA Design "D", Class "H" Insulation at 1.0 Service Factor with Class "F" temperature limits. Inverter Duty or Inverter Ready Motors shall be used at "VFD" controlled applications. These motors shall be copper-wound NEMA MG1, Part 31 Rated Design "B", Class "H" Insulation at 1.0 Standard Service Factor with Class "H" temperature limits. All motors shall be of the "high efficiency - low energy" type.
- f. All motors shall meet the following criteria:
 - 1.) Low noise
 - 2.) Removable conveyors (e.g. EDS device in feed and exit conveyors) shall be equipped with heavy-duty quick couplings for electrical connections
 - 3.) Fitted with low noise fan reduction guard or equivalent.
- g. Motor size selection shall be based on the design load and friction coefficient requirements as described in these specifications. Motor size shall not exceed 7½ HP, unless otherwise approved by the Owner or their representative. Use minimum 1 horsepower motors (unless other specified or approved by the Owner or their representative). All drive motors shall be provided in 1, 1½, 2, 3, 5 or 7½ horsepower. Size conveyor equipment drive motors to permit start-up under full load conditions at the specified frequency of start-up cycles per minute without exceeding a temperature rise of 68°C based on an ambient temperature of 40°C. Provide motors designed for 480 VAC, three phase, 60-Hertz operation.
- h. C-faced motors (with VFD control) can be utilized. Such usage shall be coordinated with the Owner or their representative.
- i. Motor mounts shall be equivalent in function to Dodge Type "A" slide motor bases with boltholes drilled and tapped, or tack-welded nuts under the holes in the top portion of the mounting plate. Use of loose nuts to hold the motor mount is unacceptable. Provide jacking bolts to resist effect of belt or chain pull on foot mounted motors.
- j. On all belts with frequent start/stop operations, such as indexing belts, all motors

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shall be continuous-running NEMA-B design, coupled with VFD control or clutch/brake arrangement.

- k. In the case where the conveyor line configuration, related controls and baggage input/processing are directly associated with the EDS or is in a tracking zone, the conveyor shall be equipped with a VFD.
- l. All clutch/brake discs shall not contain any asbestos material.
- 8. Reducers
 - a. Shaft-mounted reducers shall be attached with tapered type bushings or full length bore with keyway.
 - b. Reducers shall be sized for a Class II application (minimum). Based on actual motor horsepower, the service factor required to obtain an L10 life of 70,000 hours shall be as follows:
 - 1.) For reducers utilizing ball bearings the service factor used shall be 2.4
 - 2.) For reducers utilizing roller bearings the service factor used shall be 2.2.
 - c. Reducers shall have adequate provisions for drain, fill, inspection ports and sight gauge. The manufacturer's recommended lubrication shall be attached to the reducer by means of a riveted or bolted stamped metal tag. All units shall be installed with proper lubrication and vent plugs intact upon start-up of conveyor.
 - d. Reducers used on inclines where roll-back would be critical shall be equipped with "backstop" devices or brake motors.
 - e. All bearings within the reducer shall have a minimum L-10 life of 70,000 hours based on service factor and loading of conveyors, and on the manufacturer's published data showing load rating of each bearing used.
- 9. General Drive Requirements
 - a. Where applicable, all gear reducer-mounting frames shall be fabricated from 1/4" thick steel "C" channels. The mounting frame shall be so designed to allow bolting to both the bottom and sides of the conveyor bed. The mounting frame shall be a totally separate weldment that can be unbolted to allow for installation as either a right or left hand drive. The mounting frame shall span the full width of the conveyor bed and attach to both sides of the bed frame.
 - b. Electro-mechanical brakes, if required, shall be internally mounted. The stopping torque shall be at least equal to the starting torque of the motor.
 - c. The drive unit shall be provided with a factory warranty for 2 years or 15,000 operating hours, whichever is longer.
- 10. Mounting

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- a. C-Faced
 - 1.) Mini In-Line foot mounted reducer is an acceptable mounting method.
 - 2.) The C-faced configuration with VFD control used on conveyors capable of continuous stop/start operation (i.e. queues or indexing conveyors) shall be capable of a minimum of 60 continuous start/stop operations per minute in an unloaded condition.
- b. Foot Mounted or Base-Plate Reducer and Motor Mount
 - 1.) The gear reducer shall be mounted on a fully adjustable mount. To allow for fast, easy motor and gear reducer replacement and adjustment, the mount shall be designed as follows:
 - a.) The mount shall be a two-piece assembly:
 - (1.) The bottom portion can be bolted or welded to the mounting frame (as specified above).
 - (2.) The top portion shall be designed to slide over the bottom portion and be adjustable via a single bolt adjustment. The top of the motor mount shall have bolt holes drilled and tapped to accept the layout pattern as the gear reducer mounting feet or the multi-mount feet.
 - b.) Use of tack-welded nuts under the holes in the top portion of the mounting plate shall be acceptable in lieu of tapped holes; however, the use of nuts to hold the motor in place shall not be acceptable.
 - c.) The purpose of this design is to allow replacing the motor by using an extension and properly sized socket from above without having to hold locking nuts.
 - d.) Use of Dodge Type "A" Slide Motor Bases is recommended, or an approved equal, for this application.
 - e.) All drive units shall be equipped with a suitable guard of "clamshell" design with tamper-proof fasteners, and fabricated from a minimum of 16-gauge steel. All guards shall comply with applicable OSHA standards and have an expanded metal-screened window to allow belt inspection without removal of the guard.
- 11. All drive motors and reducers shall be equipped with drip pans. The drip pan shall be constructed out of minimum 14-gauge steel. The drip pan shall be appropriately mounted such that the pan must be secured in the horizontal attitude and shall not impact maintenance access.
- 12. Whenever possible, all drive sprockets and V-belt sheaves shall have a taper-lock type of hub construction, with keyways. When keyways are used, they shall be secured by two sets of screws, one on top of the other to ensure positive locking of keyway. Sprockets shall be steel with a minimum of thirteen Type B form teeth.

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13. Driving and driven sheaves shall be (minimum) two-groove "A" or 3VX section sheaves with taper-lock type hubs.
14. Roller chain shall be compatible with the torque and horsepower requirements of the application and shall be RC-60 minimum size. The roller chain ends shall be connected with a removable connecting link.
15. All pulley and sprocket adjustments provided for the purpose of adjusting belt tension, belt tracking, drive chain tension, and drive chain alignment shall incorporate a positive means of adjustment and restraint (i.e., tensioning screws and locking nuts). Slotted holes for mounting bolts shall not in themselves be considered satisfactory.
16. Chain drive sprockets shall be designed for a sprocket ratio between the driven and drive sprockets as close as possible to 2:1, but not less than 1.5:1 or greater than 2.25:1. The maximum size for driven and drive sprockets shall be 35 and 18 tooth respectively. Wherever possible within the standard range of stock Taper lock-type sprockets, hardened tooth sprockets shall be provided.

D. Flexible Couplings

1. Mount coupling hubs to their respective shafts with keys and two setscrews, one of which shall be over the key and the other 90° from the key. When keyways are used, they shall be secured by two sets of screws, one on top of the other to ensure positive locking of keyway. The use of a screw-locking compound in lieu of two – (2) setscrews is acceptable.
2. Select the coupling so as to permit the replacement of internal parts without removal of the motor or reducer.

E. Intermediate Sections

1. Provide conveyor frames capable of supporting a uniform load as specified with supports at a maximum center distance of 10'-0".
2. Construct the slider bed shell of 12-gauge minimum hot rolled steel and designed to present a smooth surface to the belt. The slider bed shall be well braced for rigid construction with the side frames a minimum of 6" x 1-1/2" channel or equivalent. A minimum of 1 1/4" x 1-1/4" x 3/16" angle stiffeners shall be welded to the underside of the slider bed at a maximum center distance of 3'-4" on transport conveyors and 2'-6" centers on load conveyors. Butt-coupled joints shall be provided.
3. When two – (2) sections of slider bed meet, both sections shall have chamfered slider bed lips to ensure that there are no step-up conditions between slider beds.

F. Floor Supports

1. Provide floor supports for conveyors located within 7'-6" of the floor or any mezzanine that is shown on Contract Drawings. Locate floor supports at intermediate section splices or within 1'-0" of intermediate section splices at 10'-0" maximum spacing.
2. Supports shall be on 5'-0" centers on loading/unloading conveyors and on 10'-0"

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maximum centers elsewhere. In all cases, each bed joint shall be supported.

3. All floor supports shall be of an "H" type design (i.e. two legs with a horizontal brace member) with vertical field adjustability of $\pm 3"$. Floor support vertical members shall be constructed of 10 gauge, hot rolled formed steel channel with 10 gauge, hot rolled steel universal foot and head plates.
4. All conveyor floor supports shall be secured to the floor with a minimum of two (2) anchoring devices per leg (e.g., stud expansion anchor bolts).
5. All conveyors shall be adequately sway braced in order to ensure that there is no lateral or longitudinal displacement.
6. All support structure must be designed and installed so that maintenance access to the conveyor components and access to catwalk(s), work areas and drive aisles are not blocked.
7. The location of the floor support shall not impede the installation/removal of the conveyor gap pan.

G. Safety Guards

1. Provide and install conveyor underpans on conveyors with clear heights between 18" and 7'-6" above the floor or within an envelope around a catwalk defined as 7'-6" high and 4' wide on either side of such catwalk. Fabricate underpans of either solid sheet metal or expanded metal at least 14 gauge thick and fasten to the conveyor intermediate section. The underpans, regardless of type shall be piano-hinged and provided with tamper proof fasteners for easy maintenance access, with appropriate tools; the pin shall have a lanyard attached to reduce potential of losing the pin. Sheet metal screws will not be accepted.
2. Protect all exposed moving parts of conveyors, such as, but not limited to, pulleys, rollers, lower or return belts, shafts and couplings less than 7'-6" above the floor or within an envelope around a catwalk defined as 7'-6" high and 4' wide on either side of such catwalk. The guards shall be made of sheet metal not less than 14 gauge thick, and secured with tamper proof fasteners for easy maintenance access, with appropriate tools.
3. Install appropriate safety guarding secured with tamper-proof fasteners on all exposed parts associated with the conveyor drive's rotating shaft and direct drive gearbox, in compliance with OSHA Standards 1910.219. Ensure that the proposed safety guarding does not restrict maintenance access and it is easily removable with appropriate tools, as the location requires, for maintenance access.
4. Protect all exposed parts of conveyors, such as, but not limited to, pulleys, rollers, lower or return belts, shafts and couplings within the CBRA with a metal shroud on both sides of the conveyor segment(s) to protect the TSA's staff from the exposed moving parts, dampen the noise generated by the conveyor equipment within the

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CBRA, and to prevent items from falling under the clear and suspect bag conveyors. The guards shall be made of sheet metal not less than 14 gauge thick, and hinged and pinned for easy maintenance access. Fasten with tamper-proof fasteners with captured nuts or similar means of avoiding losing parts.

5. Enclose all drive chains and belts using sheet metal protection covers at least 16 gauge thick. Hinge the covers at one end for ease of maintenance and size the covers with sufficient clearance to prevent contact to chains and belts. Fasten with tamper-proof fasteners with captured nuts or similar means of avoiding losing parts.
6. Eliminate or round unguarded exposed sharp corners and edges of items such as, but not limited to, support legs, braces and trim, to prevent injury to personnel or damage to their clothing. Locate no overhead steel framework, conveyor part, or support structure less than 8' above any catwalk, ramp or stair tread nose. If due to building constraints, support structure is less than 8', the structure, framework, and supports shall be encased in padding, identified with safety marking (yellow/black stripped tape) and a prominently positioned low overhead warning sign.
7. Install tamper proof fastened bearing covers on all exposed rotating shafts in workstation areas and in all maintenance areas with catwalks. Workstation areas shall, at a minimum, include, sort devices/conveyors, load conveyors, CBRA work areas and EDS work areas. Install appropriate safety guarding on all exposed parts associated with the conveyor drive's rotating shaft and direct drive gearbox, in compliance with OSHA Standards 1910.219. Ensure that the proposed safety guarding does not restrict maintenance access and it is easily removable with appropriate tools, as the location requires, for maintenance access.
8. Install tamper proof fastened finger guards on all Return/Idler Rollers on conveyors not equipped with underpans.
9. For conveyors in areas with a maximum noise level of 65 db (A) or less (such as the CBRAs), mount all guards with rubber isolation washers or strips (as applicable) between sideguards and the conveyor frame to minimize noise levels.
 10. Gap pans must be provided and installed on all conveyor-to-conveyor junction points or transfer locations, where there is any likelihood of small objects falling to the floor, mezzanine or catwalk. Gap pans must be solid sheet metal not less than 12 gauge, unless otherwise approved by the Owner or their representative, with minimum 2-inch high sides on the edges. The gap pan must be no wider than the conveyor width and a minimum of 18 inches long. Mounting must be such as to permit easy lowering and removal for cleaning.
11. Drive pans shall be provided and installed on all conveyor drive sections. Drive pans must be solid sheet metal. They shall be no wider than the conveyor and associated catwalk width, and no longer than the drive section.
12. All gearbox assemblies shall be equipped with drip pans. The drip pans shall be fitted with drain plugs to assist with clean up. Drip pans shall be solid sheet metal, not less

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than 12 gauge, unless otherwise approved by the Owner or their representative, with minimum $\frac{3}{4}$ " high sides on all four edges. The drip pan shall be a bolt-mounted unit of the gearbox assembly.

13. Provide safety guards and signage adjacent to the pinch points associated to High Speed Paddle Diverters.
14. Breakaway End Cap Safety Guard
 - a. Provide a safe and reliable breakaway end cap safety guard on all run out conveyors that will immediately stop the conveyor and prevent injury to personnel and damage to baggage in the event that a person or part thereof or a bag gets lodged between the conveyor belt and the end cap.
 - b. The design of the end cap safety guard shall not cause undue nuisance alarms during ordinary operation. Activation of the end cap interlock must annunciate an alarm on the MDS display.
 - c. When resetting the end cap interlock device, the operator must go through the normal subsystem startup procedure following all safety starting procedures.
 - d. Construct the end cap for public areas of stainless steel to match ticket counter stainless steel finish; in all non-public areas, paint the end cap safety yellow to comply with all safety requirements.
15. Refer to "Head and Tail Pulleys" section of this specification for details on end pulley finger safety guards.

H. Side Guards

1. Provide side guards the full length of both sides of all conveyors except at points that baggage is loaded or removed.
2. Provide hinged or removable sections only where overhead clearance restricts access for clearing jams. Design hinged or removable side guards to permit rapid removal (removable without tools). The design must preserve rigidity and alignment equivalent to fixed side guards. The Owner or their representative must approve all locations where hinged or removable sections are to be used.
3. Side guards shall be minimum 12-gauge hot rolled steel, integral to the slider bed. Side guards shall incorporate a formed 90° edge turned away from the conveyor and a formed 90° edge turned down to eliminate sharp edges. There shall be no gap between the side guard and bed section that can cause jams or baggage tags to be snagged/ripped off.
4. Use type 304 stainless steel with #4 brushed satin finish uniform throughout passenger areas (such as but not limited to claims, check-in, or curbside) and through penetrations into non-public areas. Stainless steel in public areas shall incorporate smooth flush edge seams. Radius type edges are not acceptable.
5. All stainless steel back guards in public areas such as ticket counter, curbside, and over

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size load belts shall incorporate stiffening supports that are attached to the conveyor frame by means of a welded or bolted connection. The stiffening supports shall be attached to the stainless back guarding by means of a keyholed slot in the support and a welded stud on the back guarding.

6. Use cold rolled or hot rolled low carbon steel galvanized or hot dip, primed and painted on both surfaces in areas exposed to the weather.
7. Use cold rolled or hot rolled low carbon steel primed and painted on both surfaces in all interior areas.
8. Provide side guards with vertical stiffeners a maximum of 40" on center for transport conveyors and 30" on center for load conveyors. Make the stiffeners from steel angle at least 1-1/4" by 1-1/4" by 3/16".
9. Provide 30° transition panels between side and back guards of different heights.
10. Provide holes 1.5" in diameter located either 2.5" or 3" from the top of the belt to the center of the hole through side guides for photocell beams as required. Punch the holes with a dimple away from baggage flow to minimize the possibility of snagging a bag and causing a jam. Deburr all photocell holes so that they are free of sharp edges and burrs.
11. Provide removable side guards at locations where pusher diverters or 45°merges shall be installed at a later date.
12. Mounting of any mechanical or electrical equipment on the outside radius side guard of power turns is not accepted since it restricts maintenance access to the outer perimeter chain or guide bearings of the turn belt.
13. Provide marking of CBIS conveyor sideguards as specified in Part 3 of these specifications.

I. Bearings

1. All bearings shall be pre-lubricated, self-aligning, anti-friction and sealed for the specified life of the bearing. Lubrication fittings shall be removed (removal to be approved by the Owner or their representative) at the time of installation or at the factory and replaced with appropriate plugs.
2. All bearings shall have a minimum L-10 life of 70,000 hours based on service factor and loading of conveyors, and on the manufacturer's published data showing load rating of each bearing used.
3. All bearings shall be surface-mounted flange bearings attached to the outside of the conveyor bed.
4. Bearings are to be equipped with an eccentric or squeeze locking type collar arrangement to secure the bearing to the related shaft.
5. All bearings and exposed shaft ends at load conveyors, unload conveyors, ETD work areas and EDS work areas shall be covered with bearing covers.

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J. Hardware

1. Provide zinc plated or otherwise treated fasteners. Use washers, lock washers and nuts.
2. All fasteners in public areas are to be made of stainless steel and are described elsewhere in these specifications.

2.04 FLAT PLATE CLAIM DEVICES

A. General

1. Flat plate devices shall be constructed of articulating, heavy duty, metal crescent-shaped plates forming a continuous rotating flat surface.

B. Dimensions

1. The usable plate width for flat plate devices shall be between 32" and 35" (plate width will be dependent on the flat plate manufacture selected).
 - a. The height of flat plate devices shall be as follows unless otherwise specified or shown on the Contract Drawings:
 - 1.) Claim devices: 1'-1"

C. Load Rating

1. All flat plate devices shall be capable of supporting a minimum dynamic load of 85 lb. per linear foot and a single concentrated static load of 200 pounds.

D. Operating Speeds

1. Device operating speeds for flat plate devices shall be 90 fpm.

E. Drives

1. The drive shall consist of a heavy-duty roller chain driven by a motor through a gear reducer. The motors and speed reducer assembly shall be connected using double grooved sheaves and matched V-belts. Drives shall be designed such that the speed reducer drives an endless chain equipped with a minimum of twelve heat treated dogs which shall engage drive pins in the main chain. The chain must engage at least two carrier assemblies at all times. The drive chain must be self-aligning and supported throughout its length.
2. Drives shall be provided with an appropriately sized soft-start controller.
3. The design of the drive circuitry shall be such that the drive motor safety disconnect switch will also open the control circuitry of the device whenever the disconnect switch is turned off. Whenever the disconnect switch is turned back on, it shall be required to reactivate the appropriate device start controls, thus allowing the drive motor start-up to be controlled by the soft start controller.
4. A minimum of two drive units, are required for all baggage make up applications due to redundancy requirements. The device shall be designed and configured such that if

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one of the drive units should fail, the device shall continue to operate at 100% capacity including the ability to start-up under full load conditions with the remaining drive unit. Easy access and means for disconnecting failed drive unit shall be provided to allow for system maintenance with a minimum of time and effort. Drive design and motor applications must provide for the potential of variations in “actual” motor speeds so that the drive motors are equally loaded. The motor used in the dual drive units is to be of the “high slip” design type.

5. High-Slip Motors are required by specification where the use of dual drive units is used. These motors shall be copper-wound NEMA Design "D", Class "H" Insulation at 1.0 Service Factor with Class "F" temperature limits. Inverter Duty or Inverter Ready Motors shall be used at "VFD" controlled applications. These motors shall be copper-wound NEMA MG1, Part 31 Rated Design "B", Class "H" Insulation at 1.0 Standard Service Factor with Class "H" temperature limits. All motors shall be of the "high efficiency - low energy" type.
6. For ease of drive synchronization, variable frequency controllers are acceptable.
7. The device drive and idler shaft sprockets must be restrained through the use of double setscrews to prevent any lateral movement of the sprockets on the respective shafts. Setscrews alone are not sufficient.
8. Drives shall be designed for operation from a 480 VAC, 3-phase, 60 Hz power source. The drive shall be sized to permit start-up under full load conditions.
9. One 120 VAC, single-phase, 60 Hz duplex outlet shall be provided as a maintenance outlet in the general vicinity of each drive assembly.
10. The BHS control circuitry must be designed to ensure that the flat plate device is running at full speed prior to the start-up of any feed conveyors.
11. Install in close proximity to one of the drive units a control station with a Maint/Auto switch and a jog pushbutton for use by maintenance personnel only. When the switch is in the maintenance position, the device can move (jog) in the forward direction only when the jog pushbutton is held in.

F. Pallet/Flight Assemblies

1. All pallets consisting of 5/16" thick steel plates shall be provided. These steel plates must have a black urethane coating.
2. Gaps between adjacent pallets of the device shall not exceed 1/8".
3. Elevation differences between adjacent pallets shall not exceed 1/16".
4. All exposed mounting screws shall be counter sunk.

G. Frame and Pallet Support System

1. A support system and guide for the chain and pallets constructed of standard modular assemblies bolted together shall be provided. The track space must be fabricated from

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rolled or formed structural steel and shall form an integral part of the support structure. The structural supports for the tracks shall be spaced at a maximum of 5' on center. Pallets must be supported by a minimum of two rows of polyurethane tired ball bearing wheels. Leveling screws located at the base of each frame module shall allow for easy adjustment of the assembly. Leveling screws should provide a minimum elevation adjustment of 1".

2. Once the structure of the device has been installed and properly aligned, all track joints and cam follower guide rail joints shall be welded and ground smooth to assure that the related track and guide surfaces are smooth and without vertical and horizontal differences.
3. The design of the flat plate device shall incorporate a means of expansion of the device to offset any wear in the main link bushings/connecting link pins. At a minimum, this shall include the following provisions:
 - a. Overlapping design of the cam follower guide track so that the cam follower surface is always in contact with some portion of the guide track at the expansion joint.
 - b. Heavy duty jacking bolt arrangement to assist in expanding the device when needed.

H. Finish and Trim

1. Baggage Claim Applications

- a. All steel trim elements of the flat pallet device that are located in the public area of a terminal shall be 304 stainless steel with a #4 brush finish. Stainless steel shall incorporate smooth flush edge seams. Radius type edges are not acceptable. All stainless steel trim elements must be properly aligned both vertically and horizontally. Butt joints of adjacent stainless steel trim elements must provide a smooth surface. Sharp edges on any of the stainless steel trim elements as well as voids between adjacent element joints are not acceptable. In addition, all radii of trim elements must match. All fasteners in public areas shall be made of stainless steel.
- b. Finger Guards
 - 1.) A finger guard consisting of 6", minimum 12-gauge stainless steel formed channel or angle side rails shall be installed. The 6 inch total width of the finger guard shall overlap the plates by 3 inches and shall overlap the outer radius of the turn when the plate is bent at a 90 degree turn. The gap between the pallets and the finger guard shall not exceed 3/32". The vertical and horizontal alignment of the adjacent butt joints of the finger guards must not be misaligned, nor is there to be any gap between the adjacent guards.
 - 2.) Special attention is to be given to the design, manufacture and installation of the stainless steel inner and outer perimeter finger guards as well as the vertical front face skirting at the expansion point of the flat pallet device.

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- 3.) The design, manufacture and installation of the perimeter finger guards at the device expansion points must assure that they do not create a snag point. To further reduce the potential of snagging baggage at these expansion joint locations, the finger guards are to be designed and installed in an overlapping manner. The overlapping finger guards are to be welded and ground smooth on the upstream end of each expansion joint location.
- 4.) All conveyor designs in the public areas must be coordinated with the Owner or his representative and the Project Architect.

c. Side Guards

- 1.) 21" high inner perimeter side guards shall be provided for the entire portion of the flat plate device not located in the public area. The design, manufacture and installation of these side guards shall comply with the specifications noted above for baggage make-up applications of flat pallet devices.
- 2.) The inner perimeter side guards shall be flared at the downstream side of any fire/security door. Additionally, a horizontal filler plate must be installed between the perimeter guard and the flared side guard to eliminate the bag snag point.
- 3.) An inner perimeter side guard shall be provided in the public area with stainless steel deck trim. The stainless steel trim for the interior decking of the device shall consist of a formed angle trim element 1" x 7-1/2" 12 gauge stainless steel. The formed angle trim will effectively act as a vertical skirting for the elevation difference between the pallets and the raised decking. The 1" portion of the angle shall provide a cap for the carpet (carpet is to be provided and installed by others) while the 7-1/2" portion of the angle shall provide the vertical skirting of which 6" shall be exposed. The remaining 1-1/2" shall be below the inner finger guard.

d. Decking

- 1.) Provide each flat plate claim device with a 3/4" FR-S rated fire resistant "tongue and groove" plywood decking supported by a framework of FR-S rated fire resistant structural lumber, or steel, designed for a dynamic load of 75 pounds per square foot. All plywood joints are to be fully supported by the deck support frame work/structure.
- 2.) Unless the drive is mounted outside the public area, a hinged access door(s) (with appropriate stainless steel trim as coordinated with the Project Architect) shall be provided in the decking in close proximity to the drive assembly. Additional access doors shall be provided as coordinated with by the Owner or his representative and the Project Architect over and above the access doors that are required at the drive locations to accommodate access under the decking for removal of back finger guards and maintenance

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purposes. The access door(s) shall be of sufficient size to permit removal of the drive assembly components and allow for routine maintenance of the assembly. The access door(s) shall be equipped with flush mounted grab handles.

- 3.) The top of the deck is to be carpeted. Carpeting of the deck is not in the scope of the BHS Contractors installation. Coordinate the installation of the stainless steel finishes with the deck carpet installation to provide a uniform finish.

e. Cove Molding

- 1.) A minimum 4-3/4" toe space shall be provided at the base of the front peripheral skirting. Black vinyl cove molding shall be installed at the back of the toe space and must be flush with the finished floor of the baggage claim area.
- 2.) Provide infill plates at all wall openings, material and design of infill plates shall be submitted to the Owner or his representative for review and approval prior to installation.

2.05 MISCELLANEOUS MECHANICAL EQUIPMENT

A. Fire Door (Powered)

1. Assume the responsibility for the procurement, power and control design, mechanical and electrical installation of rolling shutter, slat-type, between-jamb-mounted and interior-face-mounted fire doors, including, as a minimum, the following features:
 - a. U.L. labeled hour rating to match fire partition walls where door is installed. For example, at 2-hour rated walls provide minimum UL labeled 2 hour rated doors. Obtain the proper fire rating from the Owner or Architect for all fire doors within the scope of the BHS Contract.
 - b. Electric Operator with 480 VAC, 3 phase, 60-hertz motor provided by the door manufacturer.
 - c. Up and Down limit or proximity switches connected to PLC input.
 - d. Electrical or pneumatic bottom edge strip for automatic return to open position upon contact. A photocell or proximity switch shall be used in conjunction with the bottom edge strip for detecting a bag under the door.
 - e. Fire/heat/smoke detectors located to sense approaching fire, heat or smoke source on the conveyor shall be provided by others as per the specified requirements of their Fire Alarm System Specification.
 - f. One set of normally open dry contacts for each fire door shall be provided, mounted and wired, inside the MCP controlling the conveyor line that the fire door(s) is mounted on. Coordinate the spatial and access requirements within the MCP for these contacts with the Fire Alarm System Contractor. Connect each normally open dry contact to the appropriate PLC I/O module. The contact shall close upon

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detection of a fire, heat or smoke condition requiring the closure of the fire door.

- g. A 160°F fusible link which, when broken, will cause the door to close automatically and report to the central facility security/fire system the status of the door (e.g., open or closed). All wiring between the

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BHS MCP and the facility central security/fire alarm system for this reporting function shall be provided by others as per the specified requirements of their Fire Alarm System Specification. Provide the appropriate interface within the MCP/PLC to accommodate this reporting controls function and coordinate the interface requirements with the Fire Alarm System and Security System Contractors.

- h. A means for manual operation. If operation is accessible from one side only, select the side offering the most danger should the door close and block a potential exit.
- i. The door is to be equipped with an externally mounted limit or proximity switch. The limit or proximity switch shall be mounted in such a manner so that the "fully open" position of the door is sensed. If the door is sensed by the limit or proximity switch not be in the fully open position, the associated conveyor shall be stopped if running or shall not be permitted to start if the conveyor was not already running. Note that this limit or proximity switch is in addition to those limit switches provided with the door operator if the door is powered.
- j. Provide all steel trim elements around door opening. Coordinate the trim requirements with the Owner and Architect.
- k. Coordinate installation and framing of the fire door(s) with the Owner, Architect and other contracts.
- l. Clearly define by way of detail plans and elevations (on the submitted mechanical drawings) all of the required operational and maintenance clear zone requirements in order to avoid any obstructions with other trades involved in building construction.
- m. Coordinate the testing of fire doors the Owner or their representative, the fire system installation contractor and the appropriate authorities.
- n. All fire doors that are directly associated with BHS shall be installed perpendicular to the conveyor centerline. Coordinate installation and framing of the fire door(s) with other contracts.
- o. The design of the fire door control system is described in the BHS "Special Control Requirements" section of this specification (Part 3).

B. Security Door (Powered)

- 1. The mechanical and electrical installation, power and control of rolling shutter, slat-type, between-jamb- mounted and interior-face-mounted security doors, shall include as a minimum, the following features:
 - a. Electric Operator with 480 VAC, 3 phase, 60-hertz motor provided by the door manufacturer.
 - b. Electrical or pneumatic bottom edge strip for automatic return to open position

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upon contact. A photocell or proximity switch shall be used in conjunction with the bottom edge strip for detecting a bag under the door.

- c. The door is to be equipped with an externally mounted limit switch, photocell or proximity switch to sense door position connected to PLC input. The limit, photocell or proximity switch must be mounted in such a manner so that the "fully open" position of the door is sensed. If the door is sensed, by the limit switch, photocell or proximity switch not be in the fully open position, the associated conveyor shall be stopped if running or shall not be permitted to start if the conveyor was not already running. Note that this limit switch, photocell or proximity switch is in addition to those limit switches provided with the door operator if the door is powered.
- d. The BHS Contractor shall provide all stainless steel trim elements (around door opening) for those security doors located in public view. The BHS Contractor shall coordinate the trim element requirements with the Architect, the Owner or their representative.
- e. All security doors that are directly associated with the BHS shall be installed perpendicular to the conveyor centerline. The BHS Contractor shall coordinate installation of the security door(s) with other contracts.
- f. The design of the security door control system is described in the BHS "System Control Requirements" section of this specification (Part 3).

C. Draft Curtains

- 1. Provide draft curtains at all wall and floor penetrations between conditioned and non-conditioned spaces, tempered and non-conditioned spaces, and between conditioned and tempered spaces.
- 2. Construct the draft curtains with two staggered layers of black 8" wide anti-static vinyl (PVC) strips. Each strip shall be 0.080" (minimum) thick at center and include a 0.120" (minimum) thick beaded outer edges, installed with a 50% overlap (i.e., staggered strip layers) to create a barrier between the two spaces for dust and temperature control.
- 3. Provide stainless steel fascia in public areas.

D. Conveyor Impact Protection

- 1. Provide impact protection as located and detailed on the drawings or elsewhere as required to adequately protect conveyors and make-up devices. Construct the impact protection and supports of structural steel, heavy walled sections in shapes as indicated. Securely fasten all impact protection components to each other and to the floor.
- 2. Field verify, all dimensions shown on the drawings to insure proper fit with the equipment system interface.
- 3. Apply primer and then one coat of "yellow" paint to all impact protection steel

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members that are not exposed to the weather (e.g. within the bag room).

4. Hot-dip galvanize all impact protection steel members that are exposed to the weather.
5. Design impact protection so that maintenance access to the protected equipment is not restricted.

2.06 SPECIAL MECHANICAL EQUIPMENT REQUIREMENTS

A. General

1. Certain portions of this project require the modification, interfacing with, removal and demolition of existing conveyor equipment as shown on the Contract Drawings. Accomplishment of this work shall have to be carefully coordinated with the ongoing operations of the airlines associated with the existing baggage system in the building area.
2. Conduct a thorough field check of the existing conveyors and their relationship within the existing system as well as their relationship with the configuration of the specified system.
3. Ensure that the design and installation of all conveyor equipment provides maximum access for operation and maintenance personnel.

2.07 ELECTRICAL TECHNICAL REQUIREMENTS

A. Electrical Service to be Provided by the BHS Contractor

1. Power for the various subsystems shall be provided at locations shown on the Contract Drawings by the Owner's Electrical Contractor. Each power distribution point (PDP) shall consist of cable in an appropriately sized junction box (supplied and installed by the Owner's Electrical Contractor) connected at its source to an appropriately sized circuit breaker located at the building substation panel. The drop shall terminate with approximately 20' of coiled cable. The full load ampacity rating (FLA) shall be as indicated on the contract drawings (it shall be the BHS Contractors responsibility to verify the FLA requirements and notify the Owner or their representative of any increase/decrease). Supply power shall be 480 volts, 3 phase, and 60 hertz. Verify and advise the Owner and Engineer that the ampacity at each PDP is sufficient for the requirements of the system.
2. Provide and install all mains cable required from nominated Power Distribution Points (PDP) to the various BHS Distribution Boards and onward to the MCPs as necessary to meet requirements of the specification. The BHS Contractor shall be responsible for all electrical work "downstream" of the PDP locations including the BHS distribution boards, MCP and all other cabling in between. Size feeders from the power drops at 1.25 times the minimum NEC (or applicable local code) permitted size for the full-load amperage required. The BHS Contractor shall be responsible for all power connections from the various MCPs to all other BHS

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equipment including providing power to screening machines.

6. Provide and install all services, feeders and disconnect switches for branch circuits to each control panel, with separate circuits for each subsystem as specified and provide and install all panel boxes, wireways, conduits, conductors, transformers, breakers/fuses, and any other equipment and materials required to complete the electrical power distribution for the operation of the system. Refer to NEC Article 300 for wiring methods.
7. The amperage shown for each PDP in the subcontract drawings shall be confirmed by the bidder in his bid submission. The BHS Contractor shall, during the engineering phase, provide detailed power calculations for review and approval by the Owner or their representative in an effort to reduce the PDP amperage provided and thereby reduce the power provided to the system. Coordinate the detailed power requirements including any reductions with the Owner or their representative.
8. Provide separate circuits for controlling programmable logic controllers (PLCs) and powered fire/security doors. Note that these circuits shall originate within the respective MCP.
9. Calculate the electrical power supply requirements on the basis of total connected load with a diversity factor. Size the conductors to ensure that the voltage drop does not exceed 3% at the farthest outlet of power, heating and lighting loads, or combinations of such loads. Also ensure that the voltage drop does not exceed 5% at the farthest outlet for both feeders and branch circuits.
10. Provide 120 volt, single phase, and 60-Hertz power for operation of the BHS control circuits.
11. Obtain the control power at each MCP by means of a transformer connected to the load side of the 480 volt input power.
12. All baggage systems that use programmable controllers shall be equipped with the appropriate number and size of power regulators to ensure that the power for the respective programmable controllers is properly conditioned. Regulators are to be of the type manufactured by the Sola Corporation (or approved equivalent).
13. All electrical components, devices, accessories, and equipment shall be listed, labeled and identified as suitable for use intended by testing agency acceptable to authorities having jurisdiction. This shall include MCPs and any control panels/cabinets, whether factory or contractor fabricated.
14. Provide a power distribution panel (including all necessary equipment e.g. circuit breakers) located adjacent to each of the x-ray and EDS machines. Power to these screening machines shall be taken from the same source powering the MCP that controls the conveyor line that the screening machine is in. The x-ray and EDS contractor shall obtain power for their machines from these panels and shall be responsible for cabling between the panels and their machines. Coordinate with the x-

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ray and EDS suppliers to finalize the power requirement for the screening machines.

B. Raceways

1. General

- a. Enclose all power and control wiring, including low-voltage wiring, in Rigid Metal Conduit (RMC), Electrical Metallic Tubing (EMT), Liquid Tight Flexible Metal Conduit or wireways. Intermediate Metal Conduit (IMC) is not acceptable.
- b. Horizontal runs of conduit shall not be supported by power turns, their safeguards, or by any side guard that is designated to be removable for the purpose of maintenance access. Rack such horizontal runs and support them from the building roof or mezzanine steel in locations not interfering with the BHS, maintenance areas, or catwalk areas.
- c. Install drops to motors or other devices adjacent to the nearest available equipment or building column. Mezzanine supported equipment may be electrically fed from below the mezzanine from racked conduit supported below.
- d. Avoid conduit runs on the floor. Provide minimum clearance of 6" below horizontal conduit to the floor. The Owner or their representative must approve exceptions to the above.
- e. RMC and EMT Conduit runs must be mounted so as not to restrict maintenance access to the BHS equipment, conveyors and system/conveyor components that required servicing.
- f. Conduit runs must not be run or mounted on outside guards or perimeter chain guards of power turns.
- g. Do not run communication, low voltage (less than 30 volts), or DC control wires in the same conduit, wireway or panduit with power wires.
- h. It is acceptable to run 120 VAC minimum control wire and 480 VAC maximum power wire in the same conduit, wireway or panduit provided it is in conformance with local codes and VFD manufacturer's guidelines, as applicable.
- i. It is acceptable to run shielded 90 VDC clutch brake control wire and 480 VAC maximum power wire in the same conduit, wireway or panduit provided it is in conformance with local codes and VFD manufacturer's guidelines in lieu of running these clutch brake DC control wires in a separate conduit or wireway.

2. Rigid Metal Conduit (RMC)

- a. Conform to all aspects of NEC Article 344 for RMC (or applicable local code).
- b. Use a minimum 3/4" for all wiring.
- c. Run all conduits parallel or at right angles to structural members and equipment.
- d. Do not run conduits underground or in floor slabs unless provided for that purpose by the Building Contractor.

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- e. In public areas, make conduit runs inconspicuous by running under cover plates, behind conveyors or otherwise concealed from public view.
- f. In non-public areas, run exposed conduit in protected locations to prevent damage by moving vehicles, equipment or maintenance personnel.
- g. Use Rigid Metal Conduit in all areas of the BHS installation that are at elevations less than 8'-0" above the buildings local finished floor and in all areas that are exposed to vehicular traffic and possible damage by operating or maintenance personnel.
- h. Use malleable iron or steel threaded fittings.
- i. Include gaskets and covers for all fittings.
- j. Use standard threaded couplings at all conduit joints.
- k. Ensure that the ends of the conduit are cut square, reamed and joined butt-tight.
- l. Electro-galvanize all conduit, elbows, fittings, couplings and nipples.
- m. Make changes to conduit size only at pull boxes, distribution panels, or branches to motors. Do not use reducers for Mini In-Line reduction of conduit size.
- n. Do not run communication, low voltage (less than 30 volts), or DC control wires in the same conduit with power wires.
- o. It is acceptable to run 120 VAC minimum control wire and 480 VAC maximum power wire in the same conduit or wireway provided it is in conformance with local codes and VFD manufacturer's guidelines, as applicable.
- p. It is acceptable to run shielded 90 VDC clutch brake control wire and 480 VAC maximum power wire in the same conduit or wireway provided it is in conformance with local codes and VFD manufacturer's guidelines in lieu of running these clutch brake DC control wires in a separate conduit or wireway.
- q. Remote control, signaling and power limited circuits shall be installed in compliance with NEC Article 725, (or applicable local code) as applicable.
- r. Support conduit at intervals not to exceed 10'-0". Every individual conduit section must be supported. Install conduit supported from building walls with a clearance of not less than 1/4" from the wall to ensure against the accumulation of dirt and moisture behind the conduit, using one-hole malleable iron clamps and clamp backs. For parallel conduit runs provide trapeze hangers or wall brackets fabricated from preformed channel with conduit clamps. Make anchors in concrete of the expansion shield type. Limit conduit run on a given conveyor to that, which is required for that particular conveyor or directly adjacent (downstream/upstream) to that particular conveyor.
- s. Ensure that metallic and non-metallic motor disconnect boxes, clutch/brake safety disconnect boxes and control stations, outlet boxes, junction boxes, pull boxes and cover plates are compatible with the RMC conduit used and conform to the

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National Electrical Code (or applicable local code) for minimum wiring space requirements and material thickness. Provide all boxes with screw fastened covers. Use NEMA 12 enclosures for interior equipment and NEMA 4 for all exterior equipment. BHS contractor shall only use metal boxes; non-metal boxes shall not be used.

- t. Appropriately sized insulated bushings and jumpers shall be installed on all conduits and conduit fittings that enter metallic or non-metallic MCP(s), outlet boxes, disconnects, or j-box/pull box(s).
- 3. Electrical Metallic Tubing (EMT)
 - a. Apply the above requirements for Rigid Metal Conduit to EMT except as noted below:
 - 1.) Use rain and concrete type compression fittings with steel compression nuts.
 - 2.) Use insulated throat type connectors with case hardened nuts.
 - 3.) Use minimum size tubing of 3/4" diameter.
 - 4.) Use EMT only in areas at elevations greater than 8' above the buildings local finished floor or in areas not exposed to vehicular traffic or possible damage by operating and maintenance personnel.
 - 5.) Appropriately sized insulated bushings and jumpers shall be installed on all conduits and conduit fittings that enter metallic or non-metallic MCP(s), outlet boxes, control stations, disconnects, or j- box/pull box(s).
 - 6.) Ensure that motor disconnect boxes, clutch/brake safety disconnect boxes and control stations, outlet boxes, junction boxes, pull boxes and cover plates are compatible with the EMT used and conform to the National Electrical Code (or applicable local code) for minimum wiring space requirements and material thickness. Provide all boxes with screw fastened covers. Use NEMA 12 enclosures for interior equipment and NEMA 4 for all exterior equipment.
 - b. Conform to all aspects of the more stringent between this specification and NEC Articles 300 and 358 for EMT (or applicable local code).
- 4. Flexible Metal Conduit
 - a. Conform to all aspects of the more stringent between this specification and NEC Articles 300 and 348 (or applicable local code) for flexible metal conduit and fittings.
 - b. Use liquid-tight flexible metal conduit for connection to motors, photocells, limit

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switches or any device, which may be subject to vibrations or require adjustment after installation. The use of non- liquid-tight flexible metal conduit such as “green field” is not acceptable.

- c. Do not exceed 3' in length.
 - d. Every section of flexible metal conduit must be clamped/supported.
 - e. Appropriately sized insulated bushings and jumpers shall be installed on all conduits and conduit fittings that enter metallic or non-metallic MCP(s), outlet boxes, control stations, disconnects, or j-box/pull box(s).
 - f. Use minimum 1/2" for power wire.
 - g. Use minimum 1/2" for control wire.
5. Wireways
- a. Wireways may be used in place of rigid conduit provided the application conforms to the requirements of National Electric Code Articles 376 and 378 (or applicable local code).
 - b. Use wireways with hinged, solid covers.
 - c. Position wireways to permit access with the equipment fully operational.
 - d. Do not run communication, low voltage (less than 30 volts), or DC control wires in the same wireway with power wires.
 - e. It is acceptable to run shielded 90 VDC clutch brake control wire and 480 VAC maximum power wire in the same wireway provided it is in conformance with local codes and VFD manufacturer's guidelines in lieu of running these clutch brake DC control wires in a separate conduit or wireway.
 - f. Fasten covers using captive screws.
 - g. Do not use wireways in areas subjected to vehicular traffic.
 - h. Do not use terminal strips in wireways.
 - i. Use lay-in type wireways to avoid the necessity of threading wires through end connectors.

C. Wire and Cable

1. General

- a. Use stranded copper conductors of appropriate gauge, Type THHN or approved equal, with insulation rated for 600 volts. Use type XHHW only if required by code or the governing Airport Authority prohibits the use of PVC insulation. Conform to all aspects of the more stringent between this specification and NEC or applicable local code.
- b. Connect pre-wired electrical devices to terminal blocks mounted in junction boxes adjacent to the devices.

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- c. Do not use blade connectors (such as but not limited to fork or ring style) for connections.
 - d. It is acceptable to use multi-conductor cable for connecting portable electronic equipment. Refer to National Electrical Code (or applicable local code) for requirements on multi-conductor use.
 - e. Tag control and power circuit conductors with “machine” printed identification numbers at both ends of the wire. Tag method shall be of the sleeve or other permanent type submitted to and approved by the Owner or their representative. The use of multiple tags to create a single tag is not acceptable.
 - f. Keep all wires on reels while being pulled. Do not allow wires to contact the ground or floor.
2. Minimum wire size
- a. Power #12 gauge
 - b. Control #14 gauge
 - c. PLC I/O #16 gauge (Connections between I/O modules and terminal strips inside MCPs)
 - d. Communication Circuits #18 gauge
3. Splicing
- a. Splicing of 480VAC power wiring is unacceptable, except for interim BHS conditions when performed below. All 480VAC wire pulls shall be from the MCP to the device (e.g. from MCP to the individual motor safety disconnect).
 - b. Splices are acceptable when parallel type connections are used for "hot" and "neutral" control wires (e.g. power wire for photocells, and e-stop circuits within a subsystem).
 - c. Do not splice signal wires between I/O panel and component.
 - d. Terminate control wires on terminal strips or on screw connectors at each component only.
 - e. In conjunction with the provision of a Junction Box for each interim BHS conveyor line, at the interface junction point between existing and temporary (not part of the final works) conveyor segments, it is permitted to provide splicing between field components and the MCPs. Splice the existing wiring within new Junction Boxes (segregating AC wiring from DC wiring), using appropriate screw connection terminal blocks, as specified elsewhere in this document for all wiring within the referenced conduits. The ends of all wire strands (both temporary and existing splice points) shall be soldered (i.e., tinning the wire), to reduce the chance of corrosion of the wires and to assure proper wire connections at the terminal strips. Use Allen-Bradley “CAIL” terminal blocks or approved equal for all wire splices related to this work. Label/tag all wires at the Junction Box splice points with “Machine” printed identification numbers at both ends of the wire. Tag method shall be of the sleeve or other permanent type submitted to and approved by the

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Owner. The use of multiple tags to create a single tag is not acceptable.

4. Spare Conductors

- a. Provide a minimum of 5% spare conductors in all conduit home runs, with a minimum of two spare control wires and one spare power wire.
- b. Coil all spare conductors allowing sufficient length to permit future connection.
- c. Tag spare conductors as required above, i.e., each spare conductor is to be identified as a spare with its own unique wire identification number and field termination location.

5. Wiring Identification

- a. Color code all electric wire and cable
as follows: 1.) MCP Power Wiring:

Line Side

- a.) Apply the following to all MCP power wiring from source to line and load side of Main Disconnect fuses for MCPs. Verify color-coding of phase conductors on the line side to ensure compatibility with normal electrical supply available at the airport. Terminate the neutral, if applicable, at the terminal board:

Ite m	Wire Color
Phase A (480 VAC)	Brown
Phase B (480 VAC)	Orange
Phase C (480 VAC)	Yellow
Neutral	Grey
Mechanical Ground	Green

2.) BHS Field Components Power and Control Wiring: Load Side

- a.) Apply the following to power and control wiring from the load side of fuses in MCPs to all devices that are powered and controlled from the respective MCP as follows:

Ite m	Wire Color

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Power (To Motors and Control Transformers)	1. Black (with labeled ends indicating L1, L2 and L3 referring to their respective phases) and the Brown, Orange and Yellow colored wires of the 3 phases from the MCP 2. Run numbered, colored insulation (Brown, Orange and Yellow) wires to match phases. 3. Match existing conditions 4. As dictated by local codes.

AC Control:	Red
DC Control:	Blue
AC Neutral:	White
Mech. Ground	Green

- b.) Submit to the Owner or their representative for review and approval the wire color method to be employed for this project.

D. Grounding

1. Ground all electrical equipment to building ground mat by a dedicated equipment-grounding conductor installed in accordance with the applicable codes. Obtain from the appropriate airport authorities, local codes or the Owner's Electrical Contractor the extent and type of grounding, wiring method and points of connection required.
2. Appropriately sized insulated bushings shall be installed on all conduits and conduit fittings that enter and exit the MCP or j-box/pull box.
3. Include a green 600V insulated copper ground conductor in each conduit (raceway).
4. Refer to National Electrical Code Article 348 (or applicable local code) for flexible metal conduit grounding requirements.
5. Refer to National Electrical Code Article 250 (or applicable local code) to determine grounding conductor requirements and sizes.

E. Support

1. Mount conduit supported from building wall using uni-strut type mounting channels to provide clearance to the wall.
2. Do not weld conduit to structural members.
3. Avoid conduit runs to the floor. Provide minimum clearance of 6" between horizontal conduit and the floor and do not allow runs to cross any walk or access aisles.
4. Support cordsets running to items such as, but not limited to, photocells. The cordset

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shall not be supported/secured with plastic wire ties.

F. Boxes

1. Provide outlet boxes, junction boxes, pull boxes and cover plates compatible with the conduit used. Provide boxes with screw fastened covers. Use NEMA 4 for all exterior equipment and NEMA 12 for interior equipment.
2. Conform to NEC Article 314 (or applicable local code) for minimum requirements for outlet boxes, junction boxes, pull boxes and cover plates.
3. Appropriately sized waterproof bushings/seals shall be installed on all conduits and conduit fittings that enter/exit the box(s).
4. Unused openings in junction boxes, raceways, cabinets, and pull boxes shall be effectively closed to afford protection substantially equivalent to the wall of the equipment.

2.08 ELECTRICAL COMPONENTS

A. Wiring Devices

1. Provide full size oil-tight operators.
2. As much as possible, use the same type sensors (such as but not limited to photocells and limit switches) to minimize the number and type of spares. Select sensors with the same mounting system wherever practical.
3. Use plug-in type electrical components wherever available. Do not use blade connectors (such as but not limited to fork or ring style).

B. Control Devices/Stations

1. Control Device Locations

- a. Control Stations and Control Devices shall be located as specified herein. The location of the Control Stations and Control Devices is to be such as to provide maximum possible access to the Devices for servicing of the devices. For example, all Jam Detector and Head End Sensor Photocell devices are to be mounted so that they are accessible from catwalks adjacent to conveyors. In certain areas, protective guarding may be required to protect the Control Stations and Control Devices. However, the design and installation of this protective guarding must not prevent quick access to the control devices for adjustment, servicing or replacements.
- b. The location, mounting and guarding of control stations and control devices must not in any manner restrict the access and servicing of any mechanical components of the BHS.

2. Control Device Mounting

- a. The mounting of Control Stations and Control Devices, shall comply with the basic requirements established in the Contract Drawings and as noted in the following:

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1.) Control Stations in Public View

- a.) All Control Stations located in the view of the public shall be flush mounted with stainless steel cover plates. Such stainless steel cover plates must be secured to the adjacent wall or conveyor trim member with either Truss or Oval Head Phillips stainless steel machine screws of appropriate size. Control stations located in the view of the public shall not be mounted on the top surface of the conveyor front cladding. Pan Head screws are not acceptable.
- b.) All Control Stations located in the view of the public at load conveyors (i.e. ticket counter conveyor control stations) shall be mounted flush to the adjacent wall in a location that someone operating the Control Device shall not have to lean over the conveyor to access it (either upstream or downstream of the load conveyor). E-stop Control Devices shall be mounted inside the stainless steel trim shrouding above the toe plate. A one (1) inch hole shall be provided in the face of the stainless steel shrouding to actuate the E-Stop and a hole on the underside of the face (above the toeplate) shall be provided to reset the E-Stop. Note that the design, manufacture and installation of the stainless steel shrouding on the collection conveyor must reflect these requirements.

2.) Control Stations in Non-Public View

- a.) All Control Stations located on load conveyors in non-public view shall be mounted on the horizontal portion of a Control Station mounting assembly bridging the load conveyor. This assembly shall be located and built so as to also act as an Over-Height Photocell Mount and Bag Restraint. Consider the "chording effect" of baggage at the discharge end of a horizontal load conveyor feeding onto an incline conveyor when determining the location of such an assembly. The vertical element of the assembly may also be used for the mounting and protection of head end photocells, if applicable.
- b.) All Control Stations located on Flat Plate make up device in non-public view shall be mounted on a Control Station mounting assembly. Design, manufacture and installation of the Control Station mounting assembly for racetrack applications must be such as to provide a "solid", well braced mounting for the related Control Station and Control Devices. Note also that the Control Station mounting assembly must provide a minimum vertical bag clearance of 36" above the surface of the racetrack device. See contract drawings for specific details.

3.) Control Devices

- a.) All photocells shall be mounted in a vertical attitude with the LED photocell status indicator clearly visible to operation and maintenance personnel from the side of the associated

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conveyor or conveyor equipment. Photocells that are used for jam detection; baggage tracking, and the like are to be mounted so that the center of the photocell beam is 2-1/2" from the top surface of the conveyor belt.

- b.) Limit switches that are used to sense the position of Fire doors shall be mounted as an external unit to the door adjacent to the track of the door so that the switch can detect when the door is in the fully open position.
- c.) Indicating lamps, other than those associated with MCPs, are to be located as required to properly alert personnel.
- d.) Start-up warning alarms (i.e., audible and visual) shall be located at strategic locations to alert operations and maintenance personnel of the imminent start-up of conveyor equipment. As a minimum provide start-up alarms at baggage input areas, on top of the MCPs and along the conveyor line right-of-ways (e.g., ceiling supported or mezzanine mounted conveyors.). Audible/Visual Fault Warning and Start-up Alarms may utilize the same control devices. However, the audible and visual indications shall differentiate between the two separate functions.
- e.) Fault warning alarms (i.e., audible and visual) shall be appropriately located to alert operations and maintenance personnel of conveyor subsystem fault conditions. As a minimum provide fault alarms on top of the MCPs. Audible/Visual Fault Warning and Start-up Alarms may utilize the same control devices. However, the audible and visual indications shall differentiate between the two separate functions.
- f.) System Start-up and Fault Indication Rotating Beacons: System start-up and fault indication beacons, with amber globes, shall be located on top of the MCPs, at the baggage input areas and along the conveyor right-of-ways (e.g., ceiling supported or mezzanine mounted conveyor equipment) and mounted on the wall at the over size door between the CBRA and the outbound bagroom as indicated on drawing B3.00.02 detail 1.
- g.) Emergency Stop Switch Rotating Beacons: Emergency Stop Switch beacon with red rotating globe shall be mounted on top of the associated subsystem MCP.

3. Types of Control Devices

- a. Push-Button Switches: All Momentary Contact Push-Button switches shall be of the Allen Bradley Series 800T type (or Square D 9001K series, or equivalent as reviewed and approved by the Owner or their representative). The color coding for the Push-Buttons shall be as follows:

Function	Color

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Start/Re-Start (non-public locations)	Green (flush head)
Normal Stop (non-public locations)	Red (flush head)
Alarm Silence (non-public locations)	Yellow (flush head)
Lamp Test (non-public locations)	Gray (flush head)
Jam Reset (non-public locations)	Orange (flush head)
Others (non-public locations)	Black (flush head)

- b. Illuminated Push-Button Switches: All Illuminated momentary contact push-button switches shall be of the Allen Bradley 800T - PA16 type switch with guards (or Square D 9001K series, or equivalent as reviewed and approved by the Owner or their representative). The color coding for the Push-Buttons shall be as follows:

Function	Color
Start (for initial start up conditions at public areas)	Green

Jam Reset	Amber
Emergency Stop Reset	Red
Over-Height/Over-Length Reset	White

- c. Emergency Stop Push-Button Switches: All Emergency Stop push-button switches shall be of the Maintained Contact, "Push to Stop" Illuminated Red Mushroom Head switch, Allen Bradley 800T - FXP16RA1 type (or Square D 9001K Series, or equivalent as reviewed and approved by the Owner or their representative). Note that the Emergency Stop push-button switches must be equipped with a manual lockout clip manufactured by the switch manufacturer for locking the switch in the "conveyor off" position.
- d. Selector Switches: All Selector Switches shall be of the appropriate series based on the application, as specified, and of the Allen Bradley 800T type switch (or Square D 9001K Series, or equivalent as reviewed and approved by the Owner or their representative).
- e. Key Operated Switches
- 1.) "Off/On Function" and "Start Function" Key operated Switches for application in Public Areas shall be of the type manufactured by the Best Lock Company (or Square D 9001K Series with Best Lock Company core, or equivalent as reviewed and approved by the Owner or their representative) but must use a six-pin lock cylinder and core. The Owner will provide the final Operational Core. The Construction Core, normally supplied with the

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lock, must be removed before the project will be accepted. The switch must provide a spring loaded center return.

- 2.) Key operated Switches for all functions other than the "Off/On Function" and "Start Function" in Public Areas shall be Allen Bradley type 800T, (or Square D 9001K Series, or equivalent as reviewed and approved by the Owner or their representative).
- f. Non-Status Map Emergency Stop Switch Indicator Lamps: Certain Baggage Handling Systems shall require the installation of Emergency Stop Switch indicator Lamps external to the related adjacent to lanyard operated Emergency Stop Switches. Such Indicator Lamps are to be of the type manufactured by Crouse - Hinds, Cat. #BDA - 15GP, (or equivalent as reviewed and approved by the Owner or their representative) with Red Globes.
- g. Audible Warning Alarms
 - 1.) Start-Up Warning Alarms for mounting at Ticket Counter Control station locations shall be of the Sonalert device as manufactured by Mallory Company Stock #64F278 Type SC250E, or Allen- Bradley DEC/DEP Series alarm 855P-B10DEC22 for continuous tone or 855P-B10DEP22 for pulsing tone, to be determined by the Owner (or equivalent as reviewed and approved by the Owner or their representative). For those Control Stations located in higher ambient noise locations, an alarm of appropriate higher frequency and dB rating shall be used (or equivalent as reviewed and approved by the Owner or their representative). Selection must be made based on actual survey of the location.
 - 2.) Start-Up Warning Alarms for other locations shall be of appropriate frequency and volume levels for the application location (such as baggage make-up areas, outbound transport line areas, and inbound claim areas (public)). Such Audible Warning Alarms shall be as follows:
 - a.) Baggage Make-up Areas: Edwards Bell #340-6N5. Allen-Bradley 855H Series horn, Catalog Number 855H-BA10CD. Federal Bell #46-500-WB (or equivalent as reviewed and approved by the Owner or their representative).
 - 3.) Audible Fault Warning Alarms shall be of a horn type of appropriate frequency and volume level for the application location (such as baggage make-up areas, and outbound transport line areas). Such Audible Fault Warning Alarms shall be as manufactured by Edwards Horn #876-N5, Allen- Bradley 855H Series horn, with Amber Beacon Catalog Number 855H-BCA10CDR5 or without

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Beacon 855H-BA10CD, or Federal Vibratone Horn #350-WB (or equivalent as reviewed and approved by the Owner or their representative).

- h. Audible/Visual Combination Alarms: Combination alarms for start-up or fault warnings mounted to MCPs, EDS machines, or elsewhere as approved by the Owner or their representative, may be Allen- Bradley 855E Series with 120 VAC control.
- i. Limit or Proximity Switches: Provide precision oil tight plug-in type limit switches with contacts rated for a minimum of 10 amperes continuous duty at 120 volts A.C. Limit switches that are used to sense the position of fire/security doors are to be mounted as an external unit to the door adjacent to the track of the door so that the switch can detect when the door is in the fully open position.
 - 1.) Systems that will require the application of lanyard activated safety switches for either subsystem or system Emergency Stop Switches. Such Safety Switches must be of the "manual re-settable" type with padlock attachment as manufactured by Rees, Cat. #04944 - xxx, Conveyor Components Corporation, (or equivalent as reviewed and approved by the Owner or their representative).
 - 2.) Emergency stop lanyard operated limit switches and their associated lanyard cables are to be mounted along the catwalk or above the conveyor mounted on the stanchions associated to the conveyor.
 - 3.) Lanyard cables are to be color coded
as follows:
 - a.) E-Stop Lanyard Red
- j. Motor Safety Disconnect Switches
 - 1.) Provide motor safety disconnect switches of the 3-pole, heavy-duty type, horsepower rated and non-fusible with a quick-make and quick-break operating mechanism and a means of padlocking the switch in the OFF position.
 - 2.) Provide a N.O. auxiliary contact for connection to a PLC input.
 - 3.) Motor safety disconnect switches for motors equipped with soft start devices must have an auxiliary N.O. contact interlocked with the associated emergency stop circuit.
 - 4.) Each Motor safety disconnect switch shall be identified with a permanently attached white phenolic plate, engraved with black characters, providing the identification of the conveyor with which the motor is associated. Dymo - type labels are not acceptable. Attaching the ID plate to the safety disconnect

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door is acceptable.

5.) Use NEMA 12 enclosures for interior equipment and NEMA 4 for exterior equipment. 6.) Clutch/Brake

a.) The 3 phase Motor Safety Disconnect is also to be used to interrupt the feed and neutral circuit to any externally powered electric clutch/brake device. The following describes how this shall be accomplished:

(1.) Provide 120 Volt AC power to the line side auxiliary contact in the Motor Safety Disconnect Switch (located at the motor) from the MCP.

(2.) Wire from the load side of the auxiliary contact of the Motor Safety Disconnect Switch (located at the motor) to the terminal strip in the respective MCP.

(3.) At the respective MCP, run two (2) parallel wires from the MCP terminal strip to the following:

(a.) One parallel wire from the terminal strip to the PLC input to indicate that the Motor Safety Disconnect Switch (located at the motor) is in the “ON” or “OFF” position.

(b.) The other parallel wire shall be the input voltage for the DC power supply that will supply DC power to the associated motor clutch/brake.

k. Fire/Security Door Safety Disconnect Switches

1.) Provide safety disconnect switches of the 3-pole, heavy-duty type, horsepower rated and non-fusible with a quick-make and quick-break operating mechanism and a means of padlocking the switch in the OFF position.

2.) Provide a N.O. auxiliary contact for connection to a PLC input.

3.) Each Fire/Security Door safety disconnect switch shall be identified with a permanently attached white phenolic plate, engraved with black characters, providing the identification of the door the disconnect is associated with. Dymo - type labels are not acceptable.

4.) Use NEMA 12 enclosures for interior equipment and NEMA 4 for exterior equipment.

l. Relays: Use general-purpose industrial, panel-mounted relays with convertible contacts rated at 10 amperes continuous current at 120 volts A.C. Ensure that all relays are capable of manual operation.

m. Timers: Provide solid state, motor driven timers or utilize timer functions by PLC logic. All timers are to be mounted within the appropriate MCP. Use of timer devices within photocells is not acceptable.

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n. Magnetic Motor Starters (NEMA)

- 1.) All motor control equipment shall comply with NEMA Standard ICS-1, ICS-2, UL publication 845 and other applicable standards of NEMA, UL, IEEE, ANSI, NEC and National Electrical Safety Code (or applicable local codes).
- 2.) Provide a separate magnetic motor starter unit for each motor drive section.
- 3.) Provide one auxiliary contact on each starter and wire to a PLC input module.
- 4.) Use size "0" starters for motors of 5 HP and below and size "1" for those above 5 HP. All starters are to be equipped with:
 - a.) Thermal overload protection on all poles.
 - b.) Overload relays of the manual reset type.
 - c.) Control voltage of 120 volts.
 - d.) Electrical and mechanical interlocks where required for reversing applications.
 - e.) Open type for panel mounting.
 - f.) NEMA 12 enclosure for general-purpose application.
 - g.) NEMA 4 for weatherproof application.

o. Magnetic Motor Starters (IEC)

- 1.) In lieu of NEMA starters and fuses, IEC rated contactors are acceptable.
- 2.) IEC starters shall comply by IEC, UL, CSA and VDE standards. NEC article 430 shall apply for group motor installation.
- 3.) Provide a separate IEC motor starter for each motor drive section.
- 4.) Provide one auxiliary contact on each starter and wire to PLC input module. Provide monitoring of tripped condition on the Touch Screen Terminal. Provide visible trip indication on the IEC starter
- 5.) The IEC rated contactors are to be sized one rating higher than recommended by the manufacture.
- 6.) IEC starters shall be selected by motor full load current and the motor service factor.
- 7.) Provide IEC with lockout provision.
- 8.) Be provided with thermal overload protection on all poles.
- 9.) Provide overload relays of the manual reset type (unless they are already

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within the IEC motor starter).

p. Combination Magnetic Motor Starters

- 1.) In addition to the requirements listed for magnetic starters, equip each combination magnetic starter, if specified, with:
 - a.) An adjustable instantaneous trip circuit breaker interlocked with the enclosure cover with provisions for padlocking the disconnect switch in the "Off" position.
 - b.) An enclosure door capable of being opened only with disconnect switch in the "Off" position.

q. Overload Heaters

- 1.) Size overload heaters for each starter in accordance with the full load current rating shown on the actual nameplate of each manufacturers selection tables.
- 2.) Each individual motor starter should be equipped with overload heaters.
- 3.) Provide a N.O. auxiliary contact for each overload relay for connection to a PLC input.
- 4.) Enunciate individual overload failure on the Touch Screen Terminal fault reporting system.

r. Soft Start Devices

- 1.) Provide a soft start device for all drive units within any flat plate/slope pallet baggage make-up as recommended by the manufacturer. The use of a VFD device instead of a soft start device is acceptable.
- 2.) Provide an electrical/electronic soft start device with adjustable starting curve from 0 to 10 seconds for any conveyor drive equipped with a 7-1/2 horsepower motor or larger.
- 3.) Ensure that the electrical control circuitry design provides that the soft start device is always used whenever the associated drive motor(s) are started, regardless of start condition; i.e., regardless if drive motors are started with a control sequence or with activation of the related motor safety disconnect switch.
- 4.) The approved soft start devices, noted in the acceptable manufacturers listing, must be sized for the specific application.

s. Electric Brakes

- 1.) Provide brakes on all incline conveyors and decline conveyors, if not equipped with a VFD, and for any other conveyors where coasting of the conveyor would be detrimental to the operation of the baggage system.
- 2.) Provide an electric brake for decline conveyors that are equipped with a VFD. Wire the brake separately from the Variable Frequency Drive power source

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to prevent conveyor coasting.

- 3.) Provide dry friction, spring set, solenoid release type brakes integral with the drive motor.
- 4.) Incorporate automatic adjustment of brake disk wear or provide a brake, which requires minimal adjustment.
- 5.) Select the brake to be capable of cycling as required by the conveyor application under full load with no excessive wear.
- 6.) Choose brakes to have a minimum torque rating equal to the starting torque of the motor.
- 7.) Motor brakes that are installed on the end bell of the motors are to be equipped with an external means of "manual release" that would permit maintenance personnel to operate the motor in case of a failure of the brake.
- 8.) Conveyors furnished with a clutch/brake assembly shall be provided with a "Warner Electric" MCS-103-1 power supply (or approved equal) with one torque control, to allow the brake and clutch to be operated separately or both units on at a time. This unit shall be located in the respective MCP.

t. Variable Frequency Drives (VFD)

- 1.) A programmable Variable Frequency Device (VFD) shall be utilized to control the operation of three-phase induction AC motors for queue, power turns, merge conveyors and all conveyors in all bag tracking zones (sortation and EDS) where coasting of the conveyor would be detrimental to the operation of the baggage system. Dynamic braking shall be provided for all conveyors within the CBIS bag tracking zones.
- 2.) For incline conveyors, on which bags are being tracked, that are equipped with a Variable Frequency Drive unit "anti-roll back" provisions shall be provided on the associated gear box to prevent conveyor coasting.
- 3.) Provide an electric brake, wired separately from the Variable Frequency Drive power source, for decline conveyors, on which bags are being tracked, to prevent conveyor coasting.
- 4.) Type of VFD utilized shall be UL listed and IEC compliant.
- 5.) Provide a means of dissipating drive shaft voltages and bearing currents to ground for all conveyors which are provided with a VFD to prevent premature bearing failures.
- 6.) VFDs shall be typically installed within the respective Motor Control Panel (MCP). To conserve MCP space the BHS Contractor can propose to install the VFD remotely at the drive unit, the Owner or their representative must approve this type of configuration.

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- 7.) Provide the ability to program and monitor all drive parameters. Provide programming devices with pre-programmed parameters for various types of VFD programs (e.g. standard queue, merge) to allow simple downloading of such programs when replacement or reprogramming of a VFD is required.
 - 8.) Provide a local keypad control for start, stop, speed reference and reverse functions.
 - 9.) Provide dynamic braking resistors where required for faster stopping.
 - 10.) VFDs shall be capable of permitting the appropriate number of engagement cycles per minute for the specific application under full load with no objectionable heating, overload tripping or other VFD faults. BHS Contractor shall factor this when designing the system and provide VFDs and dynamic braking resistors of a larger power rating if required to meet the application's requirements.
 - 11.) The BHS Contractor shall factor in heat dissipation when designing the MCP and if excessive heat is anticipated from the braking resistors, then mount them in a separate NEMA 12 (for interior equipment) or NEMA 4 (for exterior equipment) rated panel.
 - 12.) When using VFDs, VFD rated shielded cable needs to be used. Use Belden, O'flex or equivalent cable. The shield should be connected to both the motor and the PE (Potential Earth) ground on the AC drive.
 - 13.) For cable length of 50 ft. or more between the drive and motor, a minimum of 1 additional amp needs to be added to the drive rating to handle cable-charging current. For Cable greater than 100 ft in length, a minimum of 2 amps need to be added to the drive rating for cable charging current.
 - 14.) If the transformer which is powering the MCP or MCC is greater than 10 times the drive rating, an input line reactor shall be provided for each AC drive.
 - 15.) Enunciate all individual variable frequency drive (VFD) failures on the fault reporting system. Automatic resetting of certain faults shall be permitted; however, all such faults shall be enunciated and logged regardless of whether or not they have been automatically reset.
 - 16.) The BHS Contractor shall submit to the Owner or their representative catalog cuts of the type of VFD proposed for review and approval.
- u. Photocells (Photoelectric Sensors)
- 1.) Provide photocells of the self-contained, retro-reflective type using an infrared modulated light source with sensitivity adjustment and LED status indicator that is readily visible. Retro-reflective type photocells are to be used for applications where the distance between the photocell and the reflector is less than 10'.

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- 2.) Photocell applications that require a scan distance of 10' or greater are to use a separate transmitter and receiver rather than the single retro-reflective photocell.
- 3.) Use photocells with quick disconnect cable for ease of replacement; the cable shall be UL recognized, 18AWG; one-piece molded design and be highly visible.
- 4.) Due to wiring constraints and noise on low voltage lines generating false triggers, DC type photocells are not permitted.
- 5.) Mount photocells to structural members or side guards using an adjustable bracket as supplied by the photocell manufacturer so that the photocell is mounted in a vertical, not horizontal, attitude. Alignment and status LEDs shall be easily visible for maintenance personnel. All sensors and cabling shall be firmly anchored and protected from equipment and personnel impact and from random forces imposed by maintenance personnel servicing the equipment or staff working in the area. Mounting and protection devices shall inhibit tampering with sensors and their setting by non-maintenance personnel.
- 6.) Photocell mountings are to be directly attached to the conveyor structure as required. Use of shims between the conveyor structure and the photocell mountings is not acceptable. No penetrations through the side guards or attachment by means of magnets or other non-permanent attachment methods shall be permitted for photocell mountings or mounting brackets.
- 7.) Hex head 1/4" - 20 bolts of appropriate length and related 1/4" - 20 hardware (flat washers, lock washers and nuts) are to be used for the mounting of the photocells. Use of round head bolts is not acceptable.
- 8.) Mount reflectors to side guards using brackets providing both vertical and rotational adjustment.
No penetrations through the side guards shall be permitted for reflector bracket mounting.
- 9.) Where holes through side guards are required, the holes shall be a maximum of 1.5" in diameter and located so that the center of the photocell beam is 2.5" above the conveyor belt. The holes in the side guards shall be dimpled away from baggage flow to minimize the possibility of snagging a bag and causing a jam. Oblong openings in the conveyor side guards are not acceptable.
- 10.) Only one side guard opening per photocell and one side guard opening per related photocell reflector would be accepted. Any unused photocell/reflector openings in the side guards must be properly filled with a welded circular blank, ground smooth and properly painted.
- 11.) Locate photocells on the side of a conveyor having the lesser chance of

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contact by operating personnel. Guard photocells if susceptible to personnel contact. The photocells are to be located on the catwalk side of conveyors to ensure maintenance access.

- 12.) Do not attach the white phenolic plate photocell device ID plate to the plug-in type photocell or its wired base. Mount the ID plate on the side guard adjacent to the photocell.
- 13.) Provide photocells as required by the functional needs of the BHS. Photocells shall indicate a reliable life of over 10 million cycles, and be repetitive and unaffected by environmental conditions such as vibration, rain, humidity, cold, heat, dust and sunlight. Provisions shall be made to effectively accomplish the sensing of any of the typical types of airline baggage and packages. Photocell installation shall minimize vibration and shall provide protection for both the sensor and its associated wiring. Specifically, care shall be exhibited in the mounting of the photocell and its control wiring to minimize the hazard of damage from the moving of baggage, contact with associated components or by personnel working on or in the vicinity of the system.
- 14.) Use liquid-tight flexible metal conduit for connection of photocells to minimize vibration and shall provide protection for both the sensor and its associated wiring.
- 15.) The BHS Contractor shall supply cordsets of an appropriate length to connect to photocells such that there is no greater than 12" of excess cable length remaining. The excess cable shall be coiled and secured to the associated conveyor with the use of cable mounting clips. The BHS Contractor shall not use plastic cable ties to secure the cordset.
- 16.) Photocells shall not be subject to interference from standard communication systems employed at the airport location due to airport and airline radio ground communications, ground to aircraft communications, aircraft to aircraft communications or any form of radar equipment operation.
- 17.) For applications that require critical fail-safe operation (e.g. for EDS Applications), the following components must be used:
 - a.) Develop and program PLC logic to ensure that the PLCs are continuously crosschecking outputs from the photocells. The purpose of this code is to ensure failsafe operation of photocells, photocell output wiring, I/O cards, I/O racks, PLC communications, and PLCs themselves. This code shall be written in such a manner that the system will stop appropriate conveyors and alert personnel in the event that the photocell, I/O card, I/O rack, any communication cable or wire breaks, or PLC failure occurs. This code should also include programming to account for long baggage or multiple bags that may appear overlength due to the absence of baggage gaps (stop

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conveyors if a bag length exceeds the maximum system bag length). In addition, implement software programming filters to prevent erroneous conveyor stoppage due to the distance between photocell mounting locations and bag straps (that may instantaneously break the photocell beam). All applications must be submitted for review and acceptance to the Owner or their Representative prior to installation.

- b.) (For applications requiring throughput of 10 bags per minute or less) – Allen-Bradley Area Access Control (AAC) units may be used. Catalog number 440L-T4F90018-Q for Transmitter and 440L-R4F90018-Q for Receiver.
- c.) (For applications requiring throughput of greater than 10 bags per minute) – Allen-Bradley Safety Light Curtain units may be used. Catalog number 440L-P4D0300-N for this Point of Operation Control unit.
- d.) As an option to (b.) or (c.) above: redundant Allen-Bradley Series 9000 transmitted beam photoelectric sensors with a diagnostic output may be provided. Implement PLC safety controls to prevent unintended use in case of a failure.

C. Electrical Device Identification

- 1. The electrical control stations, their related control devices, field wired control devices shall be identified with a permanently attached white phenolic plate, engraved with black characters, providing the identification of the control station or control device. Dymo-type labels are not acceptable. Do not attach the white phenolic plate to any field device that can be easily replaced due to failure ((i.e. plug-in type photocell or its wired base) as this would also require the removal and reattachment of the ID plate), attach the plate to the side guard or non-removable structure adjacent to the device.
- 2. The electrical control stations, their related control devices, field wired control devices and the electrical control devices mounted within the BHS related motor control panels (MCPs) shall use the following device identification format and designations. The format and identification that are used in this specification are to be used throughout the BHS project and are to appear on the designated equipment and the entire project related documentation.

a. Control Stations

- 1.) Control Stations shall be identified with the prefix CS followed by the actual Conveyor or BHS Equipment Identification Number to which the Control Station is related. For example, CS/TC1-6 identifies a Control Station located on Ticket Counter Subsystem #1 related Conveyor #6. Note that when there is more than one Control Station associated with a Conveyor or BHS Device, alpha designators will also be used. For example, CS/TC1-6A, CS/TC1-6B, CS/TC1-6C signifies that Ticket Counter, Subsystem #1 related Conveyor #6 has three Control Stations. The "A" prefix identifies the Station related to the

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charge end of the Conveyor while the last or highest letter indicates the Station closest to the discharge end of the Conveyor.

- 2.) Each Control Station shall be identified with a permanently attached white phenolic plate, engraved with black characters, providing the identification of the Control Station. Dymo- type labels are not acceptable.

b. Control Station Devices

- 1.) Control Station Devices shall be identified as follows:

Control Station Device	Identification
Start Re-Start Push-Button	SPB
Normal Stop Push-Button	PBS
Emergency Stop Push-Button	EPB
Reset Push-Button	RPB
Selector Switch	SSW
Key Operated Switch	KSW
Sonalert Warning Device	ALM
Alert Light Reset	LPB
Lamp Test Push-Button	TPB
a.) Alarm Silence Push-Button	APB
b.) Door Close Push-Button	CPB
c.) Door Open Push-Button	OPB
d.) Forward Jog Push-Button	JFB
e.) Reverse Jog Push-Button	JRB
f.) Jog Push-Button	JPB
g.) Jog Selector Switch	JSW
h.) Colored Indicator Light (the first letter of the lamp color will appear instead of the underscore)	LT_

- 2.) For example: The designation CS/TC1-6/RPB identifies a Reset Push-Button in the Control Station located at Ticket Counter Conveyor TC1-6.
- 3.) Note that the above Control Station Device designations are to appear on all electrical drawings, including wiring and schematics.
- 4.) Control Station Control Devices (push-buttons, pilot lights, switches and

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audible alarms) identification descriptors shall be clearly identified by permanently attached white phenolic plates, engraved with black characters, except emergency stop devices which are to be red with white letters, showing their operational relationships to the system(s) or subsystem(s).

- 5.) All e-stop pushbuttons shall clearly indicate all conveyors affected by that e-stop (i.e.: TC1- 1/TC1-8 indicates that the E-stop will stop conveyors TC1-1 through TC1-8). Dymo - type labels are not acceptable.
- 6.) All Jam reset pushbuttons shall indicate the conveyor segments, which are controlled by that jam reset control station.
- 7.) Control Station Control Device Function I.D. Tags must be positioned for ease of reading. Align the tag's legend so that it is legible (oriented) from the operator's access side of the control station.

c. Field Wired Control Devices

- 1.) Photocells shall be identified as PE followed by the Identification of the Baggage Handling Device or Conveyor on which the Photocell is mounted. For example: PE/TX1-6 identifies a Photocell located on Transfer Conveyor TX1-6.
- 2.) Limit Switches shall be identified as LS followed by the identification of the Baggage Handling Device or Conveyor to which the Limit Switch is related. For example: LS/TC1-2 identifies a Limit Switch on Ticket Counter Conveyor TC1-2.
- 3.) Warning Alarms shall be identified as WA followed by the Identification of the Baggage Handling Device or Conveyor to which the Warning Alarm is related. Lights shall be identified as LT followed by the identification of the Baggage Handling Device or Conveyor on which the light is mounted. For example: LT/OS1-1 identifies a light located adjacent or mounted on Oversize Bag Conveyor OS1-1.
- 4.) Hour meters shall be identified as HM followed by the identification of MCP to which the hour meter is related. For example: HM/MCP-1 identifies an hour meter on motor control panel MCP-1.
- 5.) Security Card Readers shall be identified as SR followed by the identification of the Baggage System Conveyor to which the Security Card Reader is related. For example: SR/TC1-1 identifies a security card reader related to Ticket Counter Conveyor TC1-1.
- 6.) Motor Safety Disconnect Switches shall be identified as "MSD" followed by the identification of the Baggage System Conveyor to which the Motor Safety Disconnect Switch is related. For example: MSD/TC1-09 identifies a Motor Safety Disconnect Switch related to Ticket Counter Conveyor TC1-09.
- 7.) Field Wired Control Devices (Security Card Readers, Photocells, Limit

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Switches, and Bag Status Displays) are to be clearly identified by permanently attached white phenolic plates, engraved with black characters with the control device I.D. Dymo type labels are not acceptable.

- 8.) All field installed Junction Boxes are to be provided with white phenolic plates engraved with black characters. The I.D. tags are to be located, so as to be easily read from the adjacent maintenance access areas. The I.D. tags must be consistent with the associated subsystem identifications noted on the wiring schematics. For example the second junction box from MCP- TC1 would be "JB/TC1-02".

d. Control Devices within Motor Control Panels and Workstations

- 1.) The identification of control devices and components such as relays, timers, transformers, power supplies, overloads, fuses, and PLCs within motor control panels must be identified with I.D. tags.
- 2.) The I.D. tags must be constructed of a white phenolic plate engraved with black characters. Dymo type labels are not acceptable. The I.D. tags must be located so that they can be easily read when the related motor control panel is opened.
- 3.) The I.D. tags are not to be mounted on the covers of the Panduit wireways within the related cabinet or control panel.
- 4.) The I.D. tags for motor starters must contain the conveyor I.D. For example: The motor starter
I.D. tag for conveyor TC1-1 would be "TC1-1M".

2.09 MOTOR CONTROL PANELS (MCP)

A. General

1. All control equipment for the newly installed conveyors shall be housed within new motor control panel(s) for the associated subsystems. Ensure adequate capacity within the panel(s) for all necessary control devices.
2. Provide motor control panels that are UL listed employing NEMA 12 enclosures with fully gasketed doors for interior use or NEMA 4 enclosures for exterior located MCP(s) (or applicable local codes).
3. The MCP shall include a fusible disconnect switch (with Class J or R fuses) or molded-case circuit breaker for the incoming power supply. Additionally the fused disconnect switch for the MCP shall have the following features:
 - a. Flange enclosure construction where the external handle, connecting bar/cable and disconnect switch are always connected regardless if the MCP door is open or closed.
 - b. Provides a quick make / quick break design.
 - c. Provides an indication at the circuit breaker or the fusible disconnect switch inside

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- the MCP that the disconnect is in the ON or OFF position.
- d. Provides a color coded external handle which shall provide visual indication external to the MCP if the disconnect switch is in the ON or OFF position.
 - e. Provides the ability for the external handle to be padlocked in the OFF position for to support Lock-out / Tag-out requirements
 - f. Provides a mechanical interlock to prevent the disconnect switch from being moved to the ON position unless the mechanical interlock is operated.
 - g. Provides a mechanical interlock with the motor control panel door to prevent the motor control panel door from being opened with the disconnect switch in the ON position. The disconnect switch mechanical interlock to the door must have a manual over ride provision to permit the opening the door by qualified personnel using appropriate tools with the disconnect switch in the ON position.
4. Provide a plexiglass Safety Shield with standoffs (or similar suitable finger-safe protection provisions) over the fuses / circuit breaker for the incoming 480v.
 5. The exterior of the MCP must be painted. The interior of the panel or cabinet including the mounting panel shall be painted white.
 6. Ensure that all Motor Control equipment complies with NEMA Standard ICS-1, ICS-2, UL publication 845 and other applicable standards of NEMA, UL, IEEE, ANSI and National Electrical Safety Codes (or applicable local codes).
 7. Provide thermostatically controlled cooling fans or air conditioning units within the MCP cabinet to monitor and prevent internal temperatures from exceeding 125°F or component environmental limits, whichever is less based on an ambient temperature of 100°F (configurable). Provide replaceable or cleanable filters on the intake vents. Configure, through appropriate controls functionality, the cooling equipment to run when the respective MCP internal temperature reaches 100°F and provide an audible and textual alarm at the Touch Screen Terminal applicable when the temperature exceeds 130°F (configurable).
 8. Provide integral MCP air conditioning units should they be required to prevent the internal temperature of the MCP from reaching 125°F. Provide and install condensing unit drain tubes to the nearest drainage line and coordinate hookup of same with building contractor.
 9. Prior to the installation of overload heaters on the controllers, submit a motor schedule listing motor horsepower, voltage, phase, source of feed, circuit breaker size, disconnect size, conduit and wire size and overload heater size selected to be used.
 10. Base interrupting rating of all circuit breakers, fused disconnect switches, motor control centers, and panel boards on short circuit calculations and ensure they are compatible and coordinate with base contract equipment. Refer to National Electrical Code Articles 110 and 430 (or local applicable code) to determine short circuit and

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overload requirements.

11. Mount fuses or circuit breakers for each magnetic starter directly above the magnetic starter.
12. A laminated card showing motor schedule with horsepower, fuse size and heater size shall be affixed to the inside of the MCP door.
13. The working space in front of the MCP panel shall be a minimum of 36". In all cases, the workspace shall permit at least 90 degree opening of the MCP doors. Refer to National Electrical Code Article 110 (or local applicable code) to determine working space requirements.
14. For any MCPs that are not located on a raised curb or raised floor, provide a concrete or galvanized steel plinth, pedestal, legs or similar means to raise the MCP a minimum of 4 inches above the floor to minimize the possibility of any ground water damage to the MCPs located outside of the BHS control room.
15. Appropriately sized waterproof bushings/seals shall be installed on all conduits and conduit fittings that enter/exit the Motor Control Panel(s).

B. Installation Requirements

1. Comply with the following design and installation requirements:
 - a. Wire the line side of fuses or circuit breakers to a line side terminal strip for their incoming supply.
 - b. Wire the load side of the magnetic starter to a load side terminal strip for the outgoing load.
 - c. Connect all control wires to terminal strips designated for control wiring.
 - d. Make vertical runs of power and control wiring within the panel on either or both of the right or left sides of the backboard.
 - e. Run horizontal runs of power and control wiring between the horizontal rows of starter/fuse block units.
 - f. Enclose all vertical and horizontal wiring in "Panduit" - brand plastic wireways.
 - g. Make minimal wire runs to and from these wireways only to the nearest adjacent fuse block starter or terminal block.
 - h. Use of "latching relays" is not acceptable.
 - i. Use of "alternating relays" is not acceptable.
 - j. Any "plug in" type device such as a relay, IEC starters or clutch/brake power supply must be equipped with a spring clip type restraint to prevent the "plug in" device from becoming loose in its socket.
 - k. Splicing of control or power wiring within any MCP is not acceptable. All internal and external "field" wiring must be terminated on the appropriate MCP terminal strips.

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- l. Appropriate sized waterproof bushings shall be installed on all conduits or conduit fittings that enter the related MCP.
- m. All fuses will be of the appropriate type and size of the FRN or FRS dual element type.

C. Panel Identification

1. Each Motor Control Panel must be identified with an I.D. Tag mounted on the outside face of the Panel Door to the immediate left of the MCP Main Disconnect. The Tag shall identify:
 - a. MCP Designation
 - b. Related Baggage Subsystem
 - c. Related Conveyors or Devices Controlled by the MCP
2. Provide a permanently attached white phenolic plate, engraved with black lines and characters of the subsystem layout, on the door face of each new and existing modified BHS Motor Control Panel, illustrating a graphic representation of the respective subsystem. Orientation of the graphic representation shall be the same as the actual subsystem. The MCP layout map shall be consistent with the Graphic Display of the MDS workstation equipment, which shall monitor the faults of the entire reconfigured baggage handling system.
3. The I.D. Tag shall be secured to the MCP door surface with a minimum of four rivets combined with an appropriate adhesive. Large tags shall require a minimum of four rivets, one for each corner of the tag

D. Shop Drawings

1. Submit shop drawings to show:
 - a. General Layouts of new subsystem MCPs
 - b. Power, wiring and schematic diagrams
 - c. Outline and wiring diagrams of all special devices
 - d. Manufacturer's data for all components

E. Utility Outlet

1. In each enclosure or cabinet include a minimum of one appropriately fused grounded duplex receptacle utility outlet meeting locally applicable standards of 120 volt, 20-ampere capacity conveniently located within the panel.
2. The outlet is to be fed from the line side of the MCP (supplied by others unless otherwise noted) so that the outlet power will remain on regardless of the condition of the MCP.
3. The hot wire providing power to the outlet shall be yellow. All terminations of this wire shall be guarded in order to protect personnel from accidental contact. Mount a

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warning on the outside of the panel, next to the disconnect switch stating: "CAUTION - THIS CONTROL CABINET CONTAINS YELLOW WIRES WHICH WILL REMAIN "HOT" WHEN THE DISCONNECT SWITCH IS TURNED OFF."

F. Lighting

1. Equip each enclosure or cabinet with an appropriately fused fluorescent lamp extending at least three quarters of the width of the panel. Operate the lamp by a switch located inside the enclosure on the latch side of the primary door so that the light becomes illuminated whenever the enclosure or cabinet door has been opened.
2. The lamp(s) is to be fed from the line side of the MCP, (supplied by others unless otherwise noted) so that the fluorescent lamp will remain on regardless of the condition of the MCP.
3. The hot wire providing power to the lamp shall be yellow. All terminations of this wire shall be guarded in order to protect personnel from accidental contact. Mount a warning on the outside of the panel, next to the disconnect switch stating: "CAUTION - THIS CONTROL CABINET CONTAINS YELLOW WIRES WHICH WILL REMAIN "HOT" WHEN THE DISCONNECT SWITCH IS TURNED OFF."

G. Control Devices

1. General

- b. All MCPs are to be equipped with the following control devices regardless of the type of status monitoring being employed:
 - 1.) System Ready Indication Lamp
 - a.) The MCP shall be equipped with a Green Indicator Lamp, which shall become illuminated to indicate that the system is ready for start-up and no faults are indicated on the Touch Screen Terminal or MCP.
 - 2.) MCP Re-Start Push-Button Switch
 - a.) A green momentary contact start push-button switch is to be provided for each system or subsystem that is controlled from the MCP. The MCP Re-Start Push-Button Switch shall not be able to start the subsystem from a non-operational mode. It shall only be able to Re-Start the subsystem if the MCP fault has been cleared.
 - 3.) MCP Emergency Stop Push-Button Switch
 - a.) Each MCP shall be equipped with a red illuminated maintained contact mushroom head push-button switch for each system or subsystem controlled from the MCP.
 - 4.) Jam Indication
 - a.) Amber Indicator Lamp shall be used to indicate a Jam condition. The Jam Indicator Lamp shall become illuminated whenever a Jam Detector within

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the subsystem has sensed a Jam Condition. The Indicator Lamp shall remain illuminated until the Jam Condition has been corrected.

5.) Motor Overload Indication

- a.) Blue Indicator Lamp shall be used to indicate Device or Conveyor Groups in which one or more Motor Overloads have tripped. The Motor Overload Blue Indicator Lamp shall become illuminated whenever a Motor Overload Condition develops and shall remain illuminated until the tripped Overload has been reset.

6.) Hour Meter

- a.) Each MCP shall be equipped with an Hour Meter that shall record the amount of time (in hours) that at least one of the conveyors or devices controlled by the MCP is in operation

7.) Alarms

- a.) Start-Up/Fault Warning Alarm(s): Each MCP shall be equipped with one amber rotating beacon and one audible horn to indicate imminent subsystem start-up or faults (such as but not limited to jams and motor overloads). The design of the control circuitry shall be such so that multiple faults will always activate the audible and visual alarms; i.e., if a jam condition has activated the fault alarms and the alarm silence push-button has been depressed but the actual fault has not yet been corrected, a second fault occurring after the alarm has been silenced shall again activate the alarm.
- b.) Emergency Stop Warning Alarm(s): Each MCP shall be equipped with one red rotating beacon and one audible horn to indicate an Emergency Stop situation in the subsystem.

8.) Alarm Silence Push-Button Switch

- a.) Each MCP shall be equipped with a yellow momentary contact “Alarm Silence” push-button switch. Activating the Alarm Silence Push-Button shall silence the Audible Warning Alarm. However, the appropriate Indicator Lamp shall continue to be illuminated until the Fault Condition (such as but not limited to jam, motor overload, and e-stop.) has been corrected.

H. System Status

1. Touch Screen Terminal

- a. Supply, install and program Touch Screen Terminal such as an “Allen Bradley”, family of “PanelView” terminals (or equivalent as approved by the Owner or their representative).
- b. The Touch Screen Terminal shall be installed (locations) as indicated on the

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contract drawings. One on the front face of each Inbound MCP. The Touch Screen Terminal shall be constructed as a NEMA 4 rating (outdoor) or NEMA 12 for indoor use.

- c. The Touch Screen Terminal shall be capable of accurately and clearly depict the BHS. The terminal shall be configured to display system status as described below, in both text and pictorial format. Submit to the Owner or their representative their functional design for approval.
- d. The graphics portion of the terminal shall display, in real time, dynamic pictorial format, the operational status of the conveyors and make up devices that are connected to the system PLCs. Framed icons and specific conveyor I.D.s representing conveyor sections shall change color according to the following scheme. This shall immediately highlight problem areas so that the problems that arise may be corrected in the minimum amount of time:

Condition	Color
Normal Operation – Conveyor Drive On/Running	Green
Normal Operation – Conveyor Drive Off/Timed Out	Black

Emergency Stop Actuation	Red
Motor Overload	Blue
VFD Fault	Flashing Blue
Conveyor Jam Condition	Yellow
PLC Communication Loss (Individual Components)	Red
Equipment Out of Service	Brown
Fire Alarm	Flashing Red
Over Temperature	Flashing Red

- e. The textual portion of the terminal shall display, in color coded text format, the operational status of the conveyors and make up device that are connected to the system PLCs. The terminal provides color indications of a predetermined fixed area of the system. The text portion of the terminal shall not interfere with the graphical display area. The textual portion of the terminal shall automatically scroll to show the most current fault. The textual display must also have a scroll back function to display faults that have scrolled off the display. The condition and the specific conveyor I.D representing the conveyor sections and system devices change color according to the following scheme. This shall immediately highlight problem areas so that the problems that arise may be corrected in the minimum amount of time:

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Condition	Color	Text Displayed
Normal Operation – Conveyor Drive On	Green	Running
Normal Operation – Conveyor Drive Off	Black	Timed Out
Emergency Stop Actuation	Red	E-Stopped
Motor Overload	Blue	Overload
VFD Fault	Flashing Blue	VFD Fault
Conveyor Jam Condition	Yellow	Jam
PLC Communication Loss (Individual Components)	Red	Communication Error
Equipment Out of Service	Brown	Out of Service
Fire Alarm	Red	Fire Alarm
Over Temperature	Red	Over Temperature

- f. The Touch Screen Terminal shall be connected to an audio/visual alarm, which will be activated when a system alarm is triggered (i.e. jam condition or E-stop).
- g. Provide the Touch Screen Terminal with EPROM or similar to provide memory backup.

2.10 CONTROL SYSTEM DESIGN

A. General Design Requirements

1. This control system specification is intended to define the overall functional requirements of the system. The BHS Contractor is responsible for the definitive architecture and design which shall be subject to review and approval by the Owner or their representative.
2. The term “Control System” shall be understood to cover the control of the claim device and associated fire/security doors. The Control System consists of PLC control system.
3. Identify the philosophy on which this proposal is based and clearly identify in detail the proposed control system architecture, the major components to be utilized and the methodologies employed for software development.
4. Submittal of the proposal shall acknowledge the functional intent of the control system specification. Understanding the design shall be the result of modifications/refinements to the minimum requirements established herein. These changes shall not be the basis for increased cost requests.
5. Submit for the Owner or their representative’s review and approval, a comprehensive and detailed system description. This description shall include full details of operational procedures and control system provisions associated with the BHS, including but not limited to the following:

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- a. Control system development and implementation master schedule
 - b. Schedule of system hardware employed (main elements)
 - c. Start-up/shutdown procedures
 - d. Description of conveyor control logic outlined by subsystem
 - e. Data input and output routines (i.e., management/maintenance information systems)
 - f. Automatic operational/maintenance/defect/status routines (including format)
 - g. Audio/Visual indications
 - h. Control station layouts/functions/operations
 - i. Power supply requirements (including UPS schematics/redundancy and layout)
 - j. Typical programming blocks
6. The BHS Contractor shall be available on-site to attend all meetings as required and will actively project manage the BHS design, design review process, and documentation process. The BHS Contractor shall also be required to attend a minimum of two mandated control system meetings at the job site or the Owner's office to review the Control System Functional Specifications and Electrical Control System design. Submit material to be reviewed at the meetings at least two weeks prior to the meetings. The control system meetings attendance will include as a minimum representatives from the BHS Contractor, the General Contractor, CM and the Owner or their representative. The meetings shall review the following discussion items:
- a. Design Considerations - Meeting
 - 1.) PLC System Architecture
 - 2.) Subsystem control functions.
 - a.) Start-up/Shutdown Procedures
 - b.) Jam Detection and "Restart" Procedures
 - c.) Emergency Stop and "Restart" Procedures
 - d.) Audio/visual indications and locations
 - e.) Fire/Security Door and Security Card Swipe Procedures
 - 3.) Electrical System Drawing Review
7. Control System Elements
- a. The new control system shall comprise (as a minimum) the following elements which are considered to

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be a part of the Low Level

Network:

- 1.) Subsystem MCPs
 - 2.) Programmable Logic Controllers (PLCs), which control the BHS by communicating with the device, level equipment (such as but not limited to photocells, motor starters)
 - 3.) Remote I/O located in the subsystem MCPs
8. Hardware: All control systems hardware for the BHS Computer and the BHS PLC systems, and associated purchased software shall be supplied by manufacturers whose products are supported locally, and can demonstrate a minimum of five (5) years' experience in providing control systems for conveyor systems of similar size. The Owner or their representative must approve any equipment that does not meet this requirement.
9. Computer/Controls Electrical Supply
- a. The supplied computer/control systems and equipment shall be compatible with, and operate reliably and effectively with, the normal electrical supply typically available. The equipment shall not be unduly sensitive to fluctuations in supply voltage which may typically vary by plus or minus ten percent (10%) of nominal values. Electrical power supply filters/conditioners and regulators shall be supplied for all equipment, which cannot meet the specifications stipulated.
 - b. The electrical supply distribution system has been designed to provide flow redundancy in all cases, in effect creating two independently powered baggage-handling systems. For example, portions of the system are powered (and controlled) from independent conduit feeds, motor control panel, 480 volt MCP feeders, switchgear buses, transformers and high voltage feeders such that a failure of any power source element will not affect any more than 50% of the BHS processing capability of multiple subsystems of the same type. Ensure both power and control system design (including data communications highways, and UPS) are based on a minimum requirement of 50% systems redundancy.
10. System Design Parameters
- a. The system design shall pay particular attention to the following requirements (listed in random order):
 - 1.) Energy conservation
 - 2.) Satisfactory environment

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3.) Operational flexibility

4.) Component and system reliability (including back-up provisions)

11. Environment: All communication and equipment must be capable of functioning in an industrial environment. Where special environmental conditions are essential for correct equipment operation (e.g. computer hardware), such requirements control must be clearly identified in the submittals identified in this specification. Factors such as dust, air contamination, and heat from local sources, abrasives, moving or falling objects, or vibration shall also be considered. Advise of the necessity for these provisions as well as the specific requirements for each system.

12. Responsibility for Supply and Installation

- a. Supply and install all Control System hardware. This includes control consoles and mounting structures for the monitors.
- b. The General Contractor shall supply hardware, which is designated in this specification document to be provided by the Owner.
- c. The BHS Contractor shall be required to coordinate the requirements of the control system elements in the console with the console supplier, the Owner or their representative.

13. Responsibility for Programming

- a. Program the BHS PLCs and Touchscreen Panels for all conveying and reporting functions associated with the project. Program the control system interfaces between the BHS and any other interfacing system.
- b. Programming techniques, data structures, and documentation shall be acceptable to, and approved by, the Owner or their representative. Details of the above shall be made available to the Owner or their representative.
- c. Submit the as-built programming documentation for the PLCs to the Owner as follows:
 - 1.) Two complete (duplicate) CD sets covering all applicable computer, PLC and system monitoring programming documentation.
 - 2.) Two complete (duplicate) sets of hard copy documentation.
 - 3.) Software for the BHS computer systems as well as the BHS PLC control system including all PLC ladder logic shall be provided in both searchable .pdf format and software versions.
 - 4.) The system software shall be written using as much non-proprietary software as possible.
 - 5.) Delivered software shall include both executable files and fully commented source code for all applications (with the exception of purchased “off the shelf” software). The BHS Contractor shall also include all 3rd party software

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required to view or edit the source code. If the BHS Contractor wishes to invoke “prior intellectual property” rights and withhold source code for any system software a “software escrow account” for all withheld source code; as well as documentation required to reconstruct the executables, must be established with an reputable escrow service company at the BHS Contractors expense. This software escrow account must provide the Owner access to the source code and documentation for a minimum of 10 years. Access to the escrowed information will be authorized in the event of the BHS Contractors inability to correct design errors in the software, contract default, insolvency or termination of business activities.

B. Computer and PLC Control System Architecture

1. General

- a. The Control System Architecture for the new BHS will primarily be controlled by new PLCs, these PLCs interface with BHS field devices.
- b. The BHS conveyor control system shall be based on multiple Programmable Logic Controllers (PLCs), interconnected to each other by the BHS low-level data communication highways.

C. Building Fire System

1. The BHS System shall interface directly with the building fire system (via the Owner’s network). The BHS Contractor shall be responsible to coordinate with the Fire Marshal for the location of all fire zones and for the shutdown of conveyors and fire doors impacted by a fire alarm.
2. Clearly display alarmed fire zone(s) on the MDS display
3. Provide the ability to override a fire alarm signal if the alarm is proved to not be an actual alarm thereby keeping the BHS operational.

D. Programmable Logic Controller (PLC) Functional Description

1. Provide Programmable Logic Controller(s) (PLCs) for direct interface between all input and output devices in the BHS. Wire emergency stop circuits through mechanical control relays which, when interrupted, will remove all power from the output modules of the PLC.
2. Provide each PLC with an EPROM or similar safeguard to provide memory backup.
3. Provide PLCs with Ethernet capability for connection to external devices, such as workstations.
4. Provide each PLC with a minimum of 35% excess memory or capacity for 25% expansion and each I/O with space for adding 25% more modules.
5. Input/output (I/O) modules shall have a visual indication of the status of each I/O point. The status displayed shall be for both signals input into each I/O module and the output signal from each I/O module

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6. Provide a fully annotated printout as well as a software copy of the up-to-date PLC software and program.
7. Provide primary and backup PLCs. Each of the Owner's Inbound System PLCs shall be provided with a warm backup fully programmed PLC, containing the same software/control functions of the respective primary PLCs. The minimum requirements for primary and back up (Warm Back-up) PLC are described in the "Programmable Logic Controller Functional Description" section of this specification.
8. The primary function of the Programmable Logic Controllers (PLCs) shall be the control of all conveyors including, but not limited to:
 - a. Jam detection
 - b. Normal Start/stop routines
 - c. Auto-Stop/Auto-Start timing circuits and start-up routines
 - d. Statistical reporting to the Owner's host computers
 - e. Self-diagnostics
9. All PLCs interface modules and I/O cards shall be located in MCP cabinets as specified herein.

E. Network

1. General

- a. The BHS low-level data communication networks specifications and requirements as mentioned in this specification are written based on the best hardware, software and network concepts/designs that are available in the market today. Install the latest and best hardware, software and network concepts/designs that are available in the market at the point of installation.
- b. Submit the following information with regards to the network design issues at the point of bidding to the Owner or their representative:
 - 1.) Performance of the network
 - 2.) Security: No single point of failure
 - 3.) All the protocols to be used
 - 4.) Quality of service in terms of bandwidth management
 - 5.) Installation and site management
 - 6.) Evolution of the network devices
 - 7.) Knowledge transfer
 - 8.) Network architecture and design

2. Low Level Network

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- a. For the BHS low-level network use a Data Communications Highway (DCH) (or approved equivalent) as an industrial network to link together distinct, remote stations. Each station may consist of a programmable controller (PLC), a computer, or an intelligent RS-232-C device (interface module). The DCH shall provide high-speed communication and fast data acquisition. It shall be of rugged construction and well suited to a baggage environment.
- b. The central trunkline of the Data Communications Highway shall consist of adequate cabling capable of high-speed inter-communication between up to 200 devices via interface modules. The central trunkline shall have the capability of being up to 15,000' long, with the remote stations being as far as 100' away from the trunkline. The network shall display a high degree of noise immunity and rejection from electromagnetic and radio frequency interference (EMI/RFI).
- c. The DCH shall utilize a time-sharing method of communication control, thus eliminating the possibility of any one-interface module from dominating the network. The DCH shall allow for inter-communication of many types of ASCII devices, including, but not limited to:
 - 1.) PLCs
 - 2.) Maintenance Terminals
 - 3.) Displays
 - 4.) Modems
- d. For the communication use a synchronous data stream from one interface module to another or to the primary baggage system computer, and provide data transfer, message acknowledgments, and error recovery. The data shall refer to ladder rungs; register data, I/O status, and other information.
- e. Provide RS-232 D-shell connectors with captive retaining screws, "D" concentric twist-lock twin-axial connectors, or approved equipment. In any case, ensure that they provide easy connection to control and interfacing devices, and display a high degree of noise immunity and rejection from EMI/RFI.
- f. Ensure that expansion may be accomplished by interface module-to-interface module linking with no limit.
- g. Use standard protocols with error recovery on all DCH transmissions for error checking.
- h. Place source/destination message routes in the command for each device wishing to communicate.
- i. Provide repeaters as required along the length of the communications highway to boost signal strength.
- j. Provide data ports at strategic points on the communications highway to allow for system monitoring by personal computers.

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- k. At a minimum, configure the DCH as a ring or provide redundant trunkline to ensure a single break in the trunkline does not render the system inoperable.

- l. Network Architecture

- 1.) ControlNet (or approved equivalent) may be installed as an industrial network to link together and provide high-speed communications between distinct remote components of the outbound BHS. The network must be capable of a minimum scan time of 5 ms and be capable of receiving, processing, and transmitting information within 50 ms. The network must be capable of operating in a hot backup configuration without any degraded functionality. The cables that form the main backbone shall not have the same cable-laying route and shall be routed a minimum distance of 15 feet apart from one another. This shall ensure that in the event of cable mishap involving a single cable the backbone will not be lost
- 2.) A communications bridge (for example ControlLogix Gateway (or equal)) must be incorporated to provide interfacing between distinct communication interface modules. This bridge must be capable of providing a link between the High Level network (BHS computers, Owner reservation system, message broker), Data Communication Highway, and the BHS control network (PLCs).
- 3.) The network communication speed must not be less than 5 M bits/sec. The network architecture should be designed to optimize data transfer between network devices to fulfill the required time constraints.
- 4.) At a minimum, shielded cable shall be used as the physical media to connect components of the network. Cable must be capable of normal use in high noise environments. NEMA approved cable taps, connectors, and adapters suitable for use in a bagroom environment must be used. Fiber optic cable should be used wherever possible.
- 5.) Particular attention must be given to voltage across network components. Refer to manufacturer's literature for exact range of voltage potential.
- 6.) Appropriate power supply ratings must be considered and applied for network components.
- 7.) Repeaters must be used as recommended by the manufacturer to maintain network communication speed and reliability.
- 8.) The network architecture must be designed to operate in conjunction with multiple processors. A minimum of 99 addressable nodes must be available for communication. Communication with essential components shall be prioritized and used for reporting. The overall allowable length of the network cabling and remote components must be at least 15,000 feet.

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- 9.) An Allen Bradley redundant ControlNet system (or equivalent as approved by the Owner or their representative) must be utilized.
- 10.) Network switch must be the Owner approved Cisco switch
- 11.) No more than 32 I/O points may be assigned to each I/O module.

F. Source Code

1. All software shall be delivered with well-commented source code in addition to the executable version. Software shall be delivered in both hard copy and machine-readable formats on a media acceptable to the Owner. The BHS Contractor may propose a non-disclosure agreement.
2. The Owner shall have permission to use the software as necessary to support operations at Fayetteville Regional Airport, Fayetteville, NC once obtained from the BHS Contractor.
3. A backup copy of the configured system software shall be provided on DVD-ROM or CD-ROM media. All original distribution software shall be delivered with an installable backup. While DVD-ROM or CD-ROM is the preferred media types, tape or diskette is acceptable if required by the specific software.

- END OF PART II -

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PART III - EXECUTION SPECIFICATIONS

3.01 PREPARATION

A. General

1. Verify conditions in the field prior to start of work. If unanticipated mechanical, electrical, or other elements that conflict with intended function or design are encountered, investigate and measure both nature and extent of the conflict. Submit written report to the Owner in accurate detail. Pending receipt of directive from the Owner, rearrange work schedule as necessary to continue overall job progress without undue delay.
2. Cover and protect systems and equipment from damage and soiling during installation, demolition, removal or alteration work, including equipment to be salvaged and stored. Erect and maintain dust-proof partitions and closures to prevent spread of dust or fumes to occupied portions of the building.
3. Obtain and pay for all airport security badges, permits, inspection fees, and certificates relative to all phases of the BHS construction.
4. Provide supports or bracing to prevent movement, settling, or collapse in which an area is to be removed and adjacent system is to remain. If safety of system appears to be endangered, cease operations and notify the Owner immediately. Take precautions to support endangered work until determination is made for continuing operations.
5. Locate, identify, stub off and disconnect electrical system services that are not indicated to remain. Provide bypass connections to maintain continuity of electrical service to remaining system. Obtain permission and provide advance notice to the Owner if shutdown of electrical service is necessary during changeover.

3.02 WORKMANSHIP

A. General

1. Perform installations, demolition, removal and alteration work as shown within the specified BHS right-of- ways, with due care, including support and bracing. Be responsible for damage, which may be caused by such work, to any part of existing system or items designated for reuse.
2. Perform restoration and new work in accordance with applicable technical sections of the specifications. Where cutting and new work involve the exterior building envelope, consult the Owner to ascertain if existing guarantees, warranties or bonds are in force and execute the work so as not to invalidate such agreements.
3. Execute the work in a careful and orderly manner, with the least possible disturbance to the public and to the occupants of the building(s).

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4. Materials installed by the BHS Contractor, whether provided by him or not, shall be installed in a neat and workmanlike manner. Particular attention shall be paid to manufacturer's instructions as to installation procedures.
5. Protect the employment and places of employment of each of his employees engaged in the construction work by complying with the appropriate standards as prescribed by OSHA.
6. Take necessary precautions to keep noise producing operations (such as impact hammering, Carborundum sawing, compressed air machinery and the like) to a minimum. Select equipment, which is of a quieter nature than others and enclose areas of operation with acoustical screens and partitions or other means necessary to accomplish reduction of noise.
7. Equip motorized equipment with mufflers or other types of sound control and blanket equipment with acoustical materials.
8. Locate installation, demolition and alteration equipment safely so that no part thereof shall endanger normal airport operations, including runways, terminals, terminal buildings, approach ways, and power utility, lighting and communication lines.
9. Promptly remove debris to avoid interference with system operations.
10. Cut out embedded anchorage and attachment items as required to properly provide for patching and repair of the respective finishes.
11. Ensure that the standard of work and materials throughout the Project shall be of first-class quality and workmanship in every respect, the Owner will not accept workmanship, which for any reason, is otherwise.
12. Ensure that all equipment, components and materials are free from defects.

3.03 FABRICATION & INSTALLATION SPECIAL CONSIDERATIONS

A. General

1. Equipment is to be designed to meet the requirements of handling airline baggage. This entails consideration and care to be used particularly in fabrication of all components to ensure that projections, welds, sharp corners and transfer points that may cause possible damage to various types of bundles, handbags, suitcases, and trunks are eliminated. Ensure that bottom glides on cases, strings, tags, straps, bag handles, destination tags and the like are guarded against damage on side guards, transfer points, and all surfaces which baggage may contact on the conveyor system.
2. Coordinate all on-going site work and with concurrent airport/airline operations.
3. Take into effect any long lead procurement items and take the necessary actions required to complete any installation in the ceiling space.

3.04 DELIVERY, STORAGE, HANDLING AND ON-SITE RESPONSIBILITIES

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A. Delivery, Storage, Handling

1. Assume responsibility for the receiving, unloading, storage, protection, security and distribution of all material delivered to the site associated with this Contract.
2. As necessary for the work, provide flagmen and erect proper barricades and other safeguards, post danger signs and other warnings as warranted by hazards and existing conditions.
3. Assume responsibility for receiving, storing, handling, setting and connecting all equipment required for the BHS installation.
4. Provide and maintain adequate protection against weather so as to preserve his work, materials, equipment, apparatus and fixtures free from injury, pilferage or damage.
5. Furnish to the Owner, on demand, Bills of Lading for all equipment being shipped to the work site. Identify on each Bill of Lading each component and assembly involved, the equipment items to which they belong, the date and time of pick-up and the expected date and time of delivery to site. The shipping of such material shall involve proper identification of items, proper packing and proper means for unloading them at the work site.

B. On-Site responsibilities

1. General
 - a. Erect all temporary barriers and barricades to separate work areas from areas of public access, if applicable.
 - b. Provide exhaust fans (e.g. hepafilter) to limit fumes/odors from welding, metal cutting and painting if the work being carried out is in an occupied/operational area.
 - c. Coordinate with any interfacing, on-going site work.
 - d. Provide adequate portable office facilities, communication, equipment and locker room for field force.
 - e. The BHS Contractor shall pay all costs of rental, installation, use and removal of accommodation and communication equipment.
 - f. Furnish shop drawings for any substitutions of equipment specified in this specification or shown on the

drawings. During the progress of the job, revised drawings may be issued. Ensure all work is performed based on the latest drawings issued.
 - g. Clean and maintain work spaces, travel routes, and any other areas of work effected by his trade including but not limited to:
 - 1.) Remove on a daily basis of all erection rubbish and discarded materials.

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- 2.) The burning of waste material is prohibited. Remove and dispose of scrap and waste material in accordance with applicable laws, codes, regulation ordinances and permits.
 - 3.) Be responsible for all fines received for failure to maintain or perform cleaning, and all costs due to damages directly caused by this Contractors work.
 - 4.) The BHS Contractor shall use their hoisting material for rubbish removal.
 - h. Be cognizant that the equipment and lay down areas for the work may/will require relocation as directed by the Construction Manager or the Owner.
 - i. Be responsible for any employee parking and any site transportation that may be required to/from the construction site.
 - j. Be responsible for any escort service required for the transportation of materials and employees on the ATO side of the facilities.
 - k. Enforce the Owner's instructions, laws, and regulations regarding signs, advertisements, fires and the presence of liquor and firearms by any person at the job site.
 - l. Provide the services of a competent field superintendent during erection, wiring, testing and correction of any discrepancies occurring during the Final Acceptance period.
 - m. Smoking shall only be allowed in areas as designated by the Owner.
2. Mechanical Work
 - a. Provide and install all supports, anchors and any other special considerations or requirements not provided for in this Specification but necessary to facilitate the complete mechanical installation and safe operation of all equipment and components.
 - b. Provide electrical connections for heavy-duty machinery, such as welding machines, and battery chargers as required for the installation of the BHS.
 - c. As construction proceeds, perform any additional site surveys which may be necessary.
 - d. Document in writing any mechanical, electrical or piping conflicts that may impact conveyor installation and submit to the Owner or their representative immediately following the site inspection and prior to the installation.
 3. Electrical Work
 - a. Provide the necessary conduit, wiring and other electrical components to complete the electrical installation from power distribution points (PDPs), to the equipment and be responsible for all electrical interconnections within the equipment and system.
 - b. Provide all labor, materials, equipment and service necessary for and reasonably

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incidental to proper completion of all electrical work including electronic controls as required for the proper operation of the system as detailed in these specifications. Provide within the design standardization of components, function and maintenance procedures.

- c. Drawings and specifications are to be considered as supplementing each other. Work specified but not shown, or shown but not specified, shall be performed or furnished as though mentioned in both specifications and drawings.
- d. Provide and install as required, at no additional cost to the Owner, minor items, accessories or devices reasonably inferable, as necessary, to complete the electrical installation.
- e. Refer all conflicts between the requirements of these specifications and drawings or between either and applicable codes to the Owner or their representative for clarification before proceeding with the affected portion of the installation.
- f. Obtain and pay for all permits, inspection fees, and certificates relative to the electrical work. Deliver all certificates and letters of approval to the Owner upon completion of the work.
- g. Locate all electrical equipment as shown on drawings. However, actual field conditions shall be checked to determine exact locations and avoid interference with other trades. The Owner or their representative must approve all deviations from the Contract Drawings.
- h. At no additional cost do any reasonable location adjustment of electrical equipment requested by the Owner prior to installation.
- i. At no expense to the Owner, correct work improperly installed due to lack of construction verification.
- j. Install materials and components in a neat and proficient manner. Particular attention shall be paid to manufacturer's instructions as to installation procedures.

3.05 INSTALLATION

A. General

- 1. Installation of the BHS shall be in strict compliance with the Construction Drawings, to be prepared in compliance with this Specification document and Contract Drawing Package. These drawings shall show in detail the location of each conveyor and the relationships between adjoining conveyors, conveyors and slides or chutes and any other transfer, which might affect baggage movement.
- 2. Assume responsibility for all interfaces between the BHS and the Facility. Check the "As-Built" condition of the Facility as defined in drawings and as confirmed by site inspection prior to fabrication, installation or removal of any BHS equipment. The

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system arrangement and layout shall ensure equipment alignment and clearance when installed in the Facility.

3. Provide all equipment required to complete the total system. Furnish all tools and necessary equipment for the performance of the installation tasks and exhibit sufficient planning to ensure their availability at the job site as required by the workflow. The Owner will not furnish tools, forklifts or erection equipment.
4. Staff the project to ensure timely completion. The BHS Contractor shall accelerate construction as required if schedule milestones are not met.
5. Provide all supports, anchors and any other items necessary to facilitate the complete mechanical installation and safe operation of all equipment and components.
6. Where equipment is to be installed in an operating facility provide a construction schedule to the Owner or their representative for approval that will minimize interference with normal operations.

B. Tolerances

1. Maintain the following tolerances for BHS equipment installation:
 - a. Maintain dimensions to exterior building walls or building columns within 1/4".
 - b. Install all conveyors level from side to side, within 1/8" across the width of the conveyor. In the event that the floor/ceiling is sloped, install the conveyors parallel to the floor in the direction of belt travel.
 - c. In plan and in elevation, install conveyors straight to within 1/4" of a taut line stretched at the belt elevation over the length of each intermediate section of conveyor.
 - d. Plumb supports vertical within 1/8" per 3 feet.
 - e. Maintain side clearances to building elements including walls and columns a minimum of 6" unless otherwise specified.
 - f. Verify all "As-Built" and existing building conditions prior to final fabrication.
 - g. Shimming between adjacent intermediate sections of conveyors is permissible but do not exceed 1/4" of total shim stock at any one location.
 - h. As the building area becomes available, install all header steel (even if header steel is ahead of conveyor fabrication/delivery), to preserve conveyor right-of-ways. Preserve conveyor right-of-ways in all cases as soon as practicable.
 - i. The maximum allowable lateral offset in the conveyor slider bed shall be 1/8" in 40 feet of length.

C. Side Guards

1. Install side guards so that adjoining guards do not project into the flow of baggage.

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Clean any field cut edges and welds of burrs, and slag and grind smooth. Filler material at joints or seams is not permissible.

2. Notch the formed edge of the side guards around any vertical hanger or leg.
3. All side guard joints are to provide a snag-free surface. Side guards shall provide a continuous, uninterrupted surface the entire length and height of the joints. Lapped or out-of-line joints will not be accepted. Welding of joints is not permitted.
4. Care is to be used in the design and installation of the side guards at the point of intersection with the conveyor fire/security doors. This interface point must not act as a snag/catch point for baggage or baggage tags.
5. Conveyor side guards must be flared on the downstream side of the intersection with the conveyor fire/security doors. Additionally, special detail must be provided with the conveyor bed section at this point. Its width must be extended to close the void between the bedside rails and the flared side guards.
6. Adjacent side guard joints are to be of the bolted butt coupled joint type at power turns and conveyor sections. Coupling of adjacent side guards or head/tail pulley supports to power turns shall be in alignment with the effective belt width of the turn to prevent interference with baggage movement.
7. Side guards of power turns must not be welded to adjacent straight conveyor side guards.
8. Mounting of any mechanical or electrical equipment on the outside radius side guard of power turns is not accepted since it restricts maintenance access to the outer perimeter chain or guide bearings of the power turn belt.

D. Floor Supports

1. All conveyors shall be adequately sway braced in order to ensure that there is no lateral or longitudinal displacement.
2. All support structure must be designed and installed so that maintenance access to the conveyor components, gap pans and access to catwalk(s), work areas and drive aisles are not blocked.

E. Anchoring

1. Firmly anchor all equipment and structures to the floor or building structure where permitted, subject to review and approval, by the Owner or their representative. Align, level and finish grout, as required.
2. Anchor floor supports to the floor with a minimum of two (2) stud expansion anchors having a minimum size of 1/2" diameter by 2-3/4" long, unless otherwise noted on the specification drawings.
3. Weld floor supports, which rest on a steel mezzanine or intermediate structure.
4. Anchor impact protection with a minimum of four 3/4" diameter epoxy adhesive anchors, each having a minimum tensile strength of 3000 psi, concrete of 20,000

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pounds and a minimum shear strength of 18,000 pounds, and a minimum embedment of 6", unless otherwise noted on the specification drawings.

F. Lubrication

1. Fill all reducers to the proper oil level using oil recommended by the manufacturer.
2. Install breathers at the highest opening.
3. Clean roller chains of dirt or debris and manually lubricate per manufacturer's recommendations.
4. Replace all lubrication fluids if testing or checkout period exceeds manufacturer's suggested start-up change- out interval.
5. Apply grease per manufacturer's specifications to all grease fittings (unless they are sealed for life type bearings) prior to initial start-up of the equipment.

G. Motor Installation

1. Wire each motor on all components to a separate disconnect switch which shall be mounted within sight of the motor but not more than 3 feet from the motor.
2. Provide a means of disconnecting power, including the capability of being locked in the "Off" position that meet or exceed the requirements of NEC Article 430 (or applicable local code), to any clutch or brake (if separately or group powered) mounted as part of drive unit so as to minimize the potential of electrical shock during any servicing or maintenance operations.

H. Jacking Bolt Installation

1. Install all jacking bolts in conjunction with pulley and motor bearing housings based on the following criteria:
 - a. When mounted in a threaded bracket, engage the bearing with the cup of the jacking bolt and lock the jacking bolt in position with a jam nut on the inside of the bracket (i.e., between the bearing housing and the bracket) to ensure the proper locking configuration.
 - b. When mounted in a non-threaded bracket, engage the bearing with the cup of the jacking bolt, position a jam nut on the inside of the bracket, and position a single flat washer, lock washer, and finished or semi- finished nut on the outside of the bracket (i.e., between the jacking bolt head and the bracket) to achieve the proper locking configuration.
2. Use of socket male/female adapters in conjunction with the jacking bolt is unacceptable.
3. Allow for minimum adjustability of the jacking bolt on either side of the mounting bracket equal to the maximum amount of adjustability provided for the associated bearing by the mounting slots.

I. Sheave/Sprocket Alignment

1. Align shafts, sprockets and sheaves using a steel straight edge. The use of a string for

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this purpose is not acceptable. Demonstrate during Acceptance Test that corresponding surfaces of mating sprockets/sheaves are in line within 1/32" in 24". Misalignment shall be determined by placing the straight edge against the face of one sprocket/sheave and measuring the gap it makes with the opposite sprocket/sheave. The operation shall then be reversed so that a total misalignment can be determined.

J. Fasteners

1. Protect all fasteners (such as but not limited to nuts, bolts, screws, and setscrews) against accidental loosening by the use of lock nuts, lock washers, jam nuts, or other suitable means, and against corrosion by plating or the use of corrosion resistant materials such as zinc plating or stainless steel materials.

K. Shaft Mounted Components

1. Mount all shaft mounted components using keys, splines, or equivalent, with positive retention devices.

L. Painting and Finishing

1. Equipment Finish

a. Stainless Steel

- 1.) Cover all metal components and surfaces of conveyors in public view with Type 304 stainless steel with No. 4 brush finish. Stainless steel shall incorporate smooth flush edge seams. Radius type edges are not acceptable.
 - 2.) The BHS Contractor shall also be responsible for the design; fabrication and installation of stainless steel trim frames around conveyor wall penetrations in public areas. The trim frames will be constructed of 12 gauge, 4" x 4" stainless steel angle. The BHS Contractor shall coordinate trim design/details with the Architect, the Owner or their representative.
 - 3.) All stainless steel trim elements and related connections are to be smooth and flush without openings or projections on which bag tags or straps may catch.
 - 4.) All flat head screws used to attach the stainless steel shrouding, such as the horizontal portions attached to the conveyor bed, are to be completely countersunk so that no portion of the screw head is above the adjacent surfaces. Such flat head screws are to be of the Phillips Head type. Grinding or filing of the screw heads to accomplish the above is not acceptable.
 - 5.) Field welding of any stainless steel trim element is not acceptable. Additionally, no blemishes of the stainless steel trim elements shall be accepted. This includes those blemishes that are caused by poor manufacturing practices as well as those caused in the field plus those caused by field attempts to remove any blemish.
- b. Protect all metal surfaces from corrosion using one or more of the following methods:
- 1.) Electro-galvanize or use stainless steel for slides and chutes unless otherwise

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specified on the contract drawings.

- 2.) Electro-galvanize or hot-dip galvanize conveyor side guards if exposed to outdoor environment, and paint on the outside only if used in interior areas.
 - 3.) Use cold rolled or hot rolled low carbon steel primed and painted on both surfaces in all interior areas.
 - 4.) As an alternative to items .2) and .3) above, the BHS Contractor can offer Powder Coating as an alternative due to superior quality and resistance to the elements.
 - 5.) Use as received pre-painted housings from component supplier, such as motors, gearboxes and bearing housings.
 - 6.) Paint conveyor slider bed components only on the outside exposed surfaces. Do not paint the surface in contact with the belting.
 - 7.) Finish paint electrical enclosures normally purchased primed prior to assembly and delivery to the construction site.
 - 8.) Protect all unpainted surfaces (shafts, slider bed, side guards) with a suitable rust inhibitor during shipping and installation.
 - 9.) Prime and finish paint all catwalks, stairways, ladders and support steel.
 - 10.) Provide galvanized threaded rods. Protect the ends of all threaded rods with a suitable galvanizing spray after the threaded rods are cut to length.
 - 11.) Apply an industrial quality primer and enamel to all to-be-painted surfaces in accordance with the manufacturer's directions. All paint shall be of the same make, type and color.
- c. Prepare surface to be painted in accordance with paint manufacturer's requirements and as described below. If there is a discrepancy between the two, the manufacturer's requirements will take precedence. Suitable precaution shall be taken to ensure cleanliness during the period between cleaning and other finishing processes.
- 1.) Preparation of Surface
 - a.) Prior to the application of any finish, clean all surfaces to be free of dirt, grease, oil, flux, flash metal, spatter metal, sand, rust, scale, or oxides, and all other debris that might interfere with the effective application of the finish. Clean surfaces immediately before the finishing operation. Take suitable precaution to ensure cleanliness during the period (which shall be of minimum duration) between cleaning and other finishing processes. For galvanized surfaces, adhere to the following:
 - (1.) Clean: Prepare surfaces so prime coat bonds well and adheres permanently.
 - (2.) Rust-Inhibitive Wash: Use a compatible chemical solution such as

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phosphoric metal etches. Thoroughly remove solution with water and allow drying.

- 2.) General Application: Apply primer and enamel to provide a surface of high quality appearance free from runs, sags, cracks, flaking, peeling, blushing, or other defects which may affect drying characteristics, durability, and appearance of the painted surfaces. Apply primer and enamel by brushing, spraying, or dipping.
- 3.) Basic Application: Finish surfaces with not less than one coat of primer and one coat of enamel. Apply the primer and one coat of enamel at the factory and the touch up of enamel, if required, shall be applied at the installation site, after erection, by brushing. When primer or enamel applied to the equipment prior to erection has been burned, chipped, or otherwise removed during erection, or where new unfinished metal is installed, finish the exposed surfaces with not less than one coat of primer and a finish coat of enamel, of the same color and type as originally painted, after sanding the surface to be painted down to the bare metal. After installation, clean and touch up all scuffed or otherwise marred surfaces, as above.
- 4.) Masking: Do not obscure equipment nameplates, identification plates, or other identifying markings when painting the equipment. Whenever possible, apply the plates and markings after painting. In all cases where they cannot be applied after painting, mask or otherwise protect them to retain their legibility. After painting, thoroughly and effectively remove all masking and protective coatings.

2. Conveyor Identification

- a. Permanently and indelibly mark all conveyor equipment with its respective (discrete) identification as defined on the contract drawings. All conveyor segments and other equipment shall be identified as specified elsewhere in this document by carefully and neatly painting with black paint the equipment identification characters utilizing a stencil, nominally 4" in height, in a conspicuous location (on both sides of a conveyor adjacent to the conveyor drive in the case of a conveyor). The only acceptable identification markings on any conveyor equipment, is to be of the specified conveyor identification numbers for this project. Any other form of identification on the conveyor equipment is not acceptable and must be removed.
- b. Identify conveyors in public areas by means of engraved plaques (riveted or bolted) with 2" high black lettering on a stainless steel background.
- c. Conveyor identification shall be consecutive with no missing numbers in a sequence. In the event of any additions or deletions prior to each system installation, renumber the conveyors to adhere to this requirement.
- d. Completely remove or print over any identification on reused equipment or any

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temporary markings associated on new conveyors for manufacture, shipping or installation.

- e. Where temporary markings or labels on the conveyors or other equipment are required for installation, use a medium which is readily removable with water or a readily available commercial solvent, such that they may be removed without requiring any refinishing of the surface on which they appear. After installing, remove any temporary markings.

M. Safety Signage

1. Furnish and install safety signage throughout the BHS as described within these Contract Documents and any associated addendums. The safety signage shall be located in all areas and locations where there is exposure to hazards for maintenance/operational personnel and the public. Refer to OSHA, ANSI, NEC, National Safety Council, local, federal and state codes for recommended location, size, shape, design and verbiage required for safety signage, examples of some of the types of signs are included in the contract drawings, these examples are not to be construed as the only signs required. The verbiage of the sign shall be appropriate for the particular location/hazard.
2. The safety signs shall be clearly visible and firmly affixed. The following is a list of locations where safety signage should be placed as a minimum, this list is not to be construed as being complete since it is only provided as a guide:
 - a. All potential pinch points
 - b. Rotating parts
 - c. Chain and V belt guards
 - d. On all conveyors that are under the control of auto start
 - e. Outside of electrical cabinets and disconnects boxes
 - f. Areas of low overhead clearance
 - g. Fire/Security doors
 - h. Around areas of false ceilings
3. Safety chains and prominently displayed placards/signs shall be placed at the bottom of ladders and stairs to indicate restricted area for “authorized and trained personnel only”.
4. Placards/signs indicating locations of all E-stop control stations and lanyards shall be clearly visible.

N. Welding

1. Nationally certified welders shall perform all welding, and all welding shall be in strict compliance with local and national codes. Provide to the Owner or their representative upon request, copies of certificates verifying that the welder(s) are nationally certified.

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2. Only compressed natural gas (CNG) and electric welders shall be used.
3. Connecting welding equipment to any MCP power supply shall not be acceptable.
4. Provide a fire watch at all times during welding and in compliance with local codes before approving any cutting or welding operation. A fire safety supervisor or appointee shall inspect the work area and confirm that the following indicated precautions have been taken in order to prevent fires:
 - a. Ten pound ABC Dry Chemical Fire Extinguisher to be kept on site.
 - b. No flammable liquids permitted within 50 feet of work.
 - c. Floors swept clean of combustibles.
 - d. All wall and floor openings covered.
 - e. Covers suspended beneath work to collect sparks.
 - f. Opaque screens placed between work and spectators.
 - g. Fire watch is required to observe all work and shall remain on site for a minimum of 30 minutes after completion of work.
 - h. The Owner is to be notified prior to beginning work.

O. Maintenance Access

1. Where walls immediately adjacent to conveyor equipment affect maintenance access, advise the Owner or their representative of the location and size of the wall opening that needs to be developed to permit access to drive components, bearings, and other equipment that would normally be inaccessible because of the wall.

3.06 SPECIAL CONTROL REQUIREMENTS

A. Control Stations

1. Mount controls, consisting of but not limited to push buttons, selector switches, indicator lights, in Control Stations. All controls shall be grouped to minimize the number of operating points throughout the system. In the application of a single control for a specific function, push-button stations may be employed.
2. Locate control stations as specified. Position control stations so as not to impede access to the equipment for servicing.
3. Mount all Control Stations located in public areas flush to the equipment and equip with stainless steel cover plates. Control stations located in the view of the public shall not be mounted on the top surface of the conveyor front cladding.
4. Locate Control Stations so as to be clear of normal vehicular and personnel traffic lanes. Install guards to prevent inadvertent actuation where this cannot be accomplished.

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5. Control Stations shall contain the appropriate control elements such as push buttons, selector switches, and those indicator lights, which will augment operations.
6. Control Station functions shall be identified in English using elementary concise terms supplemented by graphic symbols. All identification plates shall be mechanically affixed to the console face.
7. Control Stations shall conform to the environmental requirements specified herein. Outdoor applications shall employ weather tight, corrosion resistant boxes, switches, push buttons, and lights.
8. Emergency Stop push buttons, disrupting electrical control power, shall be employed where an emergency may require immediate shut down. Where more than one emergency stop push-button is used in any circuit or subsystem, only the indicator lamp in the activated E-Stop push-button shall be energized. Actuation of any emergency stop shall be announced on the respective status monitoring system.
9. Indicator lights, especially outside the facility, shall not be affected by extraneous light, and shall be clearly visible in all lighting conditions.
10. Control elements such as but not limited to switches, push buttons, and handles, shall be selected for ease of operation in an industrial "bag room" environment.
11. Control elements such as but not limited to switches, push buttons, indicator lights, and bulbs, shall be easily replaceable and reasonably protected from physical damage.
12. Freestanding control stations shall be mounted on extremely rugged and braced pedestals with large firmly anchored base plates. The design shall account for extraneous loading and generally abusive conditions.
13. Provide independently anchored impact protection wherever control panels, control consoles or control stations are exposed to work area traffic.

B. Photocell Functions

1. As a minimum, provide photocells to perform the following functions:
 - a. Cascade Stop
 - b. Jam Detection
 - c. Over-Height Detection
 - d. Over-Length Detection
 - e. Auto Start
 - f. Auto Stop
2. Combine photocell functions wherever possible provided proper operation of each circuit is maintained.
3. Jam Detection

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- a. Locate a head end sensor photocell to provide the signal for operation of jam detection circuits within approximately 12" of the discharge ends of all straight conveyors and 6" on power turns and queue conveyors (or an appropriate distance from the discharge end to ensure that the piece of stopped baggage

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does not transition/stop on the downstream conveyor). The center of the photocell beam is to be approximately either 2.5" or 3" above top of the conveyor belt.

- b. As a minimum, provide jam detection photocells and a jam indicator with a jam/restart/emergency stop control station in areas that have a relatively high frequency of jams. This shall include the discharge ends of all conveyors feeding onto power turns, at the bottom of inclines and decline conveyors, at all merges for both the primary and secondary lines, opposite all pushers and diverters and at any other location where experience indicates a potential jam point.
 - c. As soon as the photocell detects a jam (blocked for longer than an adjustable (0 to 10 seconds in the PLC), predetermined (nominally set to 6 seconds) length of time), initiate the following steps:
 - 1.) Stop the conveyor with the jam detection photocell and the one immediately downstream, unless the photocell is mounted on a conveyor that feeds onto a power turn. In this case the conveyor with the jam detection photocell, the power turn and the conveyor immediately downstream of the power turn are to be stopped.
 - 2.) Provide jam indication signal at the Touch Screen Terminal.
 - 3.) Illuminate the jam indicator light in the control station.
 - d. Whenever a conveyor stops for any reason, reset the jam detection timer and hold until the conveyor restarts.
 - e. The jam detection circuitry is only to function whenever the associated conveyor is running; i.e., if the conveyor is stopped and the jam detector photocell is blocked, the jam detection circuitry will not sense a jam condition and thus report a false jam condition.
 - f. Conveyors that cascade stop as a result of a jam are to be "latched stopped" through PLC logic until the jam reset push button has been activated.
4. Over-Height Detection
- a. Provide over-height detection photocells at every baggage input to the system to detect bags that are too high to clear the lowest downstream obstruction for all possible routes. This photocell shall be set at 36" above the top of the conveyor belt unless otherwise stated.
 - b. As soon as the photocell is interrupted, stop the conveyor. c. Provide jam indication signal at the Touch Screen Terminal.
 - c. Provide an oversize indicator lamp in the control station; this lamp may be the same unit as that for over-length detection. Illuminate the oversize indicator lamp in the control station if an over-height bag is detected.
 - d. Program the over-height circuit to require the following sequence to reset:

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- 1.) Actuate associated E-stop
 - 2.) Clear the photocell by removing or re-positioning the over-height bag, the oversize indicator lamp shall extinguish
 - 3.) Press the start push-button.
 - 4.) Clear the fault on the Touch Screen Terminal.
5. Over-Length Detection
- a. Provide over-length detection photocells at every baggage input in the system to detect bags that are too long.
 - b. Program the over-length measurement circuit to stop the conveyor if a preset bag length (adjustable in the PLC) is exceeded.
 - c. Provide jam indication signal at the Touch Screen Terminal.
 - d. Provide an oversize indicator lamp in the control station. This lamp may be the same unit as that for over-height detection. Illuminate the oversize indicator lamp in the control station if a preset bag length (adjustable) is exceeded.
 - e. Program the over-length circuit to require the following sequence to reset:
 - 1.) Actuate associated E-Stop
 - 2.) Clear the photocell by removing the over-length bag, the oversize indicator lamp shall extinguish
 - 3.) Press the start push-button. This push-button may be the same unit as that for over height detection.
 - 4.) Clear the fault on the Touch Screen Terminal.
6. Auto Start
- a. Provide Auto Start photocells upstream of sections of transport conveyors not specifically controlled by START/STOP switches. The same photocell may control both Auto Start and Auto Stop circuits.
 - b. Program Auto Start circuits to start a string of conveyors whenever an Auto Start photocell is interrupted.
 - c. Before any conveyors may be started, audible start-up warning alarms shall be actuated, audible throughout the area to be affected by the starting of the conveyors. Activation of the alarms shall be through the PLCs. The horn shall sound and after a period of between 5 and 25 seconds (adjustable in the PLC) the conveyor subsystem shall start.
 - d. Each conveyor in the subsystem shall be sequentially started from output to input point with an appropriate delay between each motor starter actuation as to ensure

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electrical power surges are minimized. The next sequence of conveyors controlled by Auto Start functionality shall start in a similar manner, triggered by baggage at a predetermined location within the line.

7. Auto Stop (Time-Out)

- a. Provide Auto Stop photocells upstream of sections of transport conveyors not specifically controlled by START/STOP switches. The same photocell may control both Auto Start and Auto Stop circuits.
- b. Program Auto Stop circuits to stop a string of conveyors if an Auto Stop photocell does not sense a bag for an adjustable time period (adjustable in the PLC).
- c. If a conveyor stops for any reason, reset the auto stop timer and hold until the conveyor restarts.

C. Motor Overloads

1. Size the motor overload heaters not to exceed 115% of the full load amps as indicated on motor nameplate.
2. In the event of any subsystem motor drawing excess current, appropriate protection shall be provided to isolate supply to all subsystem elements. Either the single "motor overload" indicator on the affected MCP panels shall illuminate, or if individual "motor overload" indicators are specified for each drive then the effected drive indicator will illuminate.
3. Following rectification of the cause of the overload and resetting of the overload protection device in the motor control panel or motor control center as applicable, the system may be restarted by actuation of the "start" button, at which stage, the "motor overload" indicator shall be extinguished and normal control shall resume.
4. "Motor overload" fault conditions shall be reported both visually and audibly on the Touch Screen Terminal.
5. In the event of individual conveyor motor overloads, all upstream conveyors shall revert to cascade stop mode, while all downstream conveyors shall continue to run in normal mode of operations.

D. Jam Indication/Restart

1. Provide an Illuminated Amber Jam Light (in a common enclosure with an Emergency Stop push-button and green re-start pushbutton) adjacent to all jam detection photocells as follows: As a minimum, provide jam detection photocells and a jam indicator with a jam/restart/emergency stop control station in areas that have a relatively high frequency of jams. This shall include the discharge ends of all conveyors feeding onto power turns, at the bottom of incline and decline conveyors, at all merges for both the primary and secondary lines, opposite all pushers and diverters, and at any other location where experience indicates a potential jam point.
2. Illuminate the Jam Lamp when the jam detection photocell senses a jam condition.

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3. Restart the conveyor and extinguish the lamp only after the following sequence:
 - a. Actuate (push in) Emergency Stop push-button (E-Stop indicator lamp goes on)
 - b. Clear the jam
 - c. The jam light shall “flash” (indicating the jam photocell has been cleared and the conveyor is ready for restart).
 - d. Reset (pull out) emergency stop push-button (E-Stop indicator lamp extinguishes)
 - e. Depress green “re-start” push-button (conveyors restart after warning alarm sequence)
4. Paint the control station enclosure with "Safety" yellow paint and label with the conveyor Item Designations of the conveyors being controlled in 1/2" high block letters. Jam detection reset control stations shall be placarded with the conveyor designations, which are being controlled.
5. In most cases the control stations shall be located adjacent to the conveyors under control and shall be accessible only to the personnel clearing the jam to avoid a subsystem being re-started in an unsafe condition (e.g. personnel on conveyor). Note that all such control stations shall be located on the catwalk side of conveyors so equipped with catwalks.

E. Start-Up Warning

1. Provide amber rotating beacons and audible horn alarms as start-up warnings in areas as specified.
2. Activate the beacon and the horn for an adjustable period of time prior to the start-up of the conveyor system.
3. Appropriate audible start-up warning alarms shall be provided at public areas such as ticket counter, curbside check in, and rechecked baggage input points.

F. Alarm Silence

1. Provide an ALARM SILENCE momentary contact push-button on the door of the MCP which, when depressed, shall silence the audible alarm. The design of the control circuitry shall be such that multiple faults shall always sound the associated fault warning alarm; i.e., if a jam condition has caused the alarm to have been sounded and the alarm has been silenced by the act fault but has not yet been corrected, a second fault occurring after the alarm has been silenced shall again cause the fault warning alarm to sound.
2. Do not extinguish the illuminated fault indicator until the fault has been corrected.

G. Emergency Stop Push-Buttons

1. Locate Push buttons as required to ensure that operating and maintenance personnel can easily and quickly reach an Emergency Stop Push-Button from anywhere in the system. In addition, ensure that Emergency Stop Push-buttons are installed at the

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following locations:

- a. Around the perimeter of all Flat Plate claim devices.
 - b. At each end of load/unload conveyors.
 - c. In each jam indication enclosure.
2. Wire all Emergency Stop push buttons for a single subsystem in series with the coils of one or more emergency stop relays. Size the normally open contacts of the relays in series with the power source of the PLC output module(s) controlling the conveyors in the subsystem. The PLC shall not be required to remove power from the associated conveyors for an emergency stop condition.
 3. Upon actuation of an Emergency Stop push-button, stop the associated conveyors in the subsystem, illuminate the lamp in the head of the push-button in a steady burning mode, and illuminate the red emergency stop fault light at the MCP.
 4. Restart the conveyors and extinguish the indicator lamp and MCP fault light only after the following sequence:
 - a. Reset (pull out) emergency stop push-button (indicator lamp and MCP fault light extinguish)
 - b. Depress the green "Re-Start" push-button (conveyors restart)
 5. When a jam has been detected and an Emergency Stop push-button in the jam indication enclosure is activated, follow the same sequence of stopping the conveyors and illuminating the light in the head of the push-button, but do not activate the fault warning circuits at the MCP.
 6. When the normal re-start switch for the conveyor is actuated, extinguish all emergency stop push-button lamps within the subsystem associated with that particular emergency stop actuation, actuate the start-up warning alarms and, after a delay, start all conveyors in the subsystem.
 7. Note that the activation of an Emergency Stop push-button switch must not close any powered fire/security door within the area of control of the Emergency Stop switch.
 8. "E-Stop" conditions shall be reported both visually and audibly on the Touch Screen Terminal.

H. Security/Fire Door

1. Provide a photocell to detect bags under the security/fire door.
2. The door is to be equipped with either a limit, photocell or proximity switch mounted in such a manner so that the "fully open" position of the door is sensed. If the door is sensed by the limit or proximity switch not be in the fully open position, the associated conveyor shall be stopped if running or shall not be permitted to start if the conveyor is not already running. Note that this limit or proximity switch is in addition to those limit or proximity switches provided with the door operator if the door is powered.

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3. A fire door's normal state shall be in the open position and close only upon detection of fire/smoke, per the appropriate interface with the building fire/security system. The BHS controls for the fire door and the associated subsystem(s) shall interface with the building fire/security system, as required, to provide the response to the fire alarm requirement for door closure (with related control functionality to stop the associated conveyor line).
4. The door is also to be equipped with a limit, photocell or proximity switch mounted in such a manner so that the "fully closed" position of the door is sensed. If the door is sensed by the limit or proximity switch not be in the fully closed position, annunciation shall be sent to the system fault monitoring system for rectification of the problem. Note that this limit switch is in addition to those limit or proximity switches provided with the door operator if the door is powered.
5. Interface and test the door interface with the building fire/security system for door open/closed status.
6. Program the security/fire door to operate as follows:
 - a. Normal Start/Stop
 - 1.) Start: Open the security/fire door immediately. Ticket counter inputs and curbside inputs require card swipe permissive start. PLC to provide Building Security System with "Running status".
 - 2.) (If the Door is a Fire/Security Door or a Security Door) Stop:
 - a.) Run the feeding conveyor for one minute, stop the conveyor and lower the security/fire door.
PLC to provide Building Security System with "Door Closed" status.
 - b.) If a bag is detected under the door via the door clear photocell or the door pressure switch, continue to run the conveyors until the photocell is clear and reattempt to close the door. The door should continue attempting to close, however an alarm should be displayed on the fault monitoring system that the door has failed to close after the third attempt.
 - 3.) (If the Door is a Fire Door) Stop:
 - a.) The fire door shall remain in the open position when the conveyor line stops due to either Manual or Auto Stop controls functionality. The fire door shall close only upon detection of fire/smoke per the appropriate interface with the building fire/security system.
 - b.) Upon detection of fire/smoke, if an obstruction is not detected within the door's right-of-way, stop the conveyors and lower the fire door. PLC to provide Building Security System with "Door Closed" status.
 - c.) If an obstruction is detected under the door via the door clear photocell, continue to run the conveyors until the door clear photocell is clear and

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reattempt to close the door. The door should continue attempting to close, however an alarm should be displayed on the fault monitoring system that the door has failed to close after the third attempt.

b. Upon fire detection:

- 1.) Close the dry contact
- 2.) If no bag is detected under the door by either the clear photocell or the door pressure switch, stop all conveyors and close the door.
- 3.) If a bag is detected under the door by either the door clear photocell or the door pressure switch, run the conveyors until the photocell is clear and immediately stop the upstream and downstream conveyors to allow the door to close. If the door is unable to close upon detection of a fire signal or system stop signal an alarm shall be displayed on the fault monitoring system that the door has failed to close.

c. Emergency Power:

- 1.) The fire doors and respective upstream and downstream conveyors shall be supplied with both normal and emergency power supply. Reference “ELECTRICAL & CONTROLS SPECIAL CONSIDERATIONS” paragraph related to “emergency power” for additional requirements.

d. A fire door control station shall be installed adjacent to each fire door for maintenance personnel use only (not accessible from the public side) which shall contain the following:

- 1.) Maintenance/Auto Switch
- 2.) Emergency Stop
- 3.) Start Pushbutton
- 4.) Door Open Pushbutton
- 5.) Door Closed Pushbutton

e. When the Maintenance/Auto is in the Maintenance position, the door open and door-closed switches are active. Related conveyor systems are not active when in the maintenance mode. Activation of the ticket counter or curbside security card swipe is not required when in the maintenance mode.

f. All powered security/fire doors must be equipped with a manual release mechanism to permit the disengagement of the door drive unit so that the door can be either raised or lowered.

I. Fault Warning Alarm

1. Provide an audible/visual alarm on the MCP controlling the system.
2. Activate the alarm and one of the following indicator lights whenever any fault has

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caused a section of conveyor to stop or prevent it from starting:

<u>Condition</u>	<u>Color</u>
Jam	Amber
Motor Overload	Blue
Emergency Stop	Red

J. Motor Safety Disconnect (MSD)

1. Provide Motor Safety Disconnect Switches as described in part 2 of this specification.
2. Rotation of the MSD to the off position shall cause the conveyor or other component to stop and appropriate alarm/statuses to be displayed on the Touchscreen Panel as described in part 2 of this specification.

3.07 ELECTRICAL & CONTROLS SPECIAL CONSIDERATIONS

A. Power Source

1. The electrical equipment and PLC control systems supplied by the BHS Contractor shall be compatible with, and operate reliably and effectively with, the normal electrical supply typically available at airport locations. The equipment shall not be unduly sensitive to fluctuations in supply voltage which may typically vary by plus or minus ten percent (10%) of nominal values.
2. The BHS Contractor shall provide necessary electrical supply filters, conditioners, and regulators for all equipment, which cannot meet the specifications stipulated.

B. System Ready Indication

1. A green indicator light, labeled SYSTEM READY and located on the door of each MCP shall serve to indicate that the devices under its control are ready to operate upon receipt of a START signal, from the BHS control system and local card swipe device. To accomplish this, the light shall illuminate under the following conditions, per the respective subsystem:
 - a. Power is applied to the MCP.
 - b. The local conveyor motor and Fire/Security door disconnect switches are in the "ON" position.
 - c. All Emergency Stop pushbuttons are reset.
 - d. No Motor overloads are tripped.
 - e. No Jam conditions are indicated
 - f. No faults are indicated on the Touch Screen Terminal or MCP.

C. Flat Plate/Claim Device Control Stations

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1. Flat Plate/Claim Device

- a. Provide Four "Start" Pushbutton control stations (two on the each side of the flat plate/slope pallet make-up device) for Manual Start-up operation of the make-up device; In case the flat plate/slope pallet make-up device times-out before all baggage has been sorted, activation of any start button on the flat plate/slope pallet make-up device shall cause the device to run for an additional twenty (20) minutes (adjustable) without the feed conveyors operating.
- b. Additionally, provide two "Control Stop / Start" Pushbutton control stations per make up device crossover (one control station on each side of the crossover) as specified elsewhere in the document.

3.08 BHS DETAILED CONTROL DESCRIPTIONS/REQUIREMENTS

A. General Design Requirements

1. The following subsystem control descriptions apply the referenced components and circuits to the operational aspect of the system and specify the actual elements under their control.
2. Reference the Contract Drawings for conveyor equipment power distribution and subsystem indication. Location for each of the new MCPs is referenced on the BHS Partial Plan and Control Plan Drawings. Power distribution point (PDP) locations for the new MCPs are at the immediate area of the respective MCP as shown on the BHS Partial Plans.
3. Provide software for the control system reflecting the sequence of operation for each subsystem as described in the following paragraphs. The paragraphs describe the particular subsystem specific controls that will be required in addition to those standard controls (i.e., Jam Detection, Jam ResetAuto Start, Auto-Stop, Emergency Stop, and all other controls functionality described elsewhere in this document) that will be required for each subsystem (described elsewhere in this document).
4. The BHS Contractor shall provide a dry contact to the subsystem controls so that in the event a fire is detected the conveyor system will shut down.

3.09 CONSTRUCTION PHASING SEQUENCE

A. General

1. The BHS installation and associated modifications to the existing systems will be required to be completed in phases. The BHS scope of work will be in accordance with an overall project phasing sequence. Reference attached BHS phasing plans and overall program phasing plans (i.e., B5.00.00 series). The BHS contractor shall be required to coordinate all work with the Program Manager, other disciplines working in the immediate area of construction, airline flight schedules and hours of operation, so as not to impact the Terminal's normal functions and concurrent airline operations.

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2. The BHS implementation staging is of vital importance to the success of the BHS installation of the new conveyor equipment and modifications to the existing subsystems. Installation of the new conveyor equipment and removal/modifications of the existing equipment will occur simultaneously with on-going airline operations.
3. Schedule and coordinate the BHS Scope of Work (installation, removal, refurbishment, and interim connections), in accordance with the phasing sequence indicated by the project's overall phasing plan and the phasing sequence described herein. Coordinate all work with the Owner/Program Manager, other disciplines working in the immediate area of construction, airline flight schedules and hours of operation, so as not to impact the Airport's normal functions and concurrent airline operations.
4. Short duration system shutdown will be permitted for the changeover from the existing subsystem configuration to the new. Shutdown of the system during changeover shall be scheduled during times of low impacted terminal operating demands. The contractor shall check and field-verify actual site conditions to determine and coordinate the schedule for any shutdown period. Notify the respective carrier 72 hours in advance and obtain approval before proceeding with the shutdown of the system(s).
5. All work associated with the inbound system will be available to the BHS contractor for all shifts, as dictated by the project's overall phasing plan. Transfer all of the necessary construction material, conveyor equipment, tools, and components required for the implementation of the BHS to and from the designated Lay-Down areas during the work period. All Airline operational areas associated with the BHS work shall be left broom clean at the end of the Contractor's shift without any equipment, tools, or components left in the area. BHS construction material, equipment and tools/components will be permitted in the immediate area of construction only during the contractor's work period/shift.
6. Existing BHS equipment indicated for removal shall be removed, salvaged and turned over to the Owner. Storage of the salvaged components shall be coordinated with the construction manager and the Owner in compliance with the specified requirements of this section (Part III). Equipment shall be turned over to the Owner's Airport Operations and transferred to the designated area within a 5-mile radius of the Airport Property. Dispose any equipment not desired by the Owner, in compliance with the specified requirements of this section (Part III).
7. Reference the overall program phasing plans and the following BHS. The BHS Contractor shall include as part of his proposal the best duration period, per phase, that will require completing the specified work.

3.10 DEMOLITION/EQUIPMENT REMOVAL

A. Maintain Operations

1. Remove existing equipment indicated on the Contract Drawings as "To Be Removed".

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Maintain operation of unaffected baggage handling equipment through the implementation of temporary electrical connections or the addition of supports to replace connections or supports removed in the demolition process.

2. If the removal of equipment creates unsecured access to a secured area, provide a guard on a 24-hour per day basis until installation of equipment returns the area to secured status.

B. Conduit Removal

1. Remove conduit including junction boxes and control/wiring devices rendered unused by the demolition process in its entirety to the motor control panel. Exception: abandon in place the imbedded portion only of any imbedded conduit after removing all conductors. Where a conduit passes through a floor or wall, cut the unused conduit flush with both surfaces of such floor or wall and abandon the section within the floor or wall if it cannot be removed without breaking masonry. Ensure that any area where material has been cut away is left in a clean and flush condition with no holes or protrusions showing. Where removal creates an indentation in concrete, chip away the surrounding concrete, cut the material (e.g., anchor bolts, conduit) below floor level and fill flush with cement.

3.11 DEMOLISHED MATERIALS TO BE DISPOSED

A. General

1. Remove and dispose of any materials or items demolished and not designated to become the property of the Owner or to be reinstalled.

B. Equipment Disposal

1. Remove from Airport site all debris, rubbish and other materials resulting from demolition and alternation operations on a daily basis. Transport and legally dispose equipment off-site in legal landfills or scrap yards. Obtain written permission from the property Owner on whose property the removed materials shall be placed, and submit a copy of the agreement to the Owner.
2. Burning of removed materials is not permitted on the project site.
3. Store materials, which cannot be removed daily in areas specified by the Owner.
4. Do not store or sell removed items on-site.

3.12 OPERATION AND MAINTENANCE TRAINING

A. General

1. Instruct and train the Owner operating and maintenance personnel at the work site. Conduct this training prior to Conditional Acceptance of each phase of the work and ensure competence in the operation and maintenance of the new equipment and the system/subsystems.

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2. Training is to be provided by a professionally qualified instructor. Use of site supervisors, equipment or system designers as an instructor for the formal training will not be accepted unless approved by the Owner or their representative.
3. Furnish all tools, equipment, materials and supplies, and perform all functions and services required to complete the training as specified. With the exception of safety and overview training, training shall be divided into separate categories for operations training and maintenance training further broken down to

specific trades.
4. No actual operations training of a piece of equipment will be permitted until the equipment is properly installed and is operational.
5. A detailed outline of the proposed training to be conducted shall be submitted to the Owner or their representative for review and approval in accordance with the schedule of submissions prior to the testing of the system. The training program submittal shall include, at a minimum, the following information for review:
 - a. Types and durations of training/classes.
 - b. Name and professional credentials for each instructor/trainer.
 - c. Max/min number of persons allowed per class.
 - d. Any specialty type of requirements such as classroom/conference room space, VCR, TV, or white board (to be coordinated with the Owner however the Owner is not responsible to supply the above mentioned space or materials)
 - e. Copies of all training materials, to be used during training. All training binders/materials shall be submitted for review in the format in which they will be used during the on-site training. It should be noted that the O&M manuals will not be allowed to be used for training purposes; however consolidated sections of the O&M manuals which have been tailored for classroom training are permitted.
6. Times and duration of the classes may involve irregular hours in order to provide training of the operational and maintenance personnel on different shifts.
7. All training sessions will be monitored and approved by the Engineer. Any session or portion thereof deemed unsatisfactory, based on evaluation of the training, shall be repeated by the BHS Contractor or the BHS Contractors representative at no additional cost to the Owner.
8. Develop and maintain a training attendance record for all operation and maintenance training sessions presented. The record is to note the following information in duplicate form. The original copy of the record is to be forwarded to the Owner with the second copy being retained by the BHS Contractor for his files. The recorded training information must include for each session:
 - a. Date of training session

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- b. Name of project
- c. Name of Instructor
- d. Subject of training
- e. Time of training session
- f. Signature and department of each attendee

C. Operational Training

1. Provide formal instruction of the Owner's operational personnel at the site who will be charged with operation of the BHS. Include a description and on-site demonstration of the electrical controls and their operation, modes of operation, the operating limitations of the equipment and the safety devices and their functions.
2. Minimum requirements for Operational Training shall include, but not be limited to, the following:
 - a. Operating procedures for all BHS conveyance equipment.
 - b. System Safety procedures, including lock-out and Tag-out requirements.
 - c. Bag Jam Clearing procedures, as coordinated with the Airport's O&M group.
3. Provide a minimum of 4 hours of operational training per shift for this project, for a minimum of three (3) shifts.

D. Maintenance Training

1. Provide formal training of the Owner's BHS maintenance personnel with the objective of preparing the employees to perform the required preventive maintenance to minimize breakdown and to perform necessary repairs when work stoppages or breakdowns of the equipment occur. The training shall include, but not limited to the following:
 - a. Preventive and corrective maintenance procedures, including replacement of parts; lubrication quantities, types, frequencies and application points; and an estimate of the time to perform such procedures.
 - b. Special tools, techniques, or procedures required for either preventative or corrective maintenance of the equipment, or it's auxiliary or support components.
 - c. Procedures to perform adjustments required for alignment, wear and calibration for all preventative and corrective maintenance, and an estimate of time required to perform such procedures.
 - d. Assembly and disassembly procedures, including parts lists required for appropriate and corrective maintenance. Models, "exploded" views, and audiovisual materials shall be used for training. These materials shall be handed to the Engineer upon completion of training. Hands on field training shall be provided, subject to the approval of the Owner.

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2. The formal training shall consist of classroom and on the equipment training, as required to properly train personnel for each shift, prior to the start of operation. The training must cover all aspects of the electrical and mechanical equipment provided in this project. The electrical aspects shall include but not be limited to, electrical controls and control systems and PLC control systems.
 3. On-site training shall be scheduled to commence immediately following classroom training and shall stress hands-on performance based application of the classroom training. Equipment shall be started and relevant systems and components shall be demonstrated.
 4. Off-site training, primarily for the technical trades e.g. electricians, controls technicians; mechanics shall focus on specialized, technical training and shall be provided by the manufacturer at their factory or training facility. In the event the Owner requests specialized factory training on a particular piece of equipment, the BHS Contractor shall make arrangements with the applicable manufacturer to provide such training.
 5. Provide maintenance training for any specialized equipment used in the related system that is not of the BHS Contractor's design or manufacture. The qualified representatives will present such training, from the manufacturer of the specialized equipment.
 6. Provide a minimum of 4 hours of maintenance training per shift for this project, for a minimum of three (3) shifts.
 7. Examples of specialized equipment and other BHS maintenance related training include, but are not limited to those items listed below:
 - a. Safety Procedures including Lock out/Tag-out
 - b. Operation and Maintenance Manual use
 - c. Warranty Procedures
 - d. System Preventative Maintenance
 - e. Flat Plate devices
 - f. Fire/Security Doors
 - g. Programmable Logic Controller Systems including basic ladder programming techniques
 - h. Problem Resolution Screens
- E. Supplemental Training
1. Should the Owner require supplemental training beyond that specified above, provide at a time and at rates as mutually agreed upon between the Owner and the BHS Contractor.

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- END OF PART III -

PART IV - QUALITY CONTROL SPECIFICATIONS

4.01 FIELD QUALITY CONTROL

A. Quality Control Manual

1. Provide a Quality Control Manual acceptable to the Owner or their representative.
2. Indicate inspection lists and methods that will be utilized for quality control inspection and testing to confirm compliance with the specified requirements.
3. The Quality Control Manual shall assure that there is a system for final inspection and testing of completed products, construction and installation. Such testing shall provide a measure of the overall quality of the completed product and shall be performed so that it simulates product end use and function. Final inspection and testing shall provide for reporting to the Owner or their representative any difficulties, deficiencies, or questionable conditions. When modifications, repairs, or replacements are required after final inspection or testing, there shall be re-inspection and re-testing of any characteristics affected.
4. The Quality Control Manual shall provide instructions for handling, storage, preservation, packaging, and shipping to protect the quality of products and prevent damage, loss, deterioration, degradation, or substitution of products. It shall also require and monitor the use of procedures to prevent handling damage to articles. Products in storage shall be protected against deterioration and damage.

B. Quality Assurance

1. The BHS Contractor shall be responsible for all quality control of its Work, including work performed by any of its subcontractors. It shall be the BHS Contractor's responsibility to include in its own direct subcontracts those provisions which are necessary to assure that the quality of subcontracted work will be as good as that required of the BHS Contractor by the requirements herein.
2. The Owner or their representative shall have the right to audit and inspect the BHS Contractor's and its direct subcontractors' quality systems. Such audits may be conducted on a random or routine basis and may include an audit of the BHS Contractor's inspection and test records. The Owner or their representative shall have the right to witness any tests or inspections and shall have access to all test data including test procedures, test specifications, and test results. The Owner or their representative shall have the right to conduct independent tests or inspections at its own expense on any material or equipment to be used on the project. Should such the Owner or their representative directed independent test result in failure, the BHS Contractor shall reimburse the Owner's expense for the test. The objective of all audits, inspections, or tests conducted by the Owner or their representative is to ensure that all BHS Contractor-performed work is accomplished in compliance with the Contract Documents.
3. The Owner or their representative shall have the right to reject, and the BHS Contractor shall replace at the BHS Contractor's cost, any construction,

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production or installation, or portion thereof, which has not been accomplished or documented as accomplished in accordance with the accepted Quality Control Plan.

C. Quality Assurance Representative

1. Appoint a Quality Assurance Representative acceptable to the Owner or their representative who shall be responsible for the overall quality assurance implementation and monitoring of the general requirements.
2. The quality assurance representative shall be available on-site during the construction period at all times and be qualified to advise the Owner or their representative on the overall BHS scope of work (i.e., installation/removal procedures, refurbishing, provisioning, start-up and maintenance of the equipment).

D. Configuration Management Plan

1. Maintain strict configuration control of all aspects of the design, construction, fabrication and installation of the BHS Systems. Submit a Configuration Management Plan for the Owner or their representative review and approval. The BHS Contractor shall be responsible for carrying out all aspects of this Plan.
 2. Establish a system, to identify, organize and track all documents developed as part of the BHS Contract Work throughout the duration of the project. Serialize all correspondence and transmittals, and establish a logging system for incoming/outgoing correspondence showing action requirements and action taken. Drawings, specifications, subcontract documents, reports, estimates, studies, reviews, and computer files, shall be tracked by a logging system.
3. Tracking logs for correspondence and documents shall be provided when requested by the Owner or their representative. Establish a single source for transmitting and receiving documents and correspondence. Material from the BHS Contractors subcontractor's shall be consolidated and submitted to the Owner or their representative by the BHS Contractor.
4. Logs for correspondence and document control shall be provided to the Owner or their representative on electronic media and in reproducible hard copy for use in the Owner's document control system.
5. Once configuration for an element of the BHS System is established (for example, at Design Reviews), the configuration of all such elements shall not be changed by the BHS Contractor without proper approval as provided for in the Configuration Management Plan. Once configuration changes are approved, formal Change Order Documentation shall be circulated in accordance with a distribution list (which shall include the Owner or their representative) developed for that purpose.
6. At conditional acceptance of the system (or completion of a phase), provide

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a software solution that automatically manages configuration and change management for all operating software applications to carry out the following functions as a minimum:

- a. Monitor critical computer services
 - b. Log system events across concurrent processes
 - c. Audit and log changes made to the running processes
 - d. Verify, backup and recovery programs and system files
 - e. Secure access to editing and monitoring functions
 - f. Provide file management for all system components
 - g. Manage and secure product access
7. The audit function shall track every change made to the BHS system and its operating programs, including detecting who, where and when changes were made. The archive file management function shall manage all revisions carried out to the system, as files are modified, revisions shall also be stored and be accessible for future use.

E. Safety Program Manual

1. Prepare a site-specific safety program manual acceptable to the Owner or their representative.
2. Designate a Safety Manager/Coordinator acceptable to the Owner or their representative.
3. The Safety Program shall be implemented by the BHS Contractor to identify and resolve hazards. The Safety Program shall emphasize the prevention of accidents by resolving hazards in a systematic manner. The Safety Program Plan, as described below, will identify the responsibilities of all parties for implementing the Safety Program.
4. The Safety Program shall demonstrate compliance with all applicable safety rules and regulations. The levels of compliance shall meet the OSHA Standards, ANSI Standards, NFPA Standards, NEC Standards, and trade association standards and recommendations as applicable.
5. The safety program manual shall contain as a minimum the following:
 - a. Have as its objective to provide for the safety of the passengers, employees, general public and equipment.
 - b. Encompass all elements within the BHS Contractor-provided BHS Systems.
 - c. Include all interfaces with Facilities provided by others and identify all hazards within the Facilities that may result from the unique characteristics of the BHS System.
 - d. Identify the safety roles and responsibilities of all the BHS Contractors'

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organizational elements and require accountability of each.

- e. Contain a hazard resolution process that includes the procedures necessary to identify and resolve hazards.
- f. Indicate safety inspection lists and methods that shall be utilized by all personnel employed on this project.
- g. A plan for furnishing and enforcing the use of individual protective equipment including hard hats, rain gear, protective footwear, protective clothing and gloves, eye protection, ear protection, respirators, safety belts, safety harnesses, safety lifelines and lanyards, and high visibility reflective safety vests.
- h. A plan for providing first aid facilities, supplies, and trained personnel.
- i. A plan for employee safety training to include employee safety orientation during the first week of work, weekly work crew safety meetings, periodic safety meetings for supervisory personnel, and special training prior to working with especially hazardous materials or operations.
- j. Emergency plans for items such as, but not limited to, fire emergencies, severe weather, earthquakes and other geologic hazards, or flooding emergencies, seriously injured personnel, traffic accidents along the project site, and injuries of members of the public.
- k. Pre-construction planning relative to safety and control of hazards including special tools, equipment, facilities, and individual protective gear.
- l. A plan for periodic safety inspections, investigations of all accidents and injuries and submission of timely reports.
- m. Submission of injury/accident/incident data for statistical analysis.

F. Project Management Team

- 1. Submit to the Owner or their representative for review and approval, the following listing of key personnel with resumes and qualifications that will be working on the project:
 - a. Senior Project Manager
 - b. On-Site Field Supervisor(s)
 - c. Professional Engineer(s)
 - d. Safety Manager
 - e. Configuration Control/Schedule Manager(s)
 - f. Quality Control/Assurance Manager(s)
 - g. Project Manager(s) - Electrical and Control Systems Engineering

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- h. Project Manager(s) - Mechanical Engineering
 - i. Project Manager(s) - Computer Systems Engineering
 - j. Instructors/training personnel (in addition, provide instructors professional qualifications)
- 2. Include on-site and off-site participating personnel and the percent of anticipated participation on this project. The Owner or their representative reserves the right to approve or reject key personnel from the list.
 - 3. The Project Manager and on-site Superintendent(s) shall not be changed without the Owner's or his representative's written approval.
 - 4. The BHS Contractor, individuals or entities constituting the BHS Contractor and the officers or directors of the BHS Contractor or entities or key members of the Project Management Team shall have records of past performance sufficient to assure the Owner or their representative that they have the experience, competence and integrity to successfully complete a project of this magnitude.

G. Project Management Office

- 1. Within one week of the date of commencement initiate the Project Management Office, inform the Owner or their representative of the details of the office, and authorize the Project Manager and on-site Field Superintendent to act as representatives
- 2. The Project Manager shall be given full authority to make decisions and enter into binding agreements with the Owner for all aspects of the project.
- 3. The BHS Contractor shall provide to the Construction/Program Manager, the Owner or their representative a listing of all key project personnel with 24-hour contact details (cell phone number, pager number and e-mail addresses).
- 4. The BHS Contractor shall be responsible to supply all office equipment (e.g. telephones, copiers, fax, computers, plotters, furniture) required to establish their on-site project management office.

H. Workmanship

- 1. Ensure that all equipment is manufactured and installed in accordance with the best commercial practices consistent with the intended design and usage and is acceptable to the Owner or their representative.
- 2. Ensure that all materials and components are new and free from defects. Do not supply used equipment, whether refurbished or reconditioned, unless indicated in the specifications and drawings or without the express approval of the Owner or their representative.
- 3. The Owner or their representative shall reserve the right to inspect any conveyor component at the BHS Contractor's factory prior to shipment of said components. The BHS Contractor shall co-ordinate with the Owner or

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their representative, fabrication of any components that the Owner or their representative requests to inspect such that said components are fully assembled and available for inspection by the Owner or their representative at the previously arranged time of the factory visit.

I. Pre-Installation Meeting

1. Prior to the start of the installation; attend meetings on-site as required or requested by the Owner or their representative. The Owner or their representative will schedule the Pre-Installation meetings, for the purpose of coordinating the on-site installation with ongoing airport operations.
2. Provide at the initial pre-installation meeting to the Owner or the Construction Manager the following:
 - a. Safety Program Manual
 - b. Drug Policy Manual
 - c. Submittal Schedule
 - d. Project Organization Chart to include all Sub Contractors
 - e. Principle suppliers to include long lead items and planned procurement dates
 - f. Insurance enrollment forms
 - g. Quality Control Manual
 - h. Configuration Management Plan
 - i. Diversity Program
 - j. Updated Master Schedule
 - k. Plans for coordination and notification for utility work
 - l. Plans for coordination with the work of other contractors and procedures for sharing access to the work site.
 - m. Schedule of deliveries of major equipment

J. Pre-Demolition Meeting

1. Prior to the start of any demolition; attend meetings on-site as required or requested by the Owner or their representative. The Owner or their representative shall schedule the Pre-Demolition meetings for the purpose of coordinating the on-site removal of the BHS equipment with ongoing airport operations.

K. Work Activities Bulletin

1. Submit a detailed work plan for individual subsystem testing. A BHS specific "Work Activities Bulletin" must be submitted by the BHS Contractor to the Owner or their representative for distribution to the impacted airlines, other impacted contractors (e.g. EDS manufacturer) and the Owner a minimum of

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7 days prior to the testing, demolition or cutover activity-taking place.

2. No work should be commenced unless the BHS Contractor has a signed “Work Activities Bulletin” in hand, and has distributed copies the User Airlines, the Owner or their representative.
3. The “Work Activities Bulletin” shall contain the following as a minimum:
 - a. Contractor’s internal deadlines for completion of pertinent facility interfaces by other disciplines (e.g. permanent system power, support structure, or other facility interface requirements).
 - b. Date and time planned activity to take place from start to finish
 - c. User Airlines that are impacted
 - d. Details of all conveyors to be removed with duration
 - e. Details of all conveyors to be installed with duration
 - f. Electrical installation duration
 - g. Contractors internal testing with duration
 - h. Witnessed system testing with duration
 - i. Full details of contingency plans
 - j. Details of person(s) (with qualifications) overseeing the activity
 - k. Details and number of personnel to be present who are qualified to troubleshoot all aspects of their respective equipment during the planned activity, for example:
 - 1.) Mechanics
 - 2.) Electricians
 - 3.) Controls Engineers
 - 4.) Computer programmers
4. Detailed description of activities required when completing overnight changeovers to ensure that disruption to baggage handling system is kept to a minimum. Include all preparatory work by other trades. Provide backup plan for recovery of operations if changeover work will not be completed in time.
5. Coordination and operational interface to ensure on-going airline and airport operation is not disrupted.
6. Submit as part of the submittal process a sample of their proposed “Work Activities Bulletin” format for review and approval by the Owner or their representative.

L. Field Quality Control Services

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1. Establish and maintain quality control for operations under this Section to ensure compliance with Contract Document requirements and maintain records of quality control for alteration and removal operations.
2. Submit quality control procedures for operations in conjunction with work under this Section for approval.
Do not start work prior to receiving approval.
3. The procedures shall include a checklist of points to be observed.
4. The actual quality control observations and inspections shall be documented and a copy of the documentation maintained on file.
5. Any work found not to be in compliance with the Contract Documents, shall be promptly corrected in an approved manner, at no additional cost to the Owner.
6. If the facility is under construction or modification, cooperate with other contractors who may be working in the immediate area for coordination of right-of-way clearances and verify as-built conditions.
7. Where walls immediately adjacent to conveyor equipment affect maintenance access, advise the Owner or their representative of the location and size of the wall opening that needs to be developed to permit access to drive components, bearings, and other equipment that would normally be inaccessible because of the wall.
8. Ensure that the design and installation of all conveyor equipment provides maximum access for operational and maintenance personnel.

M. Approval to Proceed

1. Before starting any work affecting existing baggage handling equipment that shall temporarily discontinue or disrupt service to the existing system/operations, notify the Owner or their representative 72 hours in advance and obtain the Owner or their representative approval in writing before proceeding with this phase of the work.

N. Preparatory Inspection

1. To be conducted prior to commencing work:
 - a. Check schedules, project conditions, protection, traffic arrangements, utilities services maintenance, and related preparatory work for conformance to submittals.
 - b. Check to assure adequate protection against damage.
 - c. Ensure that all workers are qualified.
 - d. Review installation; demolition, alteration, removal and disposal procedures to assure coordination of Contract Documents requirements with each person involved in performing the work.

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- e. Verify as-built conditions and notify the Owner or their representative of conflicts.

O. Initial Inspection

1. To be conducted after a representative sample of the work is complete:
 - a. Review the representative sample of the work against the specification and code requirements previously discussed at preparatory inspection.
 - b. Check for workmanship.
 - c. Check installation, removal and disposal of each item for conformance.
 - d. Check for damage and ensure that damaged work is corrected, at no additional cost to the Owner.
 - e. Submit documentation for review to the Owner or their representative detailing compliance of the above.

P. Follow-Up Inspection

1. Check completed work against results of initial inspection of representative sample of work against items mentioned in the preparatory inspection.
2. Verify that damaged work is corrected properly and approved by the Owner or their representative, at no additional cost to the Owner.
3. Submit documentation for review to the Owner or their representative detailing compliance of the above.

Q. Inspection Results

1. Certify inspection results: This certification shall state that the observations were performed by or under the direct supervision of the BHS Contractors Quality Assurance Representative and that the results are representative of the conditions being certified.
2. Work accomplished shall be considered satisfactory only when the records and inspections show that all variances have been corrected and that the work is in conformance with the Contract Documents.
3. Submit documentation for review to the Owner or their representative detailing compliance of the above.

4.02 TESTING AND ACCEPTANCE

A. Inspection and Testing Procedures

1. General
 - a. After installation of the BHS, the BHS Contractor shall demonstrate its operating capability. Accomplish prior to the start of the Systems Acceptance Testing all “debugging” and internal testing. In addition, carry out a “dry test run” of Acceptance Tests prior to conducting such

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tests with the Owner or their representative to ensure that tests conducted with the Owner or their representative are successful. Make available to the Owner on a daily basis any and all records of internal testing and debugging (with corrective action carried out) performed prior to Acceptance Testing.

- b. The System shall be capable of handling the maximum and minimum specified sizes and weights without jamming, damage or toppling of the baggage.
 - c. Provide all actual baggage and simulated weighted baggage required for testing. Actual baggage provided shall be representative of the many different types of baggage pieces encountered during live operations, including the maximum sizes and weights as defined in this specification. Simulated weighted baggage used shall be either weighted tubs or boxes. All baggage used for testing purposes shall be approved by the Owner or their representative prior to testing. The ratio of actual to simulated test baggage for this project shall be 50% of each. If necessary during the testing period, replace any simulated or actual test baggage that becomes damaged to the extent that it is no longer useable in order to maintain a minimum of test pieces at all times.
 - d. All tests shall be conducted with the above ratio of actual and simulated baggage except for load tests, which shall be acceptable to be performed with simulated baggage only. No sand, dirt, or other abrasive material shall be used for weight while performing load tests.
 - e. Provide appropriate service personnel "on-site" during the testing period to service or adjust, as required, the System equipment as well as to open all control boxes, control station covers, drive assembly chain/V-belt guards, and covers for the Owner inspection of the system equipment.
 - f. Provide all necessary test, measuring, and recording devices required to demonstrate the operational characteristics and performance of the equipment to the satisfaction of the Owner (clamp-on type ammeter, direct read FPM digital readout tachometer, and all other required devices).
 - g. Provide written notice (minimum 14 days) to the Owner prior to acceptance testing that they have completed all "dry test runs" of the acceptance tests and are ready for the witnessed testing. Ensure that the Owner or their representative witness all Acceptance Tests and shall indicate Acceptance by signing and dating the test data sheet. The Owner reserves the rights to back charge the BHS Contractor for the time and expenses of all who attended the Acceptance Testing on the Owner's behalf should the requested acceptance test(s) be unsuccessful and require re-testing at a later date.
2. System Inspection and Test Plan Submittal

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- a. Prepare an Inspection and Test Plan for this Project based on the information provided below and submitted per the submittal schedule detailed Part 1 of this specification for review and approval by the Owner or their representative.
- b. The BHS Contractor is to be aware that various subsystems may require testing independent of one another. Therefore, a number of tests will have to be conducted at the various stages of installation.
- c. The test plan shall be provided in both hard copies for field use during the testing process and a completed (based upon acceptance testing) electronic format agreed upon by the Owner or their representative.
- d. The test plan shall include as a minimum the following:
 - 1.) Description of each Test
 - 2.) Pass/Fail Criteria
 - 3.) Expected duration of the test
 - 4.) Number of test bags required and where they are to be positioned for the start of the test
 - 5.) Number of airline 10-digit bag tags/BSMs required for testing. Coordination with the user airlines will/may be required
 - 6.) List all test equipment required
 - 7.) Number of personnel required for the test to include:
 - a.) Test Supervisor
 - b.) Mechanical
 - c.) Electrical
 - d.) Controls/computer engineer(s)
 - e.) Personnel required to load and remove bags
 - 8.) List other affected equipment manufacturers that may be required for the test. Confirmation that these manufacturers have been notified and will be in attendance.
 - 9.) Details of all reports to be printed after the test
 - 10.) Pass/Fail and Notes/Comments sections.
 - 11.) Section for witnessed sign off, to include as a minimum BHS Contractor, the Owner or their representative
- e. The following is intended to be a guideline, and is not to be construed as all-

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inclusive:

- 1.) Mechanical Static Inspection: Submit a comprehensive, easy to read mechanical equipment inspection plan for every piece of mechanical equipment installed as part of the BHS. This inspection plan shall verify adherence to the Specification for the following items:
 - a.) Flat Plate Devices: Tray vertical clearance -- gaps between adjacent back guard sections -- gap between perimeter finger guard and top of pallet not in excess of 1/8" -- skirting above and below conveying surface -- sharp edges or shear burrs -- condition of painted surfaces -- tightness of all hardware trim -- securement screw type and countersinking -- baggage snag points -- drive assembly safety guarding -- speed reducer drip pan -- motor/speed reducer type and alignment -- motor-driven sprockets/sheaves alignment -- motor-driven chain/V-belt tension -- speed reducer leakage -- removal of construction debris -- maintenance access -- protective guard railing gap between adjacent plates not in excess of 1/16" -- plate-driving sprocket alignment -- plate-driving chain tightness
- 2.) Electrical Static Inspection: Provide a comprehensive, easy to read electrical equipment inspection plan. For the determination of terminal tightness, all terminals in motor control panels or field mounted devices shall be tightened to the manufacturer's recommended torque specifications utilizing a certified calibrated torque wrench or appropriate tool. The BHS Contractor shall be required to demonstrate to the Owner or their representative that the screws are set at the proper torque value and the BHS Contractor shall include this information in the below referenced electrical static inspection reports. This inspection plan shall verify adherence to the Specification for the following items:
 - a.) Flat Plate Devices: Control station I.D./function tags -- control station and disconnect switch accessibility/location -- illuminated push button switch protective guard ring -- tightness of all hardware -- photocell mounting -- control circuit wiring size, type, color, and number tag -- power circuit wiring size, type, color, and number tag -- wire "whiskers" at terminal points -- wiring terminal point screw tightness -- splice point wire nuts within junction boxes -- conduit routing and mounting -- tightness of conduit/sealtite fittings -- junction box covers -- unused openings in junction boxes or control device boxes -- safety disconnect switch lockout capability -- maintenance access -- record motor name plate data, size of motor overload heaters, and size of all fuses.
- 3.) Mechanical Testing: Provide a comprehensive, easy to read

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mechanical test plan. This test plan, at a minimum, shall verify the specified functionality of the following:

- a.) Flat Plate Device: Operation of “soft-start” device -- engagement of plate cam followers with drive assembly -- vertical or horizontal displacement of plates through drive assembly section -- excessive vibration -- abnormal noises -- binding of perimeter finger guards with top surfaces of plates -- operation of controls.
- 4.) Electrical Testing: Provide a comprehensive, easy to read electrical test plan that clearly identifies all installed control devices, the control device locations in the BHS, the function of the control device, all conveyors affected by the control device, and the expected field result with applicable system monitor message/display. The test plan shall be provided in both hard copy for field use during the testing process and a completed (based upon acceptance testing) electronic format agreed upon by the Owner or their representative.
 - a.) All Control Devices: Photocells -- limit switches -- status lights -- hour meter -- start-up alarms -- fault warning alarms -- fault warning alarms with multiple faults -- fault warning alarm silence buttons -- timer settings -- auto shut-down -- motor overloads -- motor disconnects -- auto start -- cascade operation -- inch and feed operation -- e stop function -- overheight/over length function -- jam function.
 - b.) Workstations: Graphical system status display -- graphic fault warning and associated text display -- report generation (daily, weekly, monthly, annual and on demand) -- accuracy of all reports -- redundancy operation between primary and back up workstations -- problem resolution text -- modification to flight and tag tables -- change sort pier assignments -- system re-route/re-configuration -- monitor redundancy functions -- communication/interfaces with -- access to all security levels -- BSM retention control -- ability to render individual equipment unavailable/available -- statistics and counter reset capability -- demonstrate statistical data backup functionality
 - c.) Cable Testing: Test all cables, including all fiber optic, Cat-5e and Cat-6 telecommunication cables, and all cables to be connected as part of an interface to another system (e.g. fire system and, PanelView Terminals).
 - d.) Interface Testing: Test all interfaces with other systems (e.g. fire system). Coordinate with other trades in support of this testing.
- 5.) Empirical Readings
 - a.) The Empirical Readings which are to be taken at the time of

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Conditional Acceptance Testing are to include the following:

- (1.) Main Feeds: Fuse size per phase, actual amperage per phase.
- (2.) Transformers: Fuse size per phase, actual amperage per phase.
- (3.) Conveyor/Device Speeds: Actual “center-line” speed of conveyor/device.
- (4.) Motors: Nameplate data, horsepower, listed motor current; fuse size per phase, actual amperage per phase, overload heater size or designation.
- (5.) VFDs: record all VFD settings
- 6.) Load Testing: Provide a comprehensive, easy to read test plan listing the expected load rating for each device, at a minimum, provide the following:
 - a.) Individual device identifications with the expected load rating for each device.
 - b.) Amperage readings per phase under No Load conditions.
 - c.) Fuse Sizes (if applicable) and motor heater settings.
 - d.) Motor nameplate FLA for each device drive and HP.
 - e.) Amperage readings per phase under Full Load conditions.
 - f.) Pass/Fail and Notes/Comments sections.

All FLA readings taken during load testing shall be recorded and included in the Final O&M Manual for record.
- 7.) Test Failure
 - a.) A failure during any test period shall be defined as any design characteristic or malfunction of the furnished equipment or

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materials that damages product or reduces any operating rate below those “specified”.

- b.) Conditions resulting from improper loading of product or loading product of sizes not included in specification requirements will not be considered as failures.

R. Conditional Acceptance

1. Conditional Acceptance for each phase will only be considered after the following are completed:
 - a. The Conditional Acceptance Inspection and Testing procedures presented below are successfully completed as specified.
 - b. Final Operation and maintenance manuals have been delivered.
 - c. Operation and maintenance training has been completed.
 - d. Spare parts as purchased by the Owner for that phase have been delivered.
 - e. All special tools and equipment required for maintenance purchased by the Owner have been delivered.
 - f. The name, address and a 24-hour phone number of a representative who has the authority and experience to make immediate replacements and repairs for the full life of all warranties has been provided.
2. Conditional Acceptance Inspection and Testing
 - a. The System, including lower level controls, shall demonstrate compliance with the approved Test Plan. The individual inspections and tests shall be performed in the order presented above. System deficiencies (punch list items) shall be corrected before performing the subsequent inspections or tests. The Owner at his discretion may request for reimbursement of costs from the BHS Contractor for multiple reinspections of system deficiencies/punch list items.
 - 1.) Mechanical Static Inspection
 - 2.) Electrical Static Inspection
 - 3.) Electrical Testing
 - 4.) Mechanical Testing
 - 5.) Empirical Readings
 - 6.) Load Testing
 - 7.) Rate Testing

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8.) Redundancy Testing

9.) EDS Matrix Testing

10.) System Endurance and Stability Test

3. Upon successful completion of the specified Inspections and Testing, the Owner will issue a written notice of Conditional Acceptance.
4. A Conditional Acceptance status will indicate that the Owner or their representative have approved the equipment as worthy for operational use.
5. The Conditional Acceptance shall not relieve the responsibility for maintenance, security and insurance on the system.
6. In no case will Conditional Acceptance relieve the responsibility for performing all the work set forth in the Contract Documents.
7. At the time of Conditional Acceptance, the amount of retention held until issuance of a Certificate of Final Acceptance shall be a summation of 10% of the total value of the project and the assessed value of open punch list items (to be determined by the Owner).
8. Conditional Acceptance is applicable to each construction phase and must be issued in writing, by the Owner, prior to commencement of subsequent construction phases. Final Acceptance of individual construction phases or subsystems shall not apply.
9. Conditional Acceptance Operational Period
 - a. Upon issue of a Certificate of Conditional Acceptance, a three (3) month Operational Period will commence in which the Owner will put all systems into on-line operations processing the daily flow of
 - b. If a problem occurs within the BHS system, and the Owner has elected to not require full-time technical site representation during the three (3) month Operational Period, supply the name(s), address(s) and a 24-hour phone number of representative(s) that can be contacted who have the authority and experience to make immediate recommendations and assist the Owner or the Owner's Maintenance Contractor to return the system to a fully on-line state in the shortest possible time frame.

S. Conditional Acceptance With Defects

1. If the System is found to be unacceptable at the time of Conditional Acceptance Inspection and Testing, the Owner will issue a written "Defects List" report containing information about the particular defects that must be remedied before Final Acceptance will be granted. At this time, if the defects do not affect the functionality of the System, the Owner may elect to advise in writing that "Conditional Acceptance with Defects" has been granted. All

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terms presented in the “Conditional Acceptance” portion of this Specification shall apply.

2. A “Conditional Acceptance with Defects” status, if issued, will indicate that the Owner has approved the equipment as worthy for operational use. Subsequent to “Conditional Acceptance with Defects” issuance, the three (3) month Operational Period will commence in which the Owner will put the System into on-line operations processing the daily flow of baggage. The Owner will maintain the right to judge whether any hazard may exist to personnel or equipment due to unacceptable inspection results and revoke this approval. In the event the approval is revoked, the three- (3) month Operational Period will be suspended until the hazard is remedied.
3. The Owner will be entitled to retain from the project payments an amount commensurate with the value of work remaining to be accomplished. Further, all outstanding work must be performed at times during periods convenient to the Owner and to the requirements of a fully operating system.
4. The Contractor must notify the Owner within the three - (3) month Operational Period that all outstanding items on the “Defects List” have been corrected and that Inspection and Testing may continue. When all items have been approved in accordance with the Specifications, this shall conclude Inspection and Testing of the BHS. Only the remaining time of the three - (3) month Operational Period will be required prior to application of the Final Acceptance conditions.

T. Delayed Conditional Acceptance With Defects List

1. If the System is found to be functionally unacceptable at the time of Conditional Acceptance Inspection and Testing, the Owner will issue a written “Defects List” report containing information about the particular defects that must be remedied before the three (3) month Operational Period will begin.
2. Items appearing on the “Defects List” will be considered incomplete, defective or not in conformance with the Specifications. The failure to include certain items does not alter the responsibility to complete the System in accordance with the Contract Documents.
3. A maximum period of 15 days will be allowed to correct the outstanding items on the “Defects List”.
4. After all the items on the “Defects List” have been corrected, notify the Owner or their representative that the System is ready for continuing Conditional Acceptance Inspection and Testing.
5. Upon completion of “Conditional Acceptance Inspection and Testing”, the terms presented in the “Conditional Acceptance” or “Conditional Acceptance With Defects List” portions of this Specification will apply, as

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appropriate.

U. Final Acceptance

1. Final Acceptance will only be considered after all phases have conformed to the Conditional Acceptance terms, all phases have successfully completed the three (3) month Operational Period, and the following criteria is met:
 - a. The System has not experienced repeated repairs and adjustments and is achieving the specified rate, accuracy and availability standards as required by this Specification.
 - b. The System has successfully completed the specified Inspections and Testing, with no outstanding punch list items.
 - c. The System is in full compliance with the Contract Documents.
 - d. The Owner and all other governing agencies have made their inspections and given their approvals.
 - e. Certificates of Installation Compliance have been issued to the Owner (e.g. weigh scale certifications)
 - f. Warranties for all materials and equipment received from Subcontractors and Suppliers have been assigned to the Owner.
 - g. A spare parts and tools audit has been conducted and all tools have been turned over to the Owner. All spare parts purchased by the Owner have been delivered.
 - h. The PLC and source codes for all programs in the BHS Computer System have been provided to the Owner
 - i. Accurate "As-built" drawings and all manuals as specified in this Specification have been delivered.
 - j. Operation and maintenance training have been completed.

- END OF PART IV -



FAYETTEVILLE REGIONAL AIRPORT

Airline Terminal Improvements – Part 2

Specifications for the Design, Manufacture and
Construction of the
Inline/Make-up Baggage Handling System
at the
Fayetteville Regional Airport (FAY)

REQUEST FOR PROPOSAL

15 July 2019

FAYETTEVILLE REGIONAL AIRPORT (FAY)
AIRLINE TERMINAL IMPROVEMENTS – PART 2
INLINE/MAKE-UP BAGGAGE HANDLING SYSTEM (BHS)
FAYETTEVILLE, NC

SECTION 34 77 16

SECTION PARTS

PART I - GENERAL SPECIFICATIONS

PART II - PRODUCT SPECIFICATIONS

PART III - EXECUTION SPECIFICATIONS

PART IV – QUALITY CONTROL SPECIFICATIONS



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SECTION 34 77 16

BAGGAGE HANDLING SYSTEM

PART I - GENERAL SPECIFICATIONS

1.01 RELATED DOCUMENTS.

A. General

1. These written Specifications, in conjunction with the accompanying Contract Drawings, constitute the Contract Documents for the Project. If there are any discrepancies between these written Specifications and the Contract Drawings, the more stringent requirement shall apply as interpreted by the Owner or their representative.
2. As indicated throughout these contract documents (drawings and specifications) the BHS is considered a security system for In-Line baggage screening in the Project. Implement and demonstrate to the Owner, the TSA and their representatives the installed BHS and In-Line CBIS in compliance with all the TSA's security protocols, BHS/EDS integration and all associated Performance and Commissioning requirements, as specified herein and consistent with the TSA's Planning Guidelines and Design Standards for Mini-Inline Configuration, specifically Appendices D1 (Design Performance Requirements) and Appendix D (Commissioning and Evaluation Requirements).
3. These Contract Documents are confidential and are not to be distributed or copied, in part or in whole, without the written consent of an authorized representative of the Owner. All documentation that is associated with the operation/functionality of the CBIS, including these contract documents (i.e., specification and drawings), documents generated by the Contractor and documents relating to SAT, Pre-TRR, TRR and ISAT are Security Sensitive Information (SSI). Control/manage and mark these documents as SSI, in accordance with 49 CFR Parts 15 and 1520. Ensure that all related documentation pertaining to the following is marked as SSI (similar to the footer of this specification):
 - a. System detection and decision logic and associated software.
 - b. Methodology of CBIS use, bag screening/clearing procedures and alarm resolution.
 - c. Technical specifications of screening equipment and system equipment parameters.
 - d. Locations at which particular screening methods or equipment are used.
 - e. Threat images and descriptions, which are associated with and shall be interfaced between the BHS and EDS.
 - f. Performance data from screening systems, including the testing of the screening systems.
4. These Contract Documents are confidential and are not to be distributed or copied, in part or in whole, without the written consent of an authorized representative of the Owner or BNP Associates, Inc.



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B. Drawings

1. Specification Drawings (Ref. Drawing B0.001 for listing), Architectural Drawings, Communications/Network Layout Drawings, Fire Protection System Drawings, MEP (Mechanical, Electrical and Plumbing) Drawings, Structural Drawings, Overall Program Phasing Plans, Addendum, Contract Provisions, Special Provisions and Supplementary Provisions apply to the work of this Section.
2. Define the facility modifications that will be performed to accommodate the Baggage Handling System alterations. These drawings shall be used for bidding purposes and preparation of design/engineering documents.
3. It shall be the BHS Contractor's responsibility to request and obtain architectural drawings, MEP (Mechanical, Electrical and Plumbing) drawings, Structural drawings and Project Phasing Plans applicable to the BHS from the Owner or their representative.

C. Special Related Documents

1. EDS Supplier Reference Documents – Reveal Imaging Technologies, Inc. – CT-80DR EDS Integration and Networking Reference Document.
2. Planning Guidelines and Design Standards (PGDS) for Checked Baggage Inspection Systems, Version 6.0 (dated September 29, 2017).
3. Contact the appropriate firm or supplier to request the necessary documents that would be required for coordination, testing, interface and reference purposes.

1.02 SUMMARY

A. General

1. This Baggage Handling System Specification is divided into four (4) parts as follows:
 - a. Part I specifies general administrative and procedural requirements for a BHS installation as specified herein and in the accompanying drawings.
 - b. Part II specifies product information including approved equipment requirements.
 - c. Part III specifies execution requirements for the BHS installation, modifications, demolition that are required.
 - d. Part IV specifies quality control requirements
2. The BHS Specification and accompanying Contract Drawings are intended to outline the work define functional requirements and establish minimum standards of quality for the Project. Meet all local, state and federal laws, codes and safety standards and assures a safe and efficient system for all personnel who operate, maintain or have access to the completed baggage handling system.
3. New security requirements have been mandated by the Transportation Security Administration (TSA) for all outbound passenger checked baggage to be screened for explosive materials. Because of these requirements, a new baggage screening addition is



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being built to house the new outbound BHS with integrated inline EDS screening as illustrated on the accompanying drawings to accommodate new Explosive Detection System and Explosive Trace Detection equipment.

4. The laws of the City of Fayetteville, the State of North Carolina, and the United States of America (USA) shall apply and govern the Contract.
5. Unless otherwise specified, all references to sums of money shall be in United States Dollars (USD), the currency of the United States of America (USA).

B. Scope of Work

1. Provide the design, engineering, fabrication, transportation to/from the site, installation, temporary BHS conditions, removal, salvage, demolition, refurbishment, modifications, testing and turning over in working order the BHS and In-Line CBIS described herein, in compliance with these written Specifications and the accompanying drawings
2. Provide a complete, operable, maintainable and safe system on a "turnkey basis", including all supports, header steel (unless otherwise specified), hangers, anchors, framing, trim, electrical power to the BHS systems from the sources indicated on the Control Drawings (such as but not limited to disconnect, wiring, and conduits), motors, motor starters, disconnects, controls, push buttons, conduit, wiring, cabinets, catwalks, ladders, stairs, crossovers and all other components, whether specifically shown and described, or implied in the plans and specifications or wherever required to effectively accomplish the intended functions of the BHS. In all cases where a device or part of the equipment is herein referred to in the singular number, it is intended that such reference shall apply to as many such devices as are required to satisfactorily complete the installation.
3. Provide all labor, materials, and equipment required for implementing the BHS as defined by these specifications, including but not limited to installation, all required acceptance testing (including required support and participation for the TSA's SAT, Pre-TRR, TRR and ISAT), all necessary wiring between BHS components, necessary protection of conveyor equipment that is under construction, materials, new conveyor equipment with all related components, provision of new BHS PLCs, PLC Networks, and other applicable components/devices and, BHS PLCs and PLC Networks, all as required, for implementing the new In-Line EDS defined by these specifications.
4. Coordinate with the TSA's Contractor the site planning, the BHS Phased-in Implementation, required BHS testing (i.e., SAT, Pre-TRR, TRR and ISAT) and all interface requirements between the security screening equipment (i.e., EDS Level 1 machines) and the BHS for all of the conveyor lines as they relate to this Project. In order to successfully accomplish the intended operation described herein, the details of all required interface(s) between the BHS and EDS machines shall be fully coordinated with the TSA's EDS OEM. The TSA's EDS OEM will be responsible for all cabling between the EDS machines and the related workstations for data and voice. The BHS contractor shall be responsible for the interconnection of all BHS related PLC and data highway connections from the BHS to the EDS machines that are required to accommodate the interfaces between the two systems (conduit/wireway, hard-wired I/O, data interface



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cabling and software driven).

5. Provide the interconnection of all BHS related PLC and ControlNet or Ethernet based connections from the BHS to the EDS machines that are required to accommodate the interfaces between the two systems (hard-wired I/O, data interface cabling and software driven). Coordinate the details of all required communication and signal interfaces (e.g., EDS machine status and control, bag loading and unloading, and bag status), between the EDS machines and the BHS with the EDS equipment supplier and the COTR in order to successfully accomplish the intended operation described herein. Details of the available signals and data, along with the required cabling between the two systems, are typically covered in the EDS supplier's Integration Guide for the respective EDS machine(s). The Contractor shall request for a copy of the EDS Supplier's Integration requirements through the COTR. Provide all necessary control cabling, along with the communication and signal interfaces, between the EDS equipment and the BHS consistent with the EDS supplier's requirements. Furthermore, provide an additional 30% of cabling conductors between the EDS equipment and the BHS, as coordinated with the EDS Supplier and the COTR, to accommodate future functions.
6. Submit implementation schedules and associated phasing plan documentation with the operating and maintenance documentation to the Owner or their representative, including required manuals, equipment parts lists and shop drawings - all in strict accordance with the specifications and applicable drawings, and subject to the terms and conditions of the Contract.
7. Provide all hardware, software, and construction supervision to insure that the BHS equipment operates on a fully integrated "Turnkey" basis.
8. The Contract Drawings are intended to generally outline the conveyor system configuration and function desired. Pertinent building dimensions are noted along with some specified conveyor dimensions and elevations. An attempt has been made to present approximate conveyor length and right-of-ways, but these shall necessarily be determined by review and inspection of building construction drawings and verified by actual field measurements by the BHS Contractor prior to preparing shop and erection drawings. An attempt has also been made to present the number, size and locations of the BHS Motor Control Panels (MCPs); verify the final number of panels with related cabinet sizes and locations based on their electrical shop drawings within 30 days of contract award.
9. Coordinate with the EDS device provider as required to coordinate the details of the required interface(s) between the BHS and EDS systems in order to successfully accomplish the intended operation described herein. The BHS contractor shall, in all cases, be responsible for any wiring/conduit between the BHS and EDS systems that are required for these interfaces (conduit/wireway, hard-wired I/O, data interface cabling and software driven).
10. Preserve all mechanical and electrical right of ways for all deferred equipment depicted on the Contract Drawings.
11. Identify all building interface requirements necessary to install the BHS over and above



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- those shown on the contract drawings in the bid documents. Verify as-built conditions and notify the Owner or their representative of conflicts. Any additional building modifications or alterations not so identified in the contract bid shall be borne by the BHS Contractor.
12. Coordinate the BHS maintenance catwalk design with the sprinkler system design, to permit the installation of the sprinkler pipes below the proposed catwalks or areas where they are projecting below adjacent conveyors. The coordination between the sprinkler system design and the BHS equipment/catwalks shall ensure the sprinkler pipes do not interfere with the BHS operation or related maintenance access.
 13. The construction of all the new equipment shall be in accordance with all codes and standards and local laws and regulations, applicable to the design and construction of this type of equipment, which are generally accepted and used as good practice throughout the industry, i.e., NFPA, Underwriters Laboratories, OSHA, SAE publications, National Electrical Code (NEC), American National Standards. Design all parts and sub-assemblies in accordance with good commercial practice and assure safe, efficient and practical design in keeping with requirements peculiar to this type of system. All equipment shall be in imperial dimensions.
 14. Submit to the Owner or their representative any request for information, clarification of specification, and variance from the specifications as a Request For Information (RFI).
 15. Obtain and pay for all permits, inspection fees, and certificates relative to all phases of BHS construction.
 16. Be responsible for all employee badges as required by the Owner for this project. The Owner shall not provide escort services for employees on the ATO and AOA side of the facility.
 17. Submit all structural attachment detail/computations and electrical drawings signed and sealed by a Professional Engineer licensed in the jurisdiction where this project is located.
 18. Provide any and all temporary power and lighting that may be required for and during the course of the installation and testing of the BHS.
 19. As set forth elsewhere in these specifications, provide the definitive architecture for the BHS PC-type Computer Terminal Workstation and PLC systems that are specified to be provided. Provide a detailed BHS/CBIS design and any/all coordination required for the BHS control system design in its entirety, including related BHS and EDS interface requirements, which shall be submitted to the Owner for review and approval.
 20. Provide one (1) BHS PC-type Computer Terminal Workstation for the outbound BHS/CBIS operation and all required PLC hardware/programming to satisfy the specified requirements for the installation of the BHS and Mini In-Line CBIS (e.g., memory capacity, the necessary interlocks/interfaces, to incorporate each sequence of the phased-in scope of work).
 21. Cooperate and coordinate with the Owner and their Architect for the location of all Mechanical, Plumbing, Electrical, Right-of-Ways and access/egress between the BHS



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- catwalks and the building to confirm the final number and locations of the BHS associated stairs/ladders, conveyor maintenance crossovers, maintenance catwalks, and all other BHS catwalks and ladders over and above those shown on the contract drawings.
22. All BHS equipment is to be floor supported. The BHS contractor shall provide detailed structural design for the CL2 conveyor subsystem to span across and not interfere with the tug/cart staging area on the North side of the new make-up device.
 23. After installation of the BHS, demonstrate its operating capability. Accomplish prior to the start of the Systems Acceptance Testing all “debugging” and internal testing. In addition, carry out a “dry test run” of all Acceptance Tests prior to conducting such tests with the Owner or their representative to ensure that tests conducted with the Owner or their representative are successful. Submit to the Owner on a daily basis any and all records of internal testing and debugging (with corrective action) performed prior to Acceptance Testing.
 24. Coordinate and adequately protect the conveyor equipment from the Mechanical, Electrical and Plumbing (MEP) modifications, as well as other related building service modifications and alterations. Ensure that adequate protection is provided around the conveyor segments (new and existing/modified) wherever the Facility and Utility modifications are occurring. Ensure that the construction of the expansion around the conveyors and the protection that shall be provided around the conveyor segments allows for the uninterrupted and continued operation of the baggage handling systems in all cases.
 25. Coordinate with all relative on-site disciplines/contractors, including the TSA’s Master Systems Integrator, for all required interfaces to the BHS. Coordinate and work closely with the TSA’s EDS provider (Reveal) and the Owner’s Security Representative for all BHS integration testing, including but not limited to providing the necessary support/participation and system demonstrations for the TSA’s mandated certification testing, such as the Pre-TRR, the TRR and ISAT. Accomplish, prior to the start of the System’s Acceptance Testing, the Pre-TRR and TRR, all “debugging” and internal testing. In addition, carry out a “dry test run” of all Acceptance Tests and Pre-TRR prior to conducting such tests with the Owner and the TSA or their representatives, to ensure that tests conducted with the TSA and the Owner or their representatives are successful. Submit to the Owner or their representative on daily basis any and all records of internal testing and debugging (with corrective action) performed prior to Acceptance Testing.
 26. Upon completion of the BHS installation, all related programming and internal testing/debugging, demonstrate the system’s operating capability to the Owner and his representatives for acceptance and for Pre- TRR to confirm compliance with the specified requirements. Provide all labor and test material as specified elsewhere in this document, including service technicians and test material handlers for the BHS Acceptance Testing, the Pre- TRR and TRR period. These test demonstrations shall be carried out per the following requirements, as part of the base contract:
 - a. Prepare BHS Test Plans in compliance with the specified requirements of Part 3, Section 3.15 (Testing and Acceptance) as well as the specified requirements of the TSA’s



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Planning Guidelines and Design Standards (PGDS) document.

- b. The Site Specific Test Plans (SSTP) for the CBIS performance and commissioning requirements shall be followed by the BHS Contractor in order to pass the Integrated Site Acceptance Test (ISAT). Meet with the Owner, the TSA and their representative, at the Airport or other location as requested by the Owner, to review the SSTP and obtain a copy from the Owner, for use in the upcoming test procedures that are outlined below, to ensure the completed CBIS meets all the protocols and requirements contained within, prior to the TSA ISAT(s).
 - 1.) Pre-TRR - All Pre-TRR testing (and retesting of failed tests) shall be carried out by the BHS Contractor, and witnessed by the Owner, local TSA and their representatives, using the BHS approved test plans – per Part 3, Section 3.15 (Testing and Acceptance) of this specification, as well as the requirements of the PGDS - and the SSTP to certify that the CBIS satisfactorily passed per the pass/fail requirements of the test plans and is ready for a TRR by the TSA's OST representative. All testing data and related Pre-TRR documentation that results from these tests, when passed, will be distributed by the Owner to the TSA's OST representative, for review and approval, along with a request for a TRR.
 - 2.) TRR - Upon successful completion of the above referenced local acceptance testing and Pre-TRR, the TSA's OST representative will be invited by the Owner to witness a TRR, which shall be demonstrated by the BHS Contractor. The tests that will be performed during this period will be selected (from previous SSTPs that were performed during the Pre-TRR) by the TSA's OST representative and those tests shall be demonstrated by the BHS Contractor, under the direction of the TSA's OST representative.
 - 3.) ISAT - Upon successful completion of the TRR to the TSA's OST representative, a TRR report will be issued by the TSA's OST to the TSA or their IV&V representative and the Owner, the Owner will submit a letter of concurrence to the TSA regarding successful TRR demonstration, to schedule the TSA or their IV&V representative's on-site visit for the ISAT. It is anticipated that the TSA or their IV&V representative will provide all test personnel and testing material for the ISAT. However, provide the necessary manpower/labor and material, as necessary, similar to previous tests performed with the Owner and local TSA, to support the TSA or their IV&V representative in performing the mandated Integrated System Acceptance Test (ISAT) for the CBIS

C. Existing System Description

1. The existing Baggage Handling System (reference drawing B1.001) at the Fayetteville Regional Airport is a stand alone screening operation located in the Terminal lobby. There are two stand alone CT-80DR's located in the North West corner of the existing check-in lobby. Passengers enter the ticketing lobby and check-in at the ticket counters then manually transport their bags to the screening area for processing by TSA. Once a bag has been cleared by the CT-80DR it is placed on one of two transport conveyors that transport



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the bags into the outbound make-up area located behind the existing ATO spaces.

2. The BHS contractor is responsible for the demolition of all existing BHS conveyor equipment, doors and MCP's. All MCP electrical feeders shall be pulled back to their main building source.

D. Outbound BHS/CBIS

1. The design intent for the Outbound BHS and the Mini In-Line CBIS shall consolidate the baggage screening and make-up operation, which will serve the originating baggage operation.
2. The outbound BHS shall be configured with the TC1/SS1 subsystems forming the main security feed subsystem. Bags will be distributed by the SS2-HSD to the SS2 subsystem. Any bags that are detected to be out of gauge at the subsystem light curtain arrays will be stopped on the conveyor immediately upstream of the EDS for removal by TSA personnel. All cleared status bags shall be processed to the make-up device (MU1) via the Clear Bag Subsystems CL1 and CL2.
3. An outbound Oversize slide shall be provided to accommodate all oversize clear bags. Oversize bags will be manually transported into the CBIS/CBRA screening area for ETD as required.
4. Outbound BHS/CBIS Subsystems:
 - a. The Ticket Counter Check-in transport conveyor subsystem consists of the TC1-01, TC1-02 and TC1-03 conveyors and associated security door.
 - b. The security screening subsystems consist of the SS1 and SS2 subsystem conveyors as follows:
 - 1.) SS1-01 (queue conveyor immediately upstream of the EDS) and the SS1-02 (EDS).
 - 2.) SS2-HSD, SS2-01 (90 degree reverse merge), SS2-02 (90 degree power turn), SS2-03 and SS2-04 (queue conveyors immediately upstream of the EDS), SS2-05 (EDS).
 - c. On-Screen Resolution conveyors include conveyor segments OSR1-01 and OSR2-01. The CBIS processing is to be configured as a "hold on alarm" configuration.
 - d. Clear Line Subsystem transport conveyors include the following conveyors:
 - 1.) CL1-01 (queue conveyor immediately downstream of OSR) and CL1-02 (90 degree merge onto the CL2 subsystem).
 - 2.) CL2-01 (queue conveyor immediately downstream of OSR), CL2-02 through CL2-08 (transport conveyors to make-up) and CL2-09 (tip chute).
 - 3.) Make-Up Device – MU1-01
5. The specified outbound Baggage Handling Equipment is directly associated with the



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operation of the Explosive Detection System (EDS) machine (to be supplied/installed by TSA's EDS supplier) for the security screening of all originating standard (EDS In-gauge) checked baggage. All new BHS equipment shall conform to the specified product requirements, controls, TSA protocols and CBIS performance and commissioning requirements of a mini-inline configuration as per the PGDS, VERSION 6.0 requirements.

6. The EDS machine's Field Data Reporting Computer System (FDRS), will monitor and record the CBIS network events such as BVS operator logins, EDS machine and TSO threat assessments, along with the Remote Resolution Baggage Viewing Stations at the BITs and related Threat Resolution Interface (TRI), as well as the ETD equipment will be provided by TSA's EDS supplier. The FDRS computer will be located along the easternmost wall next to the BHS/CBIS Computer Terminal Workstation. One (1) trace operator per EDS will perform Explosive Trace Detection screening at the associated Baggage Inspection Tables as specified in Part 3 of this specification.

E. Oversize Baggage Screening

1. Oversize bags will be manually transported into the screening area and screened at the new Oversize screening area at the associated ETD station, as illustrated in the contract documents. Once bags are cleared by the security screening staff, they will be manually transferred to the new oversize slide.

F. CBIS Requirements

1. As illustrated in the accompanying BHS drawing package, the SS1 and SS2 Security Subsystem conveyor lines will transport bags into the their respective EDS. Bags that are not within the size tolerances of the CT-80DR EDS machine will be stopped at the SS1-01 or SS2-04 conveyors for removal and screening.
2. As a part of this scope of work coordinate with the EDS supplier, as required, to verify the details of the necessary interface(s) between the BHS and EDS machine in order to accomplish the intended operation described herein. In all cases, provide all wiring, communication bridges and conduit between the BHS control system and the EDS machine that is required for these interfaces (hardware and software).
3. Subsequent to the EDS Level 1 screening process, any bags, which are alarmed by the EDS machine shall be held on the OSR conveyor and reviewed by the EDS Level 2 BVS for OSR (i.e., TSA staff). Bags shall either be identified as Alarmed and removed from the OSR conveyor and pulled onto the BIT for ETD screening or are cleared and introduced to the clear bag subsystems (CL1 or CL2) for transport to make-up.
4. Alarmed bags have been cleared through the ETD process will be re-inserted at either the OSR1-01 or OSR2-01 conveyors.
5. Through the implementation of the outbound conveyor lines, the implementation of the BHS PC-type Computer Terminal Workstations and PLC systems, as specified elsewhere in this specification, the CBIS requirements shall be provided as illustrated on the accompanying drawing package. Ensure that all bags that are processed through the automated CBIS are positively tracked and identified for the three different security



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screening levels up to and including their output location. The system shall accurately track baggage to its output location in a fail-safe manner, as specified elsewhere in this specification. Positive baggage tracking shall start at the SS1-01 and SS2-04 conveyors where the assignment of a discrete bag tracking identification number (pseudo ID) by the BHS for Mini In-Line EDS security screening, which shall be as follows:

- a. Level 1 Cleared bags shall be tracked with an interface at the Level 1 EDS machine, which shall be accomplished with a respective discrete (pseudo) identification number and continue through onto the Clear Bag Subsystem (CL1), to the outbound baggage make-up device.
 - b. Level 2 Cleared bags shall be tracked with an interface at the Level 1 EDS machine, which shall be accomplished with a respective (pseudo) discrete identification number and continue through onto the Clear Bag Subsystem (CL1) Line, to the outbound baggage make-up device.
 - c. Level 2 Alarmed and BHS Unknown bags shall be tracked with an interface at the Level 1 EDS machine, which shall be accomplished with a respective (pseudo) discrete identification number and continue to the baggage removal/reinsert conveyor segment (BRP) for removal and Level 3 screening.
 - d. EDS Unknown bags shall be tracked using a discrete pseudo ID assigned by the EDS machine and continue through to the baggage removal/reinsert conveyor segment (BRP). for removal and Level 3 screening.
6. All bags shall be continuously tracked for position throughout the Mini In-Line CBIS in dynamic PLC RAM via a memory model of a discrete bag identification number that shall be coordinated and interfaced with the EDS supplier. The bag's tracking process shall include a discrete pseudo bag ID for each bag as well as its related security status through the CBIS; this shall be accomplished via the BHS controls functionality and related BHS/EDS interface.
 7. Should the BHS not provide a discrete bag ID (e.g., due to a control device failure upstream of the EDS), the EDS machine will be configured to provide a pseudo ID for the bag, which would then be handed back to the BHS and the BHS shall track the bag using the ID it received from the EDS machine.
 8. Baggage tracking is not required on the CL1 clear baggage line, downstream of the baggage removal/reinsert conveyors (BRPs) on which the failsafe photocells are mounted.
 9. Coordinate all access provisions for TSA operators so as to minimize obstructions. Locations of control stations and electrical boxes shall be coordinated to support unrestricted operational access by TSA staff to the input-output EDS interface positions. The provisions of the conveyor supports; drive configurations, personnel guarding and side guards shall allow for maximum TSA operator accessibility.
 10. Overall CBIS Description of Operation
 - a. The BHS described in this document and illustrated in the accompanying drawing package



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provide for three (3) levels of fail-safe CBIS prior to baggage cart loading (make up). Baggage security screening shall take place before the bags reach the clear bag subsystem CL1.

- b. It should be noted that “decision point” refers to the point (i.e., Baggage Removal/Reinsert – BRP) at which a bag shall either be routed onto a clear line subsystem for transport to baggage make-up or held at the next security screening level (i.e., Level 2 Pending Decision Conveyor) for further processing.
- c. Through the required interfaces with the EDS machine, the BHS shall receive an “active” or “inactive” (i.e., out of service) status for the EDS machine, which shall on a real-time basis, be recognized by the BHS, so as to determine whether bags should be routed to the EDS machine for screening. The BHS control system shall update the displayed status for the associated BHS conveyors and EDS machine via the provided PC-type Computer Terminal Workstations, as required by the Project. Provided that the associated machine is “active”, the baggage shall then be diverted via HSD, to the Security Shunt Subsystem (SS2) feeding the EDS screening machine. As soon as the EDS machine becomes inactive, the HSD diverting bags onto the SS2 subsystem (EDS line) shall immediately cease sending bags to that device. Should bags be queued upstream of the machine after it has become inactive, an appropriate alarm shall be raised at the respective PC Type Computer Terminal Workstation(s) to identify this situation.
- d. Level 1 (EDS Machine screening in the “Hold-on Decision” mode)
 - 1.) Level 1 refers to an EDS device, the Reveal CT-80DR which will be provided for this project on the SS1 and SS2 subsystems by the TSA’s supplier and installed to operate in a fully automated, Hold-Outside mode (i.e., system automatically pass/fails the bag). All originating “in-gauge” checked bags shall be conveyed to the CT-80DR EDS machine for security screening. As a bag enters the EDS machine a discrete (pseudo) identification number shall be handed off from the BHS to the EDS machine. The EDS machine will then use this identifier to associate the individual bag with its screening status. The EDS machine’s software will automatically scan each bag and provide a bag screening status of “Cleared”, “Alarmed”, or “Errored/EDS Unknown”, based on the assessment of the bag images, and will notify the BHS via the EDS/BHS security interface network.
 - 2.) “Cleared” Level 1 bags will be tracked with an interface at the Level-1 EDS machine, which shall be accomplished with the above referenced respective discrete identification number, and continue onto the CL conveyor lines for transport to baggage make-up (MU1-01).
 - 3.) A stacked light module shall be provided for the SS1 and SS2 subsystems, installed on a post directly above the BRPs. These stacked light modules shall consist of four different colored lenses, using LED bulbs, for visual indication of the bag’s status (i.e., BLUE (for Failsafe condition); WHITE (for Unknown Bags and Pending Decision); RED (for Alarmed Bags) and GREEN (for Cleared Bags). The status of all “Cleared” Bags will be displayed on the respective stacked light module as they transition onto the Clear (CL) Bag line; the Green indicator light



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on the stacked light module shall stay illuminated until the bag(s) has fully transitioned past the BRP and onto the downstream CL1 clear bag line.

- 4.) Conveyors CL1-01 and CL2-01 shall be designated as a “Failsafe” position to stop any non-cleared bags that are detected at the discharge end photocell and illuminate the “Blue” indicator light on the stacked light module.
- 5.) If an “Alarmed” or “Errored/EDS Unknown” bag status is received from the Level 1 EDS machine, the BHS shall advance the bag onto the OSR-01 and OSR2-01 conveyors immediately downstream of the EDS machine; “Alarmed” bags, which are automatically alarmed by the Level 1 EDS machine, will be reviewed by the EDS Level 2 TSO performing On-Screen Resolution via the Threat Resolution Interface (TRI) at the BVS computer terminal.
- 6.) All “Errored/EDS Unknown” and “BHS Unknown” (typically mis-tracked) baggage shall be stopped on the OSR1-01 and OSR2-01 conveyors immediately downstream of the EDS machine and be identified by its security status for removal and processing via ETD screening.

e. Level 2 (EDS On-Screen Resolution):

- 1.) As noted above, Level 2 refers to the BVS computer terminal that will allow the viewing of the EDS alarmed images by local TSOs via the Threat Resolution Interface (TRI) between the EDS machine and the BVS computer terminal; the BVS computer terminal will be provided with the EDS machine by the TSA’s supplier and will be combined in the same area as the ETD operation.
- 2.) Baggage that receive an “Alarmed” status from the Level 1 EDS machine will exit the machine and remain on the Level 2 Pending Decision Conveyors OSR1-01 or OSR2-01, while their image is simultaneously transmitted via the EDS/BHS security interface network to the BVS computer terminal for further screening. The images shall be received and displayed on the BVS computer terminal that will be dedicated to the CT-80DR EDS machine. A TSO will view the image on the display for a configurable time duration utilizing Threat Resolution Tools (TRT) to determine if the bag is “Cleared” or “Alarmed”.
- 3.) Baggage that does not receive a “Cleared” or an “Alarmed” status from the EDS machine will have 25 seconds of OSR time at the Level 2 pending decision conveyors (OSR1-01 and OSR2-01), while the “White” indicator light on the stacked light module is illuminated (e.g., for Unknown Bags and Pending Decisions).
- 4.) If the TSO at the BVS computer terminal assigns a Level 2 “Alarmed” status or fails to give a decision prior to the expiration of the 25 second OSR time period or in case nobody is logged onto the BVS, the “Red” indicator light on the stacked light module shall illuminate to alert TSO’s of the situation that the bag status can only be resolved via a Level 3 screening process. The “Alarmed” baggage removal/reinsert conveyors (OSR1-01 and OSR2-01) and it’s security status and



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discrete (pseudo) identification number will be sent to the BHS via the BHS/EDS security interface network to reflect the change in screening to a Level 2 “Alarmed” status, so as to allow the removal of the bag from the baggage removal/reinsert conveyor for processing via ETD screening.

- 5.) If the Level 2 screening process (i.e., TSO at BVS computer terminal) has “Cleared” the bag, the bag’s security status and respective (pseudo) discrete identification number will be sent to the BHS via the BHS/EDS security interface network to reflect the change in the screening status to a Level 2 “Cleared”, in which case the “Green” indicator light on the stacked light module will illuminate and the bag shall be released from the Level 2 OSR1-01 and OSR2-01 conveyors to transition onto the Clear (CL1 and CL2) Bag subsystems for transport to baggage make-up (i.e., MU1). The Green indicator light on the stacked light module shall stay illuminated until the bag has fully transitioned past the OSR/BRP and onto the downstream CL clear bag line.
- f. Level 3 (Explosive Trace Detection screening)
 - 1.) Level 3 refers to a trace operator screening area (i.e., CBRA), which is located at the discharge end of each Security Shunt (SS) conveyor line, downstream of the EDS machine location(s). Screening is basically handled by way of directed manual search, in accordance with TSA protocols, utilizing a Remote Resolution Station (RRS) at the BIT (i.e., trace operators screening Level 2 Alarms).
 - 2.) Alarmed bags shall be removed from the baggage removal/reinsert conveyor (OSR1-01 and OSR2-01) to release the conveyor for the advancement of the next bag. “Alarmed” bags shall be screened per local TSA protocols at the dedicated Level 3 BITs that will be located adjacent to the SS conveyor line. The SS conveyor subsystems will be provided with one (1) ETD workstation each, that will consist of 5’-0” wide baggage inspection tables (BITs), an ETD machine (per BIT), Remote Resolution Station (RRS).
- g. Provide all required PLC hardware, software/firmware and related programming, (e.g., memory capacity, I/O, the necessary interlocks and interfaces) to incorporate the Mini In-Line CBIS within the outbound Baggage Handling System.
- h. Provide the necessary conveyor belt speeds and baggage queuing hold times for the outbound BHS and Mini In-Line CBIS, as required, in order to achieve the required BHS and Mini In-Line CBIS throughputs and Level 2 screening time (i.e., 25 seconds minimum).
- i. Provide “Security Fault Alarms” at the respective system’s PC-type Computer Terminal Workstations to detect the failure of a failsafe device and to alert the operators in their respective vicinity should the CBIS incorrectly transport a confirmed “Alarmed” or “EDS Unknown/BHS Unknown” bag onto the clear subsystem conveyor. In this regard, provide redundant fail-safe photocell controls at the discharge end of the CL1-01 and CL2-01 conveyors. Hardware & software shall be installed to verify the “Cleared” status of the bag ensuring that an “Alarmed” or “EDS Unknown / BHS Unknown (i.e., any bag that the CBIS cannot confirm to have been cleared by the EDS or EDS operator) was not incorrectly



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transported onto the clear subsystem conveyor. The fail-safe device / photocell shall be configured in a home run design to / from the I/O module to ensure it is operational at all times. Provide audio / visual alarm indications in the field (adjacent to the fail-safe device, as specified elsewhere in the specification) and at the PC-type Computer Terminal Workstations upon detection of a fail-safe device failure.

- j. To prevent “Out-of-Gauge” items (OOG refers to items that can be transported on the BHS conveyors but cannot fit in the EDS, refer to EDS suppliers specification for maximum bag sizes) being introduced into the Level 1 EDS machine, provide a light curtain array to detect for “out-of-gauge” items. All out of gauge bags shall be stopped on the SS1-01 and SS1-04 conveyors for removal by TSO.
- k. Coordinate with the EDS supplier the interface requirements between the BHS and EDS for all relative input/output signals or messages (e.g., Cleared, Alarmed, EDS Unknown, BHS Unknown, or Out-of-gauge) to satisfy the specified positive bag tracking requirements and real-time reporting functionality of the BHS. Ensure that as “Cleared”, “EDS Unknown”, “BHS Unknown”, “Out-of-Gauge” and “Alarmed” baggage is transported through the BHS and Mini In-Line CBIS in all of the processes described above it shall be continuously tracked for position by the BHS PLC control system. The only allowable exceptions to this shall be while inside the EDS machine itself where the EDS shall track the bag. The BHS shall interface with the EDS to permit the position of the tracked bags through the system to include the screened status of each bag between the three Screening Levels.

G. New Outbound BHS/CBIS/ CBRA Requirements

- 1. Ticket counter subsystem conveyors with stainless steel cladding.
- 2. Provision of all new conveyors with related components (primary ticket counter input and outputs to/from the two (2) Level 1 EDS machines).
- 3. Provision of High Speed Paddle Diverter for diversion, load balancing and redundancy for SS Subsystems.
- 4. Provision and installation of light curtains (upstream of EDS device) as required for the proper operation and integration of the **CT80-DR** EDS devices.
- 5. Integration of the EDS machines CT-80DR into the system configuration.
- 6. Transport conveyors between the Level 1 EDS and make-up.
- 7. Provision of Oversize Stainless Steel Slide and associated Security Door.
- 8. Baggage Handling System PC-Type Computer Terminal Workstation
 - a. One (1) Baggage Handling PC-Type Computer Terminal Workstation shall be provided to monitor the Outbound BHS with in-line EDS Security Screening equipment. This PC-type computer terminal workstation shall act as the interface between the PLCs, and any other external computer/control system that requires interface to the BHS (e.g., Building Access Control System and EDS machine) and shall include a user interface terminal, and a Maintenance Diagnostics System with associated reporting



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functionality, which shall serve three (3) primary functions, as follows:

- 1.) Data base processing.
 - 2.) Monitoring of the system status.
 - 3.) Statistical information storage.
- b. Provide the installation, integration and necessary implementation to the BHS PC-type Computer Terminal Workstation. The PC Type Workstation shall accurately reflect the completed outbound system layout and be complete in design and installation with all fault and reporting capabilities. The PC-type Computer Terminal Workstation shall monitor, report, and display the system's status (graphic and text based) identically to each other in a real-time mode.
9. Data Communication Highways (DCH)
- a. Provide a minimum of two (2) network lines for each level of controls (i.e., Ethernet Network for upper level controls (i.e. between PC-type Computer Terminal Workstation and peripheral devices) and A-B ControlNet or approved equal for lower level controls), so that a failure of one will not stop the system. Distribute the PLCs evenly on each ControlNet network, to ensure the system redundancy requirements.
10. Programmable Logic Controllers (PLCs)
- a. The control system design philosophy that shall be adopted for the BHS/CBIS shall be one of hierarchy control. All outbound conveyor and the checked baggage inspection subsystems shall be controlled by centralized redundant programmable logic controllers (PLCs) with Warm Back-up for redundancy purposes. The design of the PLCs shall be compartmentalized to separate the BHS and CBIS controls functionality; At a minimum, provide a total of two (2) warm back-up PLC systems (i.e., one for the CBIS (i.e., subsystems SS1, SS2, OSR) and one for the outbound BHS (i.e., subsystems TC1, CL1, CL2 and MU1).
 - b. Provide all the necessary PLCs, as specified elsewhere in this specification, for the lower level machine controls, as they relate to the BHS and Mini In-Line CBIS.
11. Power Distribution and Motor Control Panels (PDPs and MCPs)
- a. Provide PDPs, MCPs and PLCs for the Mini In-Line CBIS and Outbound BHS, as required, to accommodate the specified functions. The complete Outbound BHS shall be controlled by PLCs with "Warm Back-Up", as specified elsewhere in this document.
 - b. Provide all related power and control wiring with associated conduits from the BHS related Power Distribution Panels to their respective Motor Control Panels and onto their subsystem conveyor segment(s) field equipment/components, per the subsystem breakdown that is defined in the contract documents.
12. Conveyors locally equipped with 4" high sideguards at locations upstream and downstream of the EDS machines to assist TSA personnel in performing "IQTK" Test Bag Testing of the EDS machines. Conveyors required to have this type of sideguard are indicated in the



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contract drawings. Coordinate input sideguard locations with meter wide tunnel locations, control station layouts, crossovers, to devise the best possible location of these sideguards by providing a “mock-up” of the first EDS installation for review and approval.

13. New electrical components shall be provided on the conveyor sections located at the input/output ends of the EDS machines with “quick-disconnect” type connections to aid in the removal of conveyor segments/components in the event of EDS machine replacement. Conveyors required to have this type of equipment shall also be provided with caster wheels on the respective conveyor’s floor support legs, to assist in the removal/maneuvering of the conveyors segments; these conveyor segments are indicated in the contract drawings.
14. Provision of a new flat plate make-up device, associated feed conveyor/and tip chute. All control devices installed on the exterior of the Terminal building and within the outbound make-up area are to be NEMA 4 rated.
15. Security Doors
 - a. Provide, install and integrate all BHS security doors as illustrated on the contract drawings. Also, provide and install draft curtains at the new security door locations.
16. Maintenance Catwalks
 - a. Provide and install all BHS related maintenance catwalks, access ladders and cross overs as illustrated in the contract drawings.
17. New In-Line EDS and ETD Equipment Installation
 - a. Coordinate with the TSA’s Contractor for the site planning, required testing (i.e., SAT and ISAT) and all interface requirements between the security screening equipment (i.e., EDS Level 1 machines, Level 2 workstations and ETD stations) and the BHS for all of the conveyor lines as they relate to this project.
 - b. The new EDS and ETD equipment, that will be provided by the TSA, shall be installed (e.g., EDS internal system wiring, networking and related controls) at their permanent location by the TSA’s contractor.

H. BHS Allowances

1. Provide a line item cost for recommended spare parts allowance for the Owner’s review and consideration.

1.03 DEFINITIONS

A. Abbreviations

1. ACS shall mean Access Control System
2. AL shall mean alarm line
3. ANS shall mean American National Standards



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4. ANSI shall mean American National Standards Institute
5. ASCII shall mean American Standard Code for Information Interchange
6. AT shall mean Advanced Technology X-Ray Machine
7. AOA shall mean Airport Operations Area
8. ATO shall mean Airline Ticket Office
9. BAIT shall mean Bag Auto-ID Transfer
10. BHS shall mean Baggage Handling System
11. BIT shall mean Baggage Inspection Table
12. BNP shall mean BNP Associates, Inc., the Baggage Handling System Consultant/Engineer.
13. BMTT shall mean Bag Maximum Travel Time
14. BPM shall mean Baggage Processing Message
15. BRP shall mean Baggage Removal Point
16. BSM shall mean Baggage Source Message. Message sent from airline computer system to BHS computers.
17. BTM shall mean Baggage Transfer Message
18. BUM shall mean Baggage Unload Message
19. BVS shall mean Baggage Viewing Stations.
20. CL shall mean Clear Bag
21. CBRA shall mean Checked Baggage Resolution Area and shall be synonymous with the terms Resolution Room, Baggage Inspection Room and ETD Area.
22. CBS shall mean Checked Baggage Screening
23. CBIS shall mean Checked Baggage Inspection System
24. CEMA shall mean Conveyor Equipment Manufacturers Association
25. CL shall mean clear bag subsystem
26. CM shall mean Construction Manager
27. COF shall mean Coefficient of Friction
28. Cold Back-up shall mean that redundancy is based on the removal of a failed primary component (e.g. PLC) and subsequent replacement with a fully programmed component (PLC).
29. CRT shall mean Cathode Ray Tube – Video Display Terminal
30. CT shall mean Computed Tomography



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31. CT-80DR shall mean the EDS device manufactured by REVEAL imaging technologies, inc.
32. DCH shall mean Data Communication Highway. Communication line between PLCs, peripheral devices and computer systems.
33. DID shall mean Directional Input Device
34. EDS Shall mean Explosive Detection System (Computer Tomography)
35. EIA shall mean Electronic Industry Association
36. EPROM shall mean Erasable Programmable Read Only Memory
37. EOD shall mean Explosives Ordinance Disposal
38. ETD shall mean Explosive Trace Detection
39. FAA shall mean Federal Aviation Administration
40. FLA shall mean Full Load Ampacity or Full Load Amperes
41. FPM shall mean Feet Per Minute
42. GC shall mean General Contractor - a firm or person other than the BHS Contractor who shall enter or has entered into a Contract with the Owner and who shall be identified by the Construction Manager for work at the Airport relating to this contract
43. GOVT shall mean Guaranteed Operator View Time
44. GSE shall mean Ground Service Equipment
45. HBS shall mean Hold Bag Screening
46. HDD shall mean Hard Disk Drive
47. HMI shall mean Human Machine Interface.
48. HSPD shall mean High Speed Paddle Diverter
49. HVAC shall mean Heating, Ventilating and Air Conditioning
50. IATA shall mean International Airline Transportation Association
51. ID shall mean Identification
52. IEC shall mean International Electromechanical Commission
53. I/O Module shall mean Input/Output Module
54. ISAT shall mean Integrated System Acceptance Test – A full bank of tests detailed in the TSA's Site Specific Test Plan; testing will be conducted by the TSA's IV&V testing representative and shall be supported by the BHS Contractor.
55. IV&V shall mean the TSA's Independent Verification and Validation representative
56. LAN shall mean Local Area Network



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- 57. FAY shall mean Fayetteville Regional Airport.
- 58. LCD shall mean Liquid Crystal Display
- 59. LED shall mean Light Emitting Diode
- 60. LEO shall mean Law Enforcement Officer who is typically part of the local bomb disposal unit
- 61. MCP shall mean Motor Control Panel. The MCP contains the electrical control and power circuit devices for the control of the baggage system(s).
- 62. MEP shall mean Mechanical, Electrical and Plumbing System
- 63. ML shall mean mainline subsystem
- 64. MU shall mean make-up subsystem
- 65. MTBF shall mean - Mean Time Between Failures
- 66. NEC shall mean National Electrical Code
- 67. NEMA shall mean National Electrical Manufacturers' Association
- 68. NFPA shall mean National Fire Protection Association
- 69. NIC shall mean Not In Contract
- 70. NRT shall mean Near Real Time
- 71. NTP shall mean Notice-to-Proceed.
- 72. O & M shall mean Operations and Maintenance
- 73. OEM shall mean Original Equipment Manufacturer
- 74. OSARP shall mean On-Screen Resolution Protocol
- 75. OSHA shall mean Occupational Safety and Health Administration
- 76. OS shall mean Oversize or Oddsize
- 77. OSR shall mean On-Screen Resolution
- 78. OST shall mean the TSA's Office of Security Technology
- 79. FAY shall mean Fayetteville Regional Airport/The Owner
- 80. PAX shall mean Passenger
- 81. PCI shall mean Passive Control Interface
- 82. PDP shall mean Power Distribution Panel or Point. Designated location(s) to provide power for the BHS.
- 83. PE shall mean Professional Engineer
- 84. PGDS shall mean Planning Guidelines and Design Standards for Checked Baggage



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Inspection Systems, as prepared by the TSA.

- 85. PLC shall mean Programmable Logic Controller, a microprocessor that controls BHS operations.
- 86. PM shall mean Project or Program Manager
- 87. PSI shall mean Pounds per Square Inch
- 88. Pre-TRR shall mean pre-Test Readiness Review – shall be performed by the Contractor in conjunction and in coordination with the COTR and local TSA representatives to demonstrate that the system meets all of the requirements of the TSA's CBIS performance and commissioning requirements, per the TSA's PGDS, as well as the intent of the TSA's Site Specific Test Plan (SSTP) prior to the performance of the TRR testing
- 89. RF shall mean Radio Frequency
- 90. RFI shall mean Request For Information
- 91. ROW shall mean Right of Way
- 92. RT shall mean Real Time
- 93. SAC shall mean sortation allocation computer (i.e., Sort Controllers)
- 94. SAT shall mean Site Acceptance Testing required for each EDS – will be performed on each EDS machine by the EDS supplier and the TSA's testing contractor, prior to integration to verify detection
- 95. SB shall mean Suspect Bag
- 96. SIDA shall mean Security Identification Area
- 97. SS shall mean Security Screening subsystem
- 98. SSI shall mean Security Sensitive Information
- 99. SSTP shall mean Site Specific Test Plan, prepared by the TSA's IV&V representative
- 100. SVS shall mean Secondary Viewing Station
- 101. TC shall mean the ticket counter subsystem
- 102. TCU shall mean Threat Containment Unit
- 103. TOB shall mean Top of Belt
- 104. TRI shall mean Threat Resolution Interface
- 105. TRT shall mean Threat Resolution Tools
- 106. TRR shall mean Test Readiness Review – shall be performed by the BHS Contractor in conjunction and in coordination with the Airport's Security, the TSA's OST and local TSA representatives to demonstrate that the system meets all of the requirements of the TSA CBIS performance and commissioning requirements, per the TSA's PGDS, as well as the



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intent of the TSA's Site Specific Test Plan (SSTP).

- 107. TSA shall mean Transportation Security Administration
- 108. TSO shall mean Transportation Security Officer (Baggage Screener)
- 109. UL shall mean Underwriters Laboratories
- 110. UPS shall mean Uninterrupted Power Supply
- 111. USS shall mean Uniform Symbology Specification
- 112. User Airline shall mean those airlines that use the Baggage Handling System(s) related to this contract
- 113. VFD shall mean Variable Frequency Drive
- 114. VOM shall mean Volt Ohm Meter
- 115. WAN shall mean Wide Area Network
- 116. Warm Back-up shall mean that in the event of a primary component failure (e.g. PLC) the warm back up has to be manually switched to become the primary component.

B. Authorized Representative

- 1. The Owner may designate by written notice to BHS Contractor or by provision elsewhere in this Contract one or more persons, firms or corporation to act as its Authorized Representative in connection with the administration of this Contract. Except as otherwise provided in such written notice or elsewhere herein, such Authorized Representative shall have the Owner to act for the Owner with respect to the performance of this Contract by the BHS Contractor with the objective of achieving full compliance by the BHS Contractor of the terms and provisions of the Contract.
- 2. Accept and comply with instructions from such Authorized Representative as though such instructions had been given by the Owner and the BHS Contractor shall deal directly with such Authorized Representative in all matters arising under this Contract, including but not limited to matters involving Contract interpretation, disputes and arbitration procedures. However, such Authorized Representative is authorized to act in connection with this Contract solely as the representative of the Owner and not as principal hereunder.

C. General

- 1. Baggage Handling System (BHS) shall mean all components, installation materials, interfaces and other components, all necessary hardware, software, installation coordination and construction supervision of computers/PLC, controls and control hardware and software, management and support services required to implement the work and supply a fully functioning system as described by the Contract Documents.
- 2. Baggage Handling System Contractor shall be synonymous with Equipment Contractor, Equipment Supplier, Baggage Contractor, BHS Contractor, Supplier and Contractor and shall mean the firm or company that is responsible for the design, engineering, manufacture



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and installation of the conveyor equipment and systems required to implement the work and supply a fully functioning system as described by the Contract Documents.

3. In these written Specifications and on the Contract Drawings (unless inconsistent with the content or subject matter or unless a contrary intention otherwise appears) the following clarifications/definitions shall apply:
 - a. As Built shall encompass all elements of the term As Executed.
 - b. Bill of Quantities shall mean a document named therein as a Bill of Quantities issued to bidders by or on behalf of the Owner, stating quantities of work to be carried out.
 - c. Completion shall mean:
 - 1.) That stage of the execution of the Work under the Contract when the Works are completed and all other things, which are required by the Contract to be performed by the Contractor before completion, have been performed and accepted.
 - 2.) Where contract or specifications provide a period of time for completion, the last day of the period.
 - 3.) However, if the Owner grants an extension of time for completion, it means the date resulting from the extension of time.
 - d. Contract means this Deed of Agreement between the Owner and the Contractor for the performance of the Works, together with all schedules, attachments, annexure and other documents incorporated into this Contract.
 - e. Construction Manager shall mean a firm or person or such other manager as may be appointed by the Owner for the purpose of managing the Contract and, in so far as it concerns the functions exercisable by the Construction Manager, includes his nominated representatives.
 - f. Contract Sum means:
 - 1.) Where the Owner accepted a lump sum, the lump sum.
 - 2.) Where the Owner accepted rates, the sum ascertained by adding the products of the rates and the corresponding quantities in the Schedule of Rates.
 - 3.) Where the Owner accepted a lump sum and rates, the aggregate of the sums referred to in paragraphs 1 and 2 above.
 - g. Date for Completion shall mean:
 - 1.) Where contract provides a date for completion.
 - 2.) Where contract or specifications provide a period of time for completion, the last day of the period.
 - 3.) However, if the Owner grants an extension of time for completion, it means the date resulting from the extension of time.



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- 4.) The date certified by the Owner in a Certificate of Completion to be the date upon which the Works have reached completion.
- h. Day means a calendar day.
 - i. Diversion Point shall mean the point at which a bag will either be routed into the BHS for final sortation or routed to the next level of security screening for further processing.
 - j. Other Contractor or Other shall mean a firm or person other than the BHS Contractor who shall enter or has entered into a Contract with the Owner.
 - k. Baggage Screening Addition Project shall mean the construction of the new baggage Screening Building BHS project at the Fayetteville Regional Airport, as described in these written Specifications and on the Contract Drawings.
 - l. Schedule of Rates shall mean any schedule included in the Contract, which, in respect of any section or item of work to be carried out, shows the rate or respective rates of payment for execution of that work, and which may also include provisional items, provisional sums, quantities and prices. The schedules of rates are fixed sums for the duration of the Contract with the Owner.
 - m. Site means the lands and other places made available or to be made available to the Contractor by the Owner for the purpose of the Contract.
 - n. Specifications means the Specification for the Works included in the Contract and any modification of such Specification thereafter.
 - o. Subsystem shall mean a set conveyor segments and it's related field elements (e.g., control stations, consoles, scanners, and the like), which is a system itself, and a part of the whole system
 - p. Temporary Work shall mean any work required in the execution of the Contract but not forming part of the Works.
 - q. The Contract Drawings shall mean the drawings referred to in these written Specifications or The Contract; the Owner may from time to time supply modifications/revisions of such drawings and other drawings to the Contractor for the purposes of the Contract.
 - r. The Works shall mean the whole of the work to be executed in accordance with the Contract, including variations provided for by the Contract.
 - s. Words importing the singular include plural and words importing the plural include the singular.
 - t. Words importing persons include a partnership and a body corporate.
 - u. Words importing the masculine gender include the feminine and neuter genders.
 - v. Work Under The Contract shall mean any work the BHS Contractor is or may be required to execute under the Contract and includes variations, remedial work and Temporary Work.



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1.04 BHS EQUIPMENT IDENTIFICATION

A. General

1. The item numbering system and format used for physical identification of new and modified conveyors and associated equipment and in all documentation shall be consistent with the subsystem identification detailed on the contract documents. The equipment shall be numbered in consecutive order.

B. Equipment Identification

1. The item numbering system and format used for physical identification of conveyors and associated equipment and in all documentation shall be the same as that indicated on the Contract Drawings. The equipment in each subsystem shall be numbered in consecutive order.
2. The following is a listing of the subsystem abbreviations utilized in the contract drawings:
 - a. CL means Clear Bag subsystem(s) CL1
 - b. MU shall mean Make-Up Device
 - c. OSR means on screen resolution subsystem OSR1 and OSR2
 - d. SS means Security Screening subsystem(s) SS1 and SS2
 - e. TC means Ticket Counter subsystem(s) TC1

1.05 SUBMITTALS

A. General

1. All submittals shall be in accordance with the Conditions of the Contract.
2. Submit the following documentation at the time specified during the course of the work, and in accordance with the following Submittal Deadlines.
3. Prepare all documents in the English language.

B. Bid Proposal Submissions

1. The BHS Contractor is deemed to have studied the system design and requirements presented in the drawings and specification respectively and accepted the design and requirements as suitable and appropriate to safely accomplish the functions and processes described herein. Identify in bid submission any design aspect or specification requirement that is believed to be inappropriate or inadequate and shall propose alternate solutions to alleviate the perceived problem but shall, in all cases, include in the bid submittal pricing for the base system presented in the drawings. Any alternate designs developed must meet or exceed the design criteria as listed in the specifications.
2. Include in the proposal submission the following items:
 - a. Add Alternates



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- b. Complete Manifest including any proposed alternate configurations.
- c. Any exceptions to these specifications or contract terms in a separate section titled "Exceptions".
- d. Type and duration of the proposed training program if different to the minimum requirements as listed in Part III of these contract documents
- e. Recommended allowance to purchase items from the Estimated Spare parts list as detailed in the contract documents
- f. Identification of any special environmental requirements more stringent than what is shown in the Specifications (if any).
- g. Notification of any perceived safety hazard with specified design of system or its components.
- h. Notification if an adjustment is required to the Contractor's Submittal Deadlines.
- i. Proposed equipment of non-standard design and equipment substitutions.
- j. Define the technical support to be provided during testing, conditional acceptance phase and after Final Acceptance has been granted.
- k. Requirements for lay down areas include line item cost if off site storage facility has to be rented.
- l. Project schedule outline for the implementation of the BHS (indicate number of weeks for completion of work after NTP)
- m. Related project list references (indicate client, location of project, type of work, year performed/completed and overall cost).
- n. Provide listing of staff with resumes and qualifications that shall be working on the project. Indicate project manager's name, names and number of programmers, technicians, instructors/ training personnel, and all other required information. Include on-site and off-site participating staff and the percent of anticipated participation on this project. In addition, provide training instructors professional qualifications. The Owner reserves the right to approve or reject key personnel from the list.
- o. Provide a line item for the cost of additional on-site training hourly rate.
- p. Provide a line item cost for all BHS related acceptance testing including all required TSA testing. This should clearly identify the types and quantities of required testing material as well as manpower that has been assumed and included within the cost.

C. Drawings Submitted for Review

- 1. Submit for review an electronic copy of each shop and installation drawing (e.g. PDF format submitted on CDROM, DVDROM or the established project ftp site).
- 2. The Owner or their representative shall review the drawings and return them for revision and re-submittal within 14 days, where re-submittals are required. Revise and re-submit



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drawings for final review by the Owner or their representative within 14 days. Any corrections or changes indicated on Shop Drawings shall not be considered as an extra work order. Do not start fabrication until receipt of the Owner or their representative's approval.

3. The comments from the Owner or their representative shall not be taken to imply that the arrangement has been checked in detail. The BHS Contractor shall be fully responsible for the suitability, adequacy, integrity, durability and practicality of the arrangement or assembly, components and systems as set out in the drawings, specifications and other information submitted for acceptance by the Owner or their representative including all subsequent amendments. In no case shall the Owner's or his representative's review or comments relieve the Contractor in any way of his responsibility of ensuring that the equipment supplied complies with all specification and functions in accord with the wording and the intent of the applicable Specifications.
4. Do not submit drawings, which are not in full compliance with the specifications unless an Engineering Change Order Request (ECR) requesting a variable from the specifications accompanies the submittal. In this case the Owner or their representative will endeavor to respond within 21 days, but shall be under no obligation to do so.
5. Approved shop drawings shall be at the site at all times for use in the construction of the work. Failure to supply such drawings will be deemed sufficient cause to delay the work until such drawings are available for field use and reference.
6. Submit a drawing log that contains a complete list of all anticipated installation and shop drawings and submit an updated copy with each drawing submission.

D. Submittal Deadlines

1. Listed below are the submittals and recommended submittal dates. In order to maintain the Owners Project schedule advise as to any adjustments required for the Submittals.

Submittal Item	Ref. Paragraph	Deadline
Safety Program Manual	Para. 4.01E	10 days after NTP
Project Management Team	Para. 4.01F	10 days after NTP
Quality Control Manual	Para. 4.01A	20 days after NTP
Configuration Management Plan	Para. 4.01D	30 days after NTP
Detailed Master Schedule	Para. 1.05D	30 days after NTP
Structural Attachment Details	Para. 1.05F	30 days after NTP
Environmental Requirements	Para. 1.05L	30 days after NTP
Catalog Cuts and Equipment Specifications	Para. 1.05H	20 days after NTP
System Power Requirements and MCP Sizes	Para. 1.05U	30 days after NTP
BHS Equipment - Combined Heat Output	Para. 1.05G.2.c	90 days after NTP



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Figures		
Emergency Stop Zone Drawings	Para. 1.05H.4.c.6.)	60 days after NTP
Controls System Description and BHS Redundancy Schematic Diagrams	Para. 1.05G.5	90 days after NTP
Shop Detail Drawings	Para. 1.05G.2.e	60 days prior to fabrication
Motor Schedule	Para. 1.05G.4.b.6.)	60 days prior to fabrication
Installation Drawings	Para. 1.05G	60 days prior to fabrication
Training Program	Para. 1.05K	90 days prior to testing
Estimated Parts List	Para. 1.05T	90 days prior to testing
Functional Specification	Para. 1.05N	60 days prior to testing
Inspection and Test Program	Para. 1.05N	60 days prior to testing
Final Parts List	Para. 1.05R	30 days prior to testing
Work Activities Bulletin	Para. 4.01J	14 days prior to each activity
Test Reports	Para. 1.05O	15 days after completion of testing
Certificate of Testing Compliance	Para. 1.05Q	
System Reliability Calculations	Para. 1.05U	30 days after completion of testing
Certificate of Installation Compliance	Para. 1.05P	15 days after completion of installation
Contractor Documentation for the development of the SSTP by the TSA's IV&V representative	Para. 1.05BB	180 days prior to testing
As-Built Drawings	Para. 1.05G.2.d	30 days after acceptance of equipment
List of Lubricants	Para. 1.05M	60 days prior to start-up
O & M Manual – Draft for Owner Review	Para. 1.05I	60 days prior to start-up
Periodic Maintenance Inspection and Lubrication Chart	Para. 1.05J	60 days prior to start-up
O & M Manual – Final	Para. 1.05I	15 days prior to start-up
Submittal Log	Para. 1.05W	With each submittal or as required by the project.

E. Detailed Master Schedule



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1. Submit a detailed Master Schedule as specified below for review and approval by the Owner or their representative before commencing with any work. Display schedule in graphic form, large and spacious enough to be updated directly on the original submittal during the course of the project. Show the principal dates and commensurate activity times for each entry. Include in the schedule:
 - a. Beginning and ending of mechanical, electrical and controls/computer engineering for each subsystem or construction phase.
 - b. Drawing submittal and approval.
 - c. Long lead item order placement and expected delivery date.
 - d. Beginning and ending of fabrication per subsystem or construction phase.
 - e. On-dock plant to on-site transportation.
 - f. Beginning and ending of demolition, removal or alterations work per each subsystem or construction phase.
 - g. Beginning and ending of mechanical, electrical and controls/computer installation per subsystem or construction phase.
 - h. Factory Acceptance Test dates
 - i. Milestone dates for completion of pertinent facility interfaces (e.g., permanent system power).
 - j. Date(s) EDS Equipment rigging to be completed by TSA's Contractor.
 - k. Date(s) In-Line CT-80DR device(s) installation and SAT needs to be completed by the TSA's Contractor
 - l. EDS/BHS integration test plan
 - m. In-line EDS system SAT or ORT dates
 - n. Contractor's internal specification conformance acceptance test dates
 - o. In-line Pre-TRR dates
 - p. In-line EDS TRR dates
 - q. In-line EDS system ISAT dates
 - r. Equipment item test.
 - s. Training and test plan submittals.
 - t. Submittal of operation and maintenance manuals.
 - u. Operation and maintenance training periods.
 - v. Submittal of manufacturer's recommended spare parts list.
 - w. Acceptance inspections, testing/commissioning by subsystem.



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- x. System acceptance testing by subsystem or sequence.
 - y. Operational dates by subsystem or construction phase or sequence.
 - z. 30-day CBIS run-in period
 - aa. Punch list rectification.
 - bb. Final acceptance testing.
 - cc. Submittal of As-Built documentation.
2. Maintain and update the Master Schedule monthly showing the actual progress made and any revisions in the schedules or at any time that changes in the design, construction, procurement and installation cause any major change in the overall schedule. Required reporting frequency intervals may be shorter during critical periods at the discretion of the Owner or their representative. Such additional reporting frequency shall not be grounds for additional cost claims.
 3. If the monthly schedule update reflects, or the Owner or their representative determines, that the BHS Contractor is at least ten percent (10%) or fourteen (14) or more calendar days behind the original progress schedule (whichever is less) for the BHS project as a whole, a major Contract item, an item of BHS which is on the critical path, or an item of BHS not on the original critical path but that, because of the delay or anticipated delay, becomes a critical path item, then the BHS Contractor must submit its proposed recovery plan for bringing the BHS project back on schedule and for completing the BHS within the Date of Completion with the monthly/weekly schedule update.
 4. Allow for the co-ordination and interfacing of his work in line with the construction work of the new Baggage Screening Building, and other such contractors. Such co-ordination and interfacing shall include for permitting the direct contractors to complete their work before proceeding to complete the balance of project under this BHS Contract. In the event of failure to allow for such co-ordination and interfacing, no claim whatsoever shall be entertained by the Owner or their representative for any additions, amendment, re-medial or abortive works to be carried out by the BHS Contractor or the contractors to ensure satisfactory completion of the project. Obtain the overall construction program and project schedule of the Baggage Screening Building and other such direct contractors and include them into his Master Schedule.
 5. The BHS Contractor may also request revisions to the Project Schedule in the event the BHS Contractor's planning for the work is revised. If there are desired changes in the Project Schedule to reflect revisions in the method of operating and scheduling of the work, notify the Owner or their representative in writing, stating the reason for the proposed revision.
 6. Ensure there are sufficient personnel available for the purpose of coordination to ensure timely completion of the BHS and to ensure that the BHS Contractor does not hinder the work of other trades. Provide personnel with the required experience for coordination at meetings as required by the Owner or their representative so that decisions regarding



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coordination issues can be made during coordination meetings and the BHS Contractor

F. Structural Attachment Details

1. Submit structural and seismic attachment detail drawings and the design computations of all structural supports for the BHS and associated catwalks signed and sealed by a Professional Structural Engineer licensed in the State of North Carolina, the same jurisdiction where this project is located.

G. Shop Drawings, Installation Drawings, and As-Built Documents

1. General

- a. All drawings submitted shall become the property of the Owner.
- b. All drawing submittals shall be to scale. The scale utilized shall be clearly defined in the title block.
- c. The North arrow shall also be shown on all mechanical drawings.
- d. Drawings shall include the following items unless otherwise specified.

1.) Document Title Blocks

- a.) In addition to information normally presented in a drawing title block, each drawing title block shall provide the following specific information:

(1.) Three letter airline code for airport designation of the project location

(2.) Name of the Baggage Handling System

(3.) Drawing scale

(4.) Drawing title

(5.) Drawing number/sheet number

(6.) Drawing date

(7.) Drawing revision date and revision number

(8.) NOTE: All drawing revisions shall be foot noted on the drawing face as well as in the appropriate revisions section of the title block.

e. Professional Engineer Approval Requirements

- 1.) Engage Professional Engineer(s) licensed in the State of North Carolina in the relevant disciplines, at its own cost, to design, review, verify and certify the BHS structural systems including all necessary temporary works and supports.
- 2.) Minimum requirements for Professional Engineer signed and sealed drawings and calculations to be submitted are defined below. Submit any additional signed and sealed drawings, calculations or submissions required by federal, state or local codes. As a minimum, the following drawings, calculations and submissions shall be signed and sealed:



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- a.) Mechanical/Structural
 - (1.) All structural and seismic attachment details and design computations for the BHS and associated catwalks
 - (2.) All structural support details and design computations for the BHS and associated catwalks
 - (3.) Drawings and design computations of all structural attachment points to the parent building including imposed load on the building
 - (4.) Drawings defining all structural supports and attachment types and locations. Generic details will not be acceptable for this purpose.
 - (5.) Drawings defining all maintenance catwalks and methods of catwalks access including details of handrails, access stairs and ladders, and catwalks construction details.
- b.) Detailed drawings associated to the EDS and BHS hoists and associated interface to the hoist beams.
- c.) Detailed drawings with dimensions of all safety guards such as, but not limited, to the following:
 - (1.) Conveyor underpans
 - (2.) Rotating shaft guards
 - (3.) Conveyor shrouds
 - (4.) Drive v-belt / chain guards
 - (5.) Metal bearing covers
 - (6.) Finger guards
 - (7.) Gap pans
 - (8.) Drive pans
 - (9.) Breakaway end cap safety guards
 - (10.) HSPD safety guards at paddle pinch points
- d.) Electrical
 - (1.) All new BHS PDP and motor control panel connected load calculations
- e.) Provide the above mechanical/electrical PE signed and sealed drawings/calculations as listed above in part a.) and b.) in two separate submittals:
 - (1.) “For Construction” drawings/calculations
 - (2.) Final “As-Built” drawings/calculations



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2. Drawing Submittal Package Requirements

- a. Submit to the Owner or their representative final installation drawings defining BHS erection procedures, mechanical and electrical component layouts and the relationship of the equipment components to each other and to the facility prior to the commencement of fabrication. Employ an approved independent agency for the required inspection of all BHS related support attachments to the building structure and the review and approval of the Contractor's PE signed and sealed structural attachment documents and point loading diagrams as they relate to the actual installation; these special inspections of BHS related structural members shall be performed in compliance with the International Building Code (IBC) 2009, Chapter 17 – Structural Tests and Special Inspections. These services shall be performed at no additional cost to the Project.
- b. Submit a motor schedule listing: motor horsepower, voltage, source of feed, circuit breaker size, disconnect size, conduit and wire size and overload heater size selected to be used, prior to the installation of overload heaters on the controllers.
- c. Submit to the Owner or their representative for review the BHS equipment combined heat output figures with calculations for the following areas of the facility. The information typically includes friction losses from conveyor equipment and heat outputs from the drive motors, motor control panels and computer equipment:
 - 1.) Screening Area
- d. Submit As-Built drawings as per the specified submittal schedule (plans and associated sections/elevations) indicating the location of the BHS, including all mechanical components, maintenance catwalks and electrical devices, operator's control panels, MCP, switches, and other control devices. Ensure that the submitted "As-Built" documents and related information that is issued on CD-ROMs are accurate and include all BHS/CBIS related Communication/Network Layout drawings, Computer Crash Recovery Disks and all manuals. All final "As-built" drawings shall be signed and sealed by a Professional Engineer licensed in the State of North Carolina, at no additional cost to the Owner.
- e. Submit final assembly drawings, shop detail drawings and any other pertinent drawing files in AutoCAD.DXF format, version 2009 or higher, for all phases of the work, indicating BHS components, construction and assembly details of all components prior to releasing drawings for fabrication.
- f. As-Built drawings shall be submitted on CD ROM in addition to other forms of media described herein.

3. BHS Mechanical Drawing Submittal Requirements

- a. General
 - 1.) If standard parts are purchased, reproduced details and identifying part numbers shall be provided.



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- 2.) Each BHS device or conveyor that appears on plan, elevation and section drawings of the BHS shall be identified with the appropriate I.D., as established in this Specification.
 - 3.) Number conveyor equipment and control devices starting at the beginning of each conveyor system or subsystem. If there are any discrepancies between the contract document-specified equipment I.D. numbers and the actual identification of existing (to be retained) equipment, such discrepancies are to be brought to the attention of the Owner or their representative for immediate resolution.
 - 4.) All plan views of the BHS system shall be based on an overlay of the building structure as is appropriate.
 - 5.) All plan, elevation and section drawings of the BHS shall also show the vertical and horizontal clearances between the related system equipment and the building structure with its related interferences.
- b. Provide the following types of mechanical drawings: Delete Modified/Relocated if not required; Edit required mechanical/electrical components
- 1.) General arrangements with dimensions of all new, modified, and relocated equipment (plan, elevation, details and sections, as appropriate) for all mechanical, maintenance catwalks, crossovers, ladders (coordinate with the Architect and the Owner or their representative for the final number and location of all maintenance access equipment), impact protection, electrical motor control panels, electrical equipment support, electrical control workstations and displays, servers, EDS machines and ETDs.
 - 2.) Drawings with the appropriate level of detail, as noted in the contract documents, shall be provided for any equipment designed and manufactured for this project.
 - 3.) Detailed drawings are required for all BHS equipment framing, supports, hangers, and other required supports.
 - 4.) Detailed drawing indicating locations and type of safety signage.
4. BHS Electrical Drawing Submittal Requirements
- a. General
- 1.) Each BHS device or conveyor and related control and power devices that appear on any electrical drawings of the BHS shall be identified with the appropriate I.D., as established in this Specification.
- b. Submit the following types of electrical drawings:
- 1.) Plan view of the BHS noting the identity and location of each control device, control station, motor, limit switches, safety disconnect switches, and the like as related to each BHS device of the system.
 - 2.) Layout of MCP or any related control devices or indicating lamps.



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- 3.) Submit all power requirements for the subsystems of this project as per the specified submittal schedule. Any discrepancies between the specified maximum allowable electrical loads and Contractor design loads shall be clearly identified in the review submission. The Owner shall retain the right to reject any and all requests for additional power beyond those as indicated in the Contract Documents. System power requirements shall be calculated in accordance with the recommended practice and shall include connected and demand power.
 - 4.) Detailed drawing indicating locations and type of safety signage.
 - 5.) Programmable Logic Controller (PLC) computer control system in block diagram format to include the data communication system showing the connections among all PLC, sortation computers and remote I/O units if utilized.
 - 6.) Motor Manifest indicating type, part number of driven equipment, power in horsepower, full load amperes and speed.
 - 7.) MCP general layout showing enclosure size, type, power requirements, equipment location and enclosed component general arrangement. Include a separate I/O list for each PLC or remote I/O in the panel. Identify I/O assignments with Equipment Item Numbers.
 - 8.) Detailed block diagram representing internal layout of components within each motor control panel.
- c. Submit the following types of control system drawings:
- 1.) Plan view of the BHS noting the identity and location of each control device, control station, motor, limit switches, safety disconnect switches, and the like as related to each BHS device of the system.
 - 2.) Plan view of the BHS noting the identity and location of each motor with power in horsepower. Identify all motors that will have a VFD, clutch/brake or brake. Annotate which motors are controlled by Variable Frequency Drives; indicate the location of the VFD (either at the motor or located in the relevant MCP).
 - 3.) Plan view of the BHS noting the identity of each conveyor with expected speed in feet per minute.
 - 4.) Plan view of the BHS noting the identity of every photocell location annotated whether a tracking or non tracking device
 - 5.) Plan view of the BHS noting the identity of every tracking belt tachometer or shaft mounted encoder.
 - 6.) A set of drawings showing those conveyors that will stop by the activation of each specific Emergency Stop in the system as per the specified submittal schedule. The drawings should indicate (using different colors or hatches) the conveyors of the specific subsystem and any adjacent subsystems that will stop for each emergency stop or group of emergency stops as appropriate. The BHS Contractor should take



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into consideration the following when developing the e-stop zones:

- a.) When splitting up e-stop zones, consideration must be given to the MCP breaks. If the down stream MCP is shut down, upstream bags that are left in the system should be able to divert prior to the equipment that is inoperable.
 - b.) 45-degree merge e-stops should be tied into the receiving or take-away conveyor.
 - d. Submit detailed shop drawings which include all interfaces between systems that are affected by the scope of work and shall include but is not limited to connection details (connector type, communication protocol) software protocol, transmission media, location of connections and any other required information. The types of interfaces include; Message Broker, fire system, EDS systems, Provide an approved 11" x 17" reduced copy of the schematic wiring diagram(s) of each MCP including outline and wiring diagram of all special devices which shall be placed in the door pocket of the MCP.
5. Control System Description Submittal
- a. Submit Control System Description as specified in Part II of this specification.
6. BHS Control Room, Computer and Control System Descriptions
- a. Submit the Computer/Control Room requirements containing all information pertaining to the requirements of the proposed Computer/Control hardware (refer to Part II of these contract documents for full details on the BHS control room requirements), including:
 - 1.) A proposed room layout of new equipment with phasing drawings and final layout drawings showing spatial requirements.
 - 2.) Environmental requirements (temperature and humidity)
 - 3.) Submit HVAC requirements of old equipment versus new equipment
 - 4.) Raised floor for cable access
 - 5.) Fire protection
 - 6.) Electrical and power requirements (e.g., the number and location of UPS electrical sources)
 - 7.) Requirements associated to batteries installed in UPS devices per International Fire Code 608.
- H. Catalog Cuts and Equipment Specifications
1. Submit a catalog cuts manual for all manufactured and purchased items (mechanical, electrical and computer equipment) as per the specified submittal schedule.
 2. The catalog cuts shall be contained in binders of the "presentation" type equipped with "D" rings. Additionally, the binders shall be equipped with a clear spine pocket to permit the insertion of the manual title. The catalog cut manual shall be contained within at least one



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volume of appropriate size and contain the following:

- a. Record of Revisions: A "Record of Revisions" sheet shall be provided at the beginning of the catalog cut manual.
- b. Table of Contents: A Table of Contents shall be provided at the beginning of the catalog cut manual.
- c. Index Tabs: Each catalog cut shall be identified with an index tab with permanently printed information.
3. The catalog cuts must be completely legible and reproducible, directly relevant to the specific items as used in the system. Each individual item shall be clearly indicated by the inclusion of a highlighted/shaded arrow immediately adjacent to the item. Where a variation occurs from the standard component or a special custom ordered part has been used as a replacement for the standard supply, additional details shall be submitted to clarify the identity of the component.
4. The catalog cuts shall include the following items (this list is not to be construed as being complete since it is provided only as a guide):
 - a. Speed reducers
 - b. Motors
 - c. Bearings
 - d. Pulleys and rollers
 - e. Motorized pulleys
 - f. Belting
 - g. Roller chain and sprockets
 - h. Belts and sheaves
 - i. Queue conveyors
 - j. 45 degree merge conveyors
 - k. Power turns
 - l. HSPDs
 - m. Tamper-proof fasteners for safety guards
 - n. Wiring devices (including quick disconnect devices for removable conveyors)
 - o. Control devices
 - p. Soft starts, electronic
 - q. Electric brakes
 - r. Electric clutches



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- s. VFDs
- t. PLC and peripherals
- u. Power regulators
- v. Computer equipment
- w. Video monitors
- x. Flat Plate devices
- y. Directional Input Device (DID) components to include required low coefficient of friction belting at the associated conveyor
- z. Bag Status Display components

I. Operation and Maintenance Manuals

1. Purpose

- a. The prime purpose of the Operation and Maintenance (O & M) Manual is to provide the Owner's operational and maintenance personnel with a thorough understanding of the layout of the system, its function, special features, operational requirements, maintenance requirements, parts information, warranty information, and safety considerations and requirements for operating and maintaining the system safely and effectively.
- b. This specification is intended as a guide to indicate the basic requirements of the O&M Manuals. The Contractors standard O&M Manual shall be acceptable provided it is functionally equivalent to that specified below and the documents are suitable and usable for the intended purpose.
- c. The manual is to be divided into two main sections:
 - 1.) The Operational portion of the manual shall present the information required for personnel to be able to operate the system in a safe and efficient manner. The operational information shall be presented in easy to understand terms to ensure that personnel not familiar with the system will have a thorough understanding of the system upon reading the operational information.
 - 2.) The Maintenance portion of the manual shall present the information required for personnel to be able to maintain the system in a safe and efficient manner. The maintenance information shall be presented in easy to understand terms to ensure that personnel not familiar with the system shall have a thorough understanding of the mechanical and electrical equipment operation and maintenance requirements so that they shall be able to effectively and safely perform maintenance functions such as troubleshooting, servicing, and repairing.

2. Binder Type

- a. Binders shall be of the "presentation" type equipped with "D" rings. Additionally, the



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binders shall be equipped with a clear spine pocket to permit the insertion of the manual title.

- b. Binders shall be of sufficient size (number of pages) to be used by a reader with no difficulty of access. Also the documents as bound within the binder shall not be damaged by lack of free space for movement both during storage and use.
- c. Standard “letter” size format (8.5” x 11”) shall be the basic size parameter for the binder selection.

3. Format

- a. The O & M Manual shall be contained within at least two (2) volumes of appropriate size. Note that additional volumes may be required to accommodate multiple operational or maintenance information chapters.
- b. The title information shall be generally as follows:
 - 1.) First line: Three letter code of the airport in which the system is located (e.g. FAY).
 - 2.) Second line: “Operations Manual” or “Maintenance Manual”
 - 3.) Third line: “For”
 - 4.) Fourth line: Type of system: (such as: Fayetteville Regional Airport Baggage Handling System)
 - 5.) Fifth line: Date of System, as based on actual beneficial use date
 - 6.) Sixth line: Project Number (to be Coordinated with the Owner or their representative)

4. Contents of Manual

- a. Record of Revisions: A "Record of Revisions" sheet shall be provided at the beginning of the O & M Manual.
- b. Table of Contents: A Table of Contents shall be provided at the beginning of the O & M Manual.
- c. Chapter Index Tabs: Each chapter shall be identified with an index tab with permanently printed information.
- d. Chapter Index: Each chapter of the O & M Manual shall begin with an index for the related chapter.

5. Operational Information

- a. Chapter 1 - Glossary of Operational Terms
 - 1.) Chapter 1 shall include a glossary of operational related terms and equipment identification/designations.



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b. Chapter 2 - System Overview

1.) Chapter 2 shall include, at a minimum, the following items:

- a.) A basic overview of the system showing overall layout and arrangement.
- b.) Identify locations, number of and types of inputs.
- c.) Identify locations, number of and type of sort areas (as appropriate).
- d.) Identify system and subsystem conveyor designations.
- e.) Processing rate of each subsystem as well as the total system-processing rate.

c. Chapter 3 - Baggage Weight and Size Limitations

1.) Chapter 3 shall include, at a minimum, the following items:

- a.) Normal Size Baggage
- b.) Baggage that can be processed by system but requires special considerations/handling such as but not limited to skis, and golf bags.
- c.) Fragile Baggage
- d.) Oddsize Baggage

d. Chapter 4 - Detailed Description of System Operation

1.) Chapter 4 shall include, at a minimum, the following items written in a clear concise manner:

- a.) The detailed operational description of system operation must be written to provide operational personnel a thorough understanding of how to operate the system. Operational personnel include:
 - (1.) Sky Caps
 - (2.) Passenger Service Ticket Agents
 - (3.) Service Baggage Handlers
 - (4.) TSA Agents
- b.) The operational information shall cover system start-up, shut down, operational stop/start control stations, Jam Reset and Emergency stop operational requirements.
- c.) The operational information shall also provide a thorough understanding of the system fault annunciation system so that faults can be recognized and appropriate action can be directed.
- d.) The operational information shall provide an operator's troubleshooting guide for the safe and effective correction of operational problems.
- e.) The BHS shall be equipped with sortation controllers, computers and



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workstations; Provide detailed information for the items noted below, affected by the specified requirements of this project (this list is not to be construed as being complete and is provided only as a guide):

- (1.) All operator interface command entries
 - (2.) All operator initiated reports
 - (3.) All system automatically generated reports
 - (4.) All system fault alarm messages and reports
 - (5.) All graphic display information systems
 - (6.) Creation of Flight/Sort Assignment Tables: Specific sortation controller operation
 - (7.) Placing equipment "in" or "out" of service
 - (8.) Bag Status Displays
- f.) The detailing of the above information shall include (but not be limited to):
- (1.) Thorough explanation and purpose of the command message or report.
 - (2.) Required keyboard or operator response.
 - (3.) Explanation of expected system response
- g.) The operator's information must also include procedures and recommendations for alternative modes of system operation as may be required due to various equipment or subsystem failures.

e. Chapter 5 - Operational Safety

- 1.) Chapter 5 must provide safety information related to the proper and safe operation of the specified system and its equipment from an operator's point of view and at a minimum must cover the following items (this list is not to be construed as being complete since it is provided only as a guide):
 - a.) Pre-operating procedure
 - b.) Start-up and Shut-down Procedure
 - c.) Emergency Stop and Restart Procedure
 - d.) Jam Detection, Jam Clearance and Restart Procedure
 - e.) Equipment Lockout/Tag-out Procedures (the procedure shall reflect/refer to the most current OSHA, ANSI and Local Code, Policies and Standards)

6. Maintenance Information

- 1.) Chapter 1 - Glossary of Terms and Identification
 - a.) Chapter 1 must include a glossary of all terms and equipment



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identification/designations associated with the specified system. Any industry vernacular, vocabulary, descriptions or definitions necessary for further communication of information shall also be provided.

2.) Chapter 2 - Description of System Equipment

a.) Chapter 2 must include, at a minimum, the following items:

- (1.) Detailed description of the mechanical conveyor equipment used in the system including widths of conveyors, general specifications and capabilities of the system.
- (2.) Detailed description of the electrical equipment used in the system, including the location of motor control panels (MCP(s)), PLC(s), fire/security door(s), sortation controller(s), encoding console(s), workstation(s), and bag status displays.

3.) Chapter 3 - Electrical Control Sequence of Operation

a.) Chapter 3 shall include a detailed description of the electrical control sequence of operation and the proposed locations of related field equipment/components, such as the items listed below. (this list is not to be construed as being complete since it is provided only as a guide):

- (1.) Location and operation of Control Stations
- (2.) Location and operation of Photocells
- (3.) Location and operation of Limit Switches
- (4.) Operation of MCP(s)
- (5.) Operation of PLC(s)
- (6.) Operation of Fire/Security Door(s)

b.) Operation of Sort Controllers

c.) Operation of Bag Status Displays

4.) Chapter 4 - Maintenance Safety Procedures

a.) Chapter 4 must provide safety information related to the proper and safe operation and maintenance of the specified system and its equipment from a maintenance point of view and at a minimum, the following items shall be covered (this list is not to be construed as being complete since it is provided only as a guide):

- (1.) Pre-operating Procedure
- (2.) Start-up and Shut-down Procedure
- (3.) Emergency Stop and Restart



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- (4.) Jam Detection, Jam clearance and Restart Procedure
- (5.) Equipment Lockout/Tag Out Procedure (the procedure must reflect/refer to the most current OSHA, ANSI, and local codes, policies and standards)
- 5.) Chapter 5 - Service, Inspection and Preventive Maintenance
 - a.) Chapter 5 must provide detailed information for the proper servicing of all of the system equipment and at a minimum must cover (this list is not to be construed as being complete since it is provided only as a guide):
 - (1.) A general explanation, regarding what the servicing requirements is for the related system equipment.
 - (2.) Detailed preventive maintenance program outlining required functions and frequencies for the proper preventive maintenance of the components that make up the system equipment items such as belt conveyors, power turns, flat plate devices, slope plate devices, HSPDs, pushers, servers/computers, bag status displays, DIDs, security doors, motor control panels. At a minimum, the following items shall be covered however; this list is not to be construed as being complete since it is provided only as a guide. It shall be noted that the information shall be "brand specific" for the actual equipment provided for this system only. Information for equipment types and brands not provided in this system will not be acceptable.
 - (3.) Inspections for:
 - (a.) Straight Conveyors, Power Turns, Merge Conveyors, Pushers/High Speed Paddle Diverters, and Slope Pallet Devices.
 - (4.) Lubrication of:
 - (a.) Motor Bearings, Pulley Bearings (as required), Drive Chains, Speed Reducers, and Power Turn Perimeter Chains/Guides, and all other items requiring lubrication.
 - (5.) Cleaning of:
 - (a.) Motors, Drive Chains, Speed Reducers, Photocells (and related reflectors), Motor Control Panels, and Servers.
 - (6.) Adjustment of:
 - (a.) Straight Conveyor Belt Tracking, Straight Conveyor Belt Tensioning, Power Turn Conveyor Belt Tracking/Tensioning, Merge Conveyor Belt Tracking/Tensioning, Pushers, Flat Plate Devices, Slope Pallet Devices, Drive V-Belt and Sheave Alignment, Drive V-Belt Tensioning, Drive Chain and Sprocket Alignment, Drive Chain Tensioning, Photocell alignment and sensitivity, Drive Motor Clutches, Drive Motor Brakes, and sensitivity and Limit Switches.



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6.) Chapter 6 - Warranty Information and Procedures

- a.) Chapter 6 shall provide detailed information regarding the specific Warranty Conditions that prevail on the specified system.
- b.) Additionally, the detailed information regarding the system warranty must include the following:
 - (1.) Date of Beginning and Expiration of Warranty Period.
 - (2.) Specific instructions regarding the procedures for the documentation and return of items under warranty.
 - (3.) Provide detailed information regarding the specific warranty conditions that apply to the specified system, assemblies, components and parts
 - (4.) Names and telephone numbers of the "point of contact" for warranty questions and discussions. Note that the "point of contact" information shall be provided for both "normal" 0800 to 1700 Monday through Friday hours as well as "after hours". Direct communication shall be made available 24 hours/day, 7 days/week, 52 weeks/year.

7.) Chapter 7 - Troubleshooting

- a.) Chapter 7 shall provide detailed information for the proper remedial and corrective action required (troubleshooting) for repair of the system equipment malfunctions.
- b.) At a minimum, the following items must be included in a detailed "problem and correction" type of troubleshooting chart (this list is not to be construed as being complete since it is provided only as a guide):
 - (1.) All mechanical equipment
 - (2.) All electrical equipment
 - (3.) All control equipment
 - (4.) All computer equipment
 - (5.) BHS/EDS Interfaces
 - (6.) BHS/Airport Systems Interfaces
- c.) The troubleshooting information provided in the chart is to cover an exhaustive list of possible causes of system failure or malfunction.
- d.) A procedural approach should be used in the documentation to allow service personnel to resolve problems. This method shall emulate the actual problem as well as provide the related solution. Information should be provided to assist in discernment of cause and effect issue as well as find solutions through cross referencing.



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- e.) The information is to be arranged in a three (3) - column format with respective headings of:
 - (1.) Trouble
 - (2.) Probable Cause
 - (3.) Corrective Action.
 - f.) Empirical Readings: This chapter shall include the Empirical Readings, as noted in "Testing and Acceptance" section of this Specification that were recorded at the time of the Conditional Acceptance Testing and Inspection of the system. This information is to be provided as a maintenance reference.
- 8.) Chapter 8 - Removal and Installation Procedures
- a.) Chapter 8 shall provide detailed information for the proper removal and installation of all of the system equipment components.
 - b.) It must be noted that the information shall be "brand specific" for the actual equipment/components provided for this system only. Information for equipment/components types and brands not provided in this system will not be acceptable.
 - c.) At a minimum, the following items shall be included in this chapter (this list is not to be construed as being complete since it is provided only as a guide):
 - (1.) Basic Considerations
 - (2.) Safety Precautions
 - (3.) Procedural Orientation
 - (4.) List of special tools, gauges and equipment required for the maintenance of the system, together with illustrations and instructions as to how they are to be used. Sources for procurement of these items shall also be provided.
 - (5.) Torque Values
 - (6.) V-Belt Tension Procedures and Values
 - (7.) Drive Chain Tension Procedures and Values
 - d.) Component List (this list is not to be construed as being complete since it is provided only as a guide):
 - (1.) All the components for straight conveyors.
 - (2.) All the components for power turn conveyors.
 - (3.) All the components for merge conveyors
 - (4.) All the components for queue conveyors



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- (5.) All the components for flat plate make up
- (6.) All the components for Bag Status Displays
- (7.) All the components for workstations
- (8.) All the components for sortation controllers
- (9.) All the components for HSPDs/pushers/diverters.
- (10.) All the components for DIDs
- (11.) All the components for MCPs

9.) Chapter 9 - Illustrated Parts Information

- a.) Chapter 9 must contain detailed illustrated parts information. The illustrated parts information shall be provided for all systems, assemblies, subassemblies, components and parts, including but not limited to all mechanical, electrical, workstation, computer, bag status displays, and other necessary equipment.
- b.) Clear, concise exploded view isometric drawings showing the parts, the relationship of adjacent parts with one another within a given conveyor equipment assembly as well as the diagram number that shall reference the specific part on the adjacent parts information sheet.
- c.) The parts information sheet shall be adjacent to the isometric drawing and shall contain:
 - (1.) Part reference number from isometric drawing
 - (2.) Part description
 - (3.) Part Number
 - (4.) Manufacturer of part
 - (5.) Number of parts found in the conveyor equipment isometric drawings
- d.) Provide the above information in a manner so that the isometric drawing (up to 11" x 17" that can be folded up) shall be on the left hand side of the open manual with the associated parts information sheet as the right hand page of the open manual.
- e.) Include model and serial numbers for all special equipment such as power turn conveyors, HSPDs, and the like. All parts shall be referenced to a "next-higher-assembly" level within the drawing hierarchy. The system of referencing shall allow the reader to follow assembly / disassembly procedures in a methodical and orderly manner throughout the documentation.

10.) Chapter 10 - Manufacturer's Literature

- a.) Chapter 10 shall provide all of the manufacturer's literature for all of the conveyor equipment mechanical, electrical and electronic components.



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- b.) Information shall be "brand specific" for the actual equipment/components provided for this system only. Information for equipment/components types and brands not provided in this system will not be acceptable.
- c.) Unless unavailable, the actual original manufacturers literature shall be provided. At a minimum, only a first copy of a manufacturer's original literature will be accepted if the actual original manufacturer's literature cannot be provided.
- d.) All such copies shall be clear and legible.
- e.) All manufacturers' literature shall be appropriately highlighted with a legible solid black arrow for identification of the specific model or type of device used in the specified system.
- f.) All manufacturers' literature shall include information adequate for proper servicing of the item, proper operation of the item as well as all required information for the ordering of the item.
- g.) Complete list of parts manufacturers including address, telephone number and point of contact.

11.)Chapter 11 - Mechanical Drawings

- a.) Chapter 11 shall contain a complete, clear and legible 11" x 17" set of "As-Built" BHS mechanical drawings. Additionally, a PDF copy of these drawings shall also be provided on CD-ROM and inserted into a sleeve pocket within this chapter.
- b.) The 11" x 17" drawings are to be folded so that they will fit within the O & M Manual.

12.)Chapter 12 - Electrical Drawings

- a.) Chapter 12 shall contain:
 - (1.) A complete list and definition of the electrical symbols used in the electrical drawings.
 - (2.) A complete, clear and legible 11" x 17" set of "As-Built" BHS electrical drawings. Additionally, a PDF copy of these drawings shall also be provided on CD-ROM and inserted into a sleeve pocket within this chapter. The As-built drawings shall contain as a minimum the following:
 - (a.) Detailed wiring connection drawing noting each control device, control station, motor, and all other controls devices, in block form with a detail of the actual "field wiring" numbers and configuration.
 - (b.) Detailed conduit routing diagram indicating size of conduit, size and number of conductors, junction boxes, control devices, motors, safety disconnect switches, and motor control panels.



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(c.) Detailed block diagram representing internal layout of components within each motor control panel.

(d.) Schematic Wiring Diagram of each MCP, including outline and wiring diagram of all special devices. An additional approved 11" x 17" reduced copy shall be placed in the door pocket of the MCP.

(3.) The 11" x 17" drawings are to be folded so that they will fit within the O & M Manual.

13.) Chapter 13 - PLC Listings

a.) Chapter 13 shall include a complete, clear and legible set of "As-Built" BHS PLC listings. The listing shall include the following:

(1.) Complete set of PLC program ladder logic diagrams as well as PLC and Sortation controller listings for the related system.

(2.) A complete Sequence of Operation shall be included on the schematic diagrams or the PLC ladder logic diagrams.

(3.) PLC ladder logic diagrams shall have detailed "right hand" margin descriptors clearly identifying the function of each device and its associated contact rung locations.

(4.) Include a separate I/O list for each PLC or remote I/O in the panel. Identify I/O assignments with Equipment Item Numbers.

7. Draft O & M Manuals

a. Submit two (2) sets of a draft Operations and Maintenance Manual for review and approval to the Owner or their representative prior to Start-up of the system(s).

8. Final O & M Manuals

a. Three Sets of the Final O & M Manuals shall be presented to the Owner in accordance with the submittal schedule. Timely submittal of a system's O & M Manual is absolutely essential to the proper operation and maintenance of the BHS.

b. All six sets of the O & M Manuals must be updated by supplement to reflect any Field Changes, equipment changes due to warranty changes, and any other changes., that were made during the Warranty Period of the System, so that all sets of manuals shall reflect "As-Built" information.

c. An electronic medium copy of the O & M Manuals shall also be required on CD-ROM at no additional cost to the Owner.

J. Periodic Maintenance Inspection and Lubrication Chart

1. Provide a master chart or series of charts involving periodic maintenance of all equipment items in the system and defining, under equipment item subdivisions, the points and frequency of recommended periodic maintenance functions, including inspection,



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lubrication and replacement.

2. This chart need not detail the procedures involved with such periodic maintenance functions since such procedures will be found in the maintenance manual, but reference shall be made to specific sections or pages therein.

K. Training Program

1. Provide an operational and maintenance training program as specified in Part III of these Specifications.
2. The training program shall be submitted to the Owner or their representative for review and approval prior to the start of System Testing and in accordance with the schedule of submissions.

L. Environmental Requirements

1. Submit any special environmental requirements above and beyond what is shown in these specifications that may be essential for correct equipment operation (e.g., computer hardware, scanner arrays and any other items with special requirements).

M. List of Lubricants

1. Submit a complete list of lubricants to be used on the equipment components. This list shall be standardized on one supplier in order to minimize the number of different lubricants used.

N. Inspection, Functional Specification and Testing Program

1. Submit an Inspection, Functional Specification and Testing Program for the BHS to demonstrate compliance with all specified requirements. Prepare the inspection and test plans based on the information provided in this specification. Meet with the Owner, the TSA and their representatives, at the Airport or other location as requested by the Owner, to review the SSTP and obtain a copy, to ensure the completed CBIS meets all the protocols and requirements contained within, prior to the Pre-TRR with the Owner, the TRR with the TSA's representative (OST) and ISAT with TSA representative (IV&V). The BHS Contractor's test plan submittal shall include the tests that are associated with the SSTP for the TSA's CBIS Performance and Commissioning Requirements, which will include, as a minimum, the tests that are outlined in Part 3 of this specification. This program shall comply with the guidelines presented in the Acceptance and Testing section of Part 4 of these Specifications (34 77 16) as well as in the TSA's PGDS Appendix D and include the required support and participation by the BHS Contractor for the TSA's SAT testing of the EDS machines, separate Pre-TRR, TRR and ISAT, all consistent with the IV&V group's Site Specific Test Plans (SSTP) for the Checked Baggage Inspection Systems Performance & Commissioning Requirements as well as the requirements of the TSA's PGDS.
2. The Functional Specification and Test Program shall identify and demonstrate all System Control Functions relating to the operational, functional and system performance tests. The Functional Specification/Test Plan is to list each Control Station, and Control Device, and its related Control Function that is to be demonstrated/tested. Refer to the Acceptance and



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Testing Section of this specification for detail test plan content requirements.

3. The testing plan shall include testing of all systems integrated with the BHS e.g. fire system, ACAMS, EDS devices and other interfaced devices.
4. The Inspection, Functional Specification and Testing Program shall be submitted for the Owner or their representative's review and approval prior to the start of System Testing in accordance with Schedule of Submissions.

O. Test Reports

1. Submit a report after completion of the internal testing, debugging and system tests performed prior to Acceptance Testing summarizing the detailed results of the tests, to the Owner or their representative prior to requesting final acceptance testing by the Owner or their representative.
2. In addition carry out a "dry test run" of Acceptance Tests prior to conducting such tests with the Owner or their representative to ensure that tests conducted with the Owner or their representative are successful.
3. Provide the Owner or their representative, upon request; the results of all in-plant tests, conducted on assemblies or sub-assemblies of equipment or equipment of like that are to be installed.

P. Certification of Installation Compliance

1. Submit certificates issued by Regulating Authorities (in compliance with work permits (electrical, mechanical, welding, Fire Marshall and other Authorities)), that the equipment has been properly installed, meets all safety standards and is operating within the required accuracy.

Q. Certification of Test Compliance

1. Submit BHS Equipment Supplier's Certification that the system has been tested in compliance with the supplier's requirements for testing and has met all testing requirements.

R. Final Parts List

1. Provide a detailed listing and description of all individual system (subsystem) components with reference to layout and assembly drawings.
2. The listing of system parts shall include the following information:
 - a. Name of part
 - b. Complete description of part
 - c. Each specific location that the listed part is used in the system(s).
 - d. Total number of parts in system(s)
 - e. Manufacturer of part



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- f. Manufacturer's part number
 - g. Source of supply
 - h. Recommended quantity of spares per each item
 - i. Price per unit
 - j. Lead time or availability of part
 - k. Complete list of manufacturers, with addresses, telephone numbers and point of contact.
 - l. Manufacturer's catalog literature and specifications for all purchased parts.
- S. System Power Requirements and MCP Sizes
 - 1. Submit all the motor control panel (MCP) sizes and related power requirements for the all subsystems of this project. The power requirements shall indicate conveyor segment horsepower removed, horsepower added, and the total connected load of the new and existing modified subsystems (horsepower and full load amps).
- T. Estimated Spare Parts List
 - 1. Submit a list of estimated spare parts required for the first year of operation for the Owner or their representative's review and consideration for a budgetary allowance - include unit price per unit for the estimated spare parts list based on reasonable airline market rates. Spare parts may/shall be purchased for each phase prior to the commissioning of that phase. Include recommended inventory and replacement levels for each phase prior to commissioning as well as part description and identification quantities in system, delivery times, manufacturers and suppliers (their part or ordering numbers).
 - 2. Include any special test instruments required for maintenance beyond the normal inventory of a conveyor maintenance shop. Include a device for measuring conveyor speed and shaft rotational speed, a VOM and a clamp-on hand-held Ammeter.
 - 3. Submit a spare parts list in accordance with Schedule of Submissions.
- U. System Reliability Calculations
 - 1. Submit system reliability calculations demonstrating compliance with the "System Reliability" requirements specified herein.
- V. Semi-Monthly Status Reports
 - 1. The BHS Contractor's Project Manager shall submit a Monthly/Weekly Status Report to the Owner or their representative, which shall include schedule updates in accordance with the provisions of the contract terms. The Owner or their representative shall have the right to change the time of submitting and the details of the report. The monthly/weekly status reports shall cover, including but not limited to, the following information:
 - a. Percentage of mechanical, electrical and controls/computer engineering completion, per subsystem.



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- b. Percentage of fabrication completed
- c. Equipment delivery schedule (month look ahead)
- d. Percentage of equipment installed complete:
 - 1.) Mechanical
 - 2.) Electrical
 - 3.) Controls
 - 4.) Computer
- e. Updated detailed Project Schedule.
- f. Task activities planned for the next week/month
- g. BHS Engineering Issues.
- h. Interface Issues including but not limited to the following:
 - 1.) Fire and Security Systems
 - 2.) EDS devices
 - 3.) The Owner's Reservation System
 - 4.) Building Management System
 - 5.) Baggage Reconciliation System
 - 6.) CBRA workstations / Bag Status Displays
 - 7.) PDP and MCP power supply
- i. Right of Way Issues.
- j. Brief description with status of accepted and proposed change orders with associated cost.
- k. Status of payments
- l. Manning by trade.
- m. Percentage of testing completed.
- n. Any other issues.

W. Submittal Log

- 1. Provide a log to the Owner or their representative listing all required project submittals to include, at a minimum, the following information:
 - a. Type of submittal.
 - b. Submittal revision number. (The submittal revision number shall also be clearly identified within the submitted document as well.)



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- c. The date in which the submittal is sent out for review.
 - d. Company or individual the submittal is sent to.
 - e. Date in which the submittal was returned after review has been completed.
 - f. Review status.
 - g. The log entries shall be maintained as current on no less than a weekly basis with submission to the Owner upon request.
- X. Contractor Documentation for the Development of the SSTP by the TSA's IV&V Representative
- 1. Submit the following completed and approved for construction documentation. These documents will be forwarded by the Owner to the TSA's IV&V representative for the development of the SSTP:
 - a. BHS Controls System Descriptions that shall include all subsystem Controls Descriptions of Operation (Detailed Functional Specifications)
 - b. BHS Redundancy schematic diagrams
 - c. E-Stop Zone Drawings
 - d. BHS Mechanical Drawings including Plan and Elevation Views
 - e. Sequenced Implementation Plans with associated Narrative and Drawings
 - f. Construction and Testing Schedule
 - 2. The above referenced documents shall be submitted to the Owner, with accompanying cover letter, stating the purpose of this submittal. All accompanying drawings shall be clearly visible and legible when plotted on "D" size stock. All documents shall be submitted in both hard and soft copies (e.g. text documents in MS Word or PDF format and drawings in AutoCAD [.dwg or .dxf] or PDF format.)

1.06 CONTRACTOR'S QUALITY ASSURANCE GENERAL REQUIREMENTS

A. Laws, Codes, Rules and Regulations

- 1. Comply with applicable Local, State and Federal laws, rules and regulations pertaining to the following:
 - a. Installations, alteration, removal and demolition, including but not limited to the Federal Occupational Safety and Health Act and the Construction Safety Act.
 - b. Protection of the public during installations, alterations, including but not limited to, requirements for safety of operations, noise control, removal and disposal of waste materials, control of dust, dirt, pollutants, flammable materials, explosive materials, corrosive substances, and protection against fire.

B. BHS / CBIS Contractor Qualifications



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1. Authenticate a minimum of five (5) years of demonstrable experience as a turnkey Baggage Handling System Contractor, equipment manufacturer and supplier of automated baggage handling and screening systems, the capability to comply with all stimulus funding, TSA, federal, state and local manufacturing and purchasing requirements and no less than two (2) completed projects that each meet all of the following criteria:
 - a. BHS project value of no less than \$5,000,000 USD (BHS portion only; excluding TSA-provided equipment).
 - b. Provided system that included direct interface with In-Line EDS machines, passed the TSA ISAT testing process, was approved for live operations by TSA and has been successfully operational for no less than one (1) calendar year (without TSA rescinding or degrading its approved status).
 - c. Provided system with controlling PLC systems, baggage tracking and computerized report generation for operational as well as maintenance status and graphic fault annunciation for the automated baggage system.
2. All bidders shall include with their bid, verification that they meet this criteria, a listing and description of previous projects meeting this criteria (no less than two), and contact information for the Owner's use in verification.
 - a. If proposing to team with an approved controls subcontractor (other than the bidder's own company), the qualifying projects must have been performed with the same team being proposed (i.e., provide two qualifying projects that utilized the same prime Contractor and controls subcontractor) or both companies must independently meet all of the requirements (i.e., provide two qualifying projects each).

C. Non-Standard Equipment

1. Any proposed equipment which is appreciably different from items previously fabricated or which has not displayed satisfactory performance in a similar environment for at least one year (for a minimum of 18 hours per day, 7 days per week), shall be so noted in the proposal. As a reference, any of the following components that do not meet the requirements listed in the previous sentence shall be considered non-standard:
 - a. Directional Input Devices (DIDs)
 - b. CBIS Equipment Installation and Related interface to DIDs.
2. Prior to the start of fabrication, a prototype of the new item shall be built and test data shall be presented showing that the item has successfully performed the equivalent of one full year of operation. The Owner or their representative shall be invited to witness the test and review the test data at no additional cost to the Owner.
3. The testing requirements and demonstration will identify such requirements as follows:
 - a. Number of hours of run time
 - b. Number of test cycles



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- c. Processing rates
- d. Mean time between failures
- e. Repair time, serviceability
- 4. The Owner or their representative must approve the design before the final design and fabrication, provided that the BHS is produced by a firm with at least 3 years of experience in manufacturing and installing such systems comparable to that required under this contract. The Owner or their representative must approve the use of firms with less than 3 years' experience.
- 5. In lieu of developing a prototype, arrangements may be made for the Owner or their representative to inspect an existing component in operation at an airport at no additional cost to the Owner.

1.07 PROJECT CONDITIONS

A. General

- 1. The Owner or their representative does not guarantee the accuracy or the completeness of the information relating to the new or existing utility services, facilities, or structures that may be shown on the drawings or encountered in the work. Any inaccuracy or omission in such information shall not relieve the responsibility to protect such existing features from damage or unscheduled interruption of operations and services.
- 2. Prior to commencing the work in the general vicinity of an existing system, utility service or facility, notify the Owner or their representative 72 hours in advance and obtain approval before proceeding with the work.
- 3. Failure to give the 72-hour notice shall be cause for the Owner or their representative to suspend the BHS Contractor's operations in the general vicinity of the System, utility service or facility.
- 4. Should damage to or unscheduled interruption of airline operations, utility service or airline facility occur by accident or otherwise, the BHS Contractor shall notify the Owner or their representative and take all reasonable measures to prevent further damage or interruption of service. In such events, cooperate with the utility service, Owner until such damage has been repaired and service restored to the complete satisfaction of the utility service or the Owner.
- 5. Coordinate all building modifications performed by any trade to accommodate the installation of the BHS.

B. Installation Conditions

- 1. This BHS is to be installed within an existing Airport Terminal working simultaneously with other trades.
- 2. The BHS Contractor shall visit the site to familiarize himself with the site conditions and to understand local conditions that may affect the project before submitting his bid



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proposal. Where possible the BHS Contractor shall familiarize himself on the availability of temporary access, temporary lighting and power, telephone services, storage facilities, water supply, waste disposal facilities, labor supply, weather conditions, parking of vehicles, loading and unloading of materials, and equipment. In particular, he shall take into account in his bid proposal any effect that any adjacent construction, operations and maintenance works may have on the BHS installation. The BHS Contractor shall ascertain for himself and allow in his bid proposal for all necessary precaution and for any difficulties that may arise in the execution of the BHS Contract. No claims whatsoever arising out of the site constraints, difficulties of access, temporary services and facilities, labor, and any other charges will be entertained by the Owner.

C. Ramp Area Proximity

1. The portions of the construction/installation associated with this project shall take place immediately adjacent to an active aircraft ramp area and airline operations area.

D. Lay-down Area Restrictions

1. Lay-down and shake out areas may be limited to the confines of the immediate building. All Lay-Down areas shall be designated and approved by the Owner or their representative.
2. Refer to the Architectural Contract drawings for preliminary lay down areas that could be utilized by the BHS Contractor. Coordinate usage of lay-down areas with the General Contractor.

E. Restoration of Service Costs

1. Incur all restoration of service costs due to the negligent or accidental damage of any airport utility service or facility. The Owner reserves the right to deduct such costs from any monies due, or which may become due, from the BHS Contractor, or its surety.

F. Right-of-Ways

1. It is acknowledged by all parties that the BHS Contractor has first priorities to the right-of-ways available and/as provided by others. Cooperate with other contractors for coordination of all building right-of-ways performed by other trades to accommodate the installation of the BHS.
2. In addition, the BHS Contractor shall preserve all right-of-ways for deferred equipment depicted on the Contract Drawings.

1.08 PROTECTION OF THE WORK

A. General

1. Make such explorations and probes as are necessary to ascertain any required protective measures before proceeding with installation. Give particular attention to equipment supports and bracing requirements so as to prevent any damage to BHS equipment.
2. Provide, erect and maintain catch platforms, dust partitions, lights, barriers, warning signs and other items as required for proper protection of operating personnel, the public,



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occupants of building, workmen engaged in installation and adjacent construction. Comply with the requirements and restrictions of the Contract Drawings.

3. Do not store or place materials in passageways, stairs or other means of egress. Do not close or obstruct walkways, passageways, stairways, streets, walks, terminals, runways, rights-of-way, or other occupied or used facilities without written permission from the Owner or their representative. Conduct operations with minimum traffic interference.
4. Utilize suitable coverings to protect existing work. Be responsible for any damage to the existing BHS and facilities or other contents by reason of the insufficiency of protection provided. Promptly repair damage caused to adjacent facilities and restore as new.
5. Repair any damage to work in place. This includes repair of both new and existing fireproofing materials removed to allow the installation of BHS structural attachment supports, header steel, and any other BHS equipment.

1.09 SYSTEM DESIGN AND PERFORMANCE REQUIREMENTS

A. General

1. All equipment shall be in strict accordance with the specifications described herein. It should be noted and stressed that the system shall be engineered, fabricated and installed with the objective of being of rugged, heavy duty, impact resistant equipment capable of withstanding the abuse and exposure to damage experienced in an air transportation baggage handling facility. Other key factors to be considered in the development of the system and its elements shall be simplicity, reliability, maintainability, and safety.
2. The BHS Contractor is deemed to have studied the system design and requirements presented in the drawings and specification respectively and accepted the design and requirements as suitable and appropriate to safely accomplish the functions and processes described herein. Identify in the bid submission any design aspect or specification requirement that is believed to be inappropriate or inadequate and shall propose alternate solutions to alleviate the perceived problem but shall, in all cases, include in the bid submittal pricing for the base system presented in the drawings. Any alternate designs developed by the BHS Contractor must meet or exceed the design criteria as listed in the specifications.
3. Consideration shall be given to the design, fabrication and installation of all projections, welds, and transfer points between conveyor segments and conveyor items to eliminate damage to the various types of baggage processed.
4. The system and subsystem layout configuration and item/component functional requirements are specifically described on the contract drawings. However, alternate solutions, may be proposed on an optional bid cost basis for consideration by the Owner. Any alternate designs developed by the BHS Contractor shall meet or exceed the design criteria as listed in the specifications.

B. Material and Equipment Approvals

1. Where manufacturer's name, brand or trademark is specified, it has been selected to



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establish a standard of quality for the materials, components or equipment required. Materials, components or equipment of different manufacture considered to be equal to the materials, components or equipment specified will receive full consideration and shall be subject to approval by the Owner or their representative before being incorporated into the work. The contract price shall in all instances be based only upon materials, components or equipment specified. A list of material, component or equipment suppliers shall be submitted to the Owner or their representative for approval. Provide a listing of sources where any material, component or equipment, for which a substitution approval is being requested, can be obtained.

2. Furnish all engineering data, engineering/shop drawings, literature, test results, calculations, and any other requested information, for review of substituted material, components or equipment. The BHS Contractor shall pay for any redesign necessary to accommodate an “approved equal”.

C. Request for Deviations from Drawings or Specifications

1. Requests for deviations from drawing or specification requirements may be approved at the discretion of the Owner or their representative to permit use of standards inherent in the equipment when it has been determined by the Owner or their representative that such deviations will in no way be detrimental to the conveyor equipment, the safety, operation and maintenance of the specified system, system design, system reliability and its associated inventory of spare parts.
2. Any materials, components or equipment submitted for substitution for this BHS shall be previously proven under the loads as specified in Part I of this Specification in an operational or test equivalent environment for a minimum of 1 year, 18 hours per day, 7 days per week.

D. Baggage Conveyors

1. Conveyor Loads

a. Design the conveyors and their supports using the following loading criteria:

- 1.) The live and dead static load imposed on the building (composed of the conveyor components, supports and baggage) used for designing structural elements, rollers and pulleys shall be 100 pounds per linear foot except for merges and conveyors designated as Oddsize Conveyors, in which case it shall be 150 pounds per linear foot.
- 2.) All conveyor equipment shall be capable of supporting a single concentrated static load of 250 pounds.
- 3.) The live dynamic load to be utilized for sizing drives, belts, bearings, and other components, shall be 60 pounds per linear foot for load, unload and accumulating conveyors operating up to a speed of 120 feet per minute. For all other conveyors (e.g. transport, or sortation) it shall be 40 pounds per linear foot operating at a conveyor speed of 90 feet per minute and a throughput of 25 bags per minute



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adjusted proportional to speed and throughput. As an example, a sort line traveling at 360 feet per minute and rated at 60 bags per minute would have to be rated at 24 pounds per linear foot for load testing. The following formula shall be utilized to determine the test ballast for the purpose of load testing and preparation of related test plans during the BHS acceptance period:

- 4.) Formula: $40 \text{ lbs per Linear Foot} \times (90 \text{ FPM} / \text{actual conveyor speed}) \times (\text{throughput rate} / 25 \text{ bags/min}) = \text{xx lbs per linear foot}$

2. Conveyor Dimensions

- All equipment shall be of U.S dimensions. (Insert Metric dimensions if other than US project)
- Unless otherwise specified on drawings, construct conveyors to the following dimensions:

Conveyor Type	Overall Width	Between Guide Width	Belt Width
Standard Conveyor and Power Turns	42"	39"	36"

Note: 1. Standard Power Turn Inside Radius shall be 4' 0".

3. Conveyor Side Guard Heights

- Refer to Part II of this specification for side guard heights.

4. Conveyor Speeds

- Unless otherwise specified, conveyors speeds shall be selected by the following criteria:

Type/Location	Speed (Feet/Min)
Public Area Load Conveyors	90
Flat Plate / /Make Up Devices	90
Non-Public Load / Unload Conveyors	120
CBRA Area Load / Unload Conveyors	90
Transport to EDS	90 **

** As required by the applicable EDS device manufacturer. Refer to Part II of the project specification for details.

b. Speed Changes

- Make speed changes between adjacent conveyors to increase or decrease a maximum speed (nominally 30 feet per minute) so as not to adversely affect baggage spacing or tracking. Conveyor speed changes between adjacent conveyor segments shall be set that the specified positive bag tracking requirements are not



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compromised.

- 2.) Feed conveyor speed onto the related make-up device will not be greater than 120 feet per minute, unless otherwise specified.

E. System Processing Rates

1. Unless otherwise specified, System Processing Rate shall be:

Conveyor Type	Minimum Processing Rate
Ticket Counter Lines (Each Subsystem)	25 bags per minute
EDS Device	220 bags per hour
Transport to EDS	As required by EDS device manufacturer in order to satisfy TSA processing requirements.

2. The design of the system shall ensure the following:

- a. EDS machine throughput shall be measured at the point or points where bags are returned from the TSA screening system to the existing BHS outbound system.
- b. All “Non-Cleared” bags shall arrive at the CBRA, and that the Error Rate shall be:
 - 1.) Less than (<) 2% - if the Re-insertion belt/line is provided
 - a.) $\text{Error Rate} = ((\text{Total Bags at Reconciliation}) - (\text{“Non-Cleared Bags” with valid tracking IDs})) / (\text{Total Bags Inducted})$.
- c. 1% or less of total bags Jam in the Checked Baggage Inspections System as measured in a 24 hour period. No more than three (3) bags (real or virtual) will be involved in any given bag jam event.
- d. Fail-Safe features activate on all mis-diverted bags but activation rate is less than 0.5% of total bags.
- e. Note: Throughput rates shall not be less than the above referenced amounts unless pre-approved by the Owner, the TSA or their representatives.

F. Baggage Characteristics

- a. Design the BHS to convey standard airline baggage tubs and to process baggage having the following characteristics:
- b. Size of Single Piece

Conveyor Type	Length	Width	Height
Standard Conveyor Maximum	54"	33"	34"
Standard Conveyor Minimum	12"	12"	4"
CT-80 DR Maximum	47"	31.5"	25"



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Note 1: Average bag length for the purpose of rate testing shall be 28". The system shall be capable of accommodating 42" bag lengths without compromising the baggage-processing rate. The standard outbound conveyors shall also be capable of accommodating 54" bag lengths at lower processing rates. The specified dimensions for the standard baggage sizes are intended to provide the maximum individual dimension for each of the three magnitudes indicated, and not to exceed the maximum baggage weight. For any given length or width dimension, the baggage conveying surface area must not exceed 12 ft². For example:

- (1.) Given a 54" max length dimension, the width must not exceed 32" wide.
- (2.) Given a 33" max width dimension, the length must not exceed 52" long.
- (3.) Weight of Single Piece

Conveyor Type	Weight
Standard Conveyor Maximum	120 lbs.
Standard Conveyor Minimum	1 lb.

c. Shape

- 1.) At least one flat conveyable surface. Baggage meeting the above size limitation but lacking a flat conveyable surface (such as baby carriages, round duffle bags, and the like) shall be processed in standard airline tubs.
- 2.) Design system to accommodate 90% of the baggage normally encountered with or without the use of standard airline tubs, including but not limited to, golf bags.

d. Surface Material

- 1.) Complete spectrum of package materials found in air transport baggage, including paper, cardboard, cloth/canvas, plastic, leather, wood, and metals in the following conditions:
 - a.) Dry to Wet
 - b.) With/Without:
 - (1.) Paper/cloth/plastic tape/wrapping
 - (2.) Plastic/steel bands
 - (3.) Fiber cord
 - (4.) Twine
 - (5.) Wheels
 - (6.) Straps

G. Physical Constraints



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1. Design the BHS to accommodate the following physical constraints imposed on the System by either operational or facility considerations:
 - a. All conveyors, supports and related components (unless shown as floor supported, within the confines of protective guard rails, or within a confined and protected space) shall have a minimum underside clearance of 8'-0" from the bottom of the support structure to the floor, unless otherwise specifically noted on the Contract Drawings.
 - b. Minimum clearance on all conveyors from the top of the conveyor belt to the underside of any obstruction shall be 36 inches, unless otherwise specifically noted on the Contract Drawings.
 - c. All inclined and declined conveyors shall have the following:
 - 1.) A maximum slope of 18° for non-tracking conveyors
 - 2.) A nominal slope of 15° for non-tracking conveyors
 - 3.) 12° slop for CBIS tracked conveyors unless otherwise indicated on contract drawings
 - 4.) In all cases, where space permits a shallower angle, the Contractor shall minimize the slope utilizing the least possible incline/decline angle to achieve the proper elevation change.
 - d. All inclined or declined spiral power turns shall have a maximum elevation change of 1 foot in rise or fall per 45° of turn.
 - e. If any of these design criteria cannot be maintained, notify the Owner or their representative in writing for resolution.

H. Vibration

1. Provide shaft mounted components (pulleys, sprockets, and other shaft mounted components) and other components subjected to vibration with some means of preventing loosening of the component such as snap rings, cotter pins, or other methods approved by the Owner or their representative.
2. Mount all conveyors on vibration isolation pads or hangars except those components supported from a ground floor slab or other structural floor whose characteristics prevent vibration from the conveyors from being transmitted to adjacent structure(s) or perceived surrounding area.
3. Vibration isolation devices shall be determined based on individual support loads, vibration frequency and vibration amplitude so that appropriate vibration isolation is proved.
4. Provide vibration isolation devices that prevent perceivable vibration from being transmitted to the surrounding building structure.
5. Ensure that all National, State, and Local codes for seismic requirements are met for the project.



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I. Balancing

1. Dynamically balance all rollers and pulleys.

J. Service Conditions

1. Design each element to operate satisfactorily in its respective environment as follows:
 - a. Mechanical - Indoor (Bagroom Environment)
 - 1.) Temperature: 32° to 120° F (0° to 48°C)
 - 2.) Relative Humidity: 5% to 99% Non-condensing
 - 3.) Protected from direct exposure to weather
 - b. Electrical/Electronic Equipment Inside Control Panels
 - 1.) Temperature: 32° to 140° F (0° to 60°C)
 - 2.) Relative Humidity: 5% to 99% Non-condensing
 - c. Electrical/Electronic Equipment - Indoor (Bagroom Environment)
 - 1.) Temperature: 32° to 120° F (0° to 48°C)
 - 2.) Relative Humidity: 5% to 99% Non-condensing
 - 3.) Protected from direct exposure to weather
 - d. Mechanical - Outdoor or in Unheated Enclosures
 - 1.) Temperature: -20° to 120° F (-30° to 48° C)
 - 2.) Relative Humidity: 5% to 100% condensing
 - 3.) Covered but not protected from driving rain.
 - e. Electrical/Electronic Equipment - Outdoor or in Unheated Enclosures
 - 1.) Temperature: -20° to 120° F (-30° to 48°C)
 - 2.) Relative Humidity: 5% to 100% condensing
 - 3.) Covered but not protected from driving rain.
 - f. Electrical Equipment Inside Computer/Control Room
 - 1.) Temperature: 55° to 80° Fahrenheit (13° to 27° Celsius)
 - 2.) Relative Humidity: 5% to 50% Non-condensing
2. During construction if sealed office area is not available for the BHS related computer equipment, a filtered air environment area should be provided (by others).
3. Provide and clearly identify any special environmental requirements more stringent than what is shown in these specifications that may be essential for correct equipment operation (e.g., computer hardware, scanner arrays, and any other components with special



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environmental requirements).

4. The above listed requirements do not take into consideration separate requirements that may be required for any related non-BHS equipment that may be provided and installed by others (such as but not limited to EDS devices and EDS workstations) or personnel that may drive environmental requirements in various areas where BHS equipment also exists.

K. System Safety

1. Design, manufacture, supply, install and construct the BHS in accordance with all of the requirements in the Contract Documents, and shall meet or exceed all applicable laws rules, orders, regulations and codes. In this regard, the BHS Contractor shall be responsible throughout this Contract to bring to the attention of the Owner or their representative in writing any changes in such laws, rules, orders, regulations and codes and any condition(s), whether caused by its design or any BHS Contract requirements, which the BHS Contractor believes may result in or has resulted in an unsafe condition(s). Rectify at the BHS Contractor's own cost any such condition(s) resulting from its design and not directly as a result of any Contract requirement(s). Where the Owner and the BHS Contractor mutually determine that such condition(s) is directly a result of any Contract requirement(s) or any changes in laws, rules, orders, regulations and codes, then the Owner and the BHS Contractor shall seek a mutual resolution of the condition(s) to be effected by a Change to the Contract.
2. Utilize control methods and techniques, circuitry, mechanical and electrical equipment and operating/maintenance procedures to provide maximum safety for operation and maintenance personnel and to minimize potential damage to the equipment and to the baggage being processed. Incorporate fail-safe techniques to prevent the occurrence of unsafe conditions, which could result from an equipment failure or improper implementation of the operating procedures.
3. As employed herein, the failsafe principle shall be interpreted as follows: In the event an equipment failure or external influence such as improper operation, high temperature, power failure, or other adverse condition affects the proper function of a system or element involved with the safety of life or health, said system or element shall revert to a state known to be safe to all personnel interfacing with the equipment.
4. Ensure that all provided and installed equipment meets all applicable local, state and federal safety codes, including applicable OSHA standards and requirements, for baggage handling systems/conveyors and industrial machinery environments.

L. Personnel Safety

1. The operation of the system shall be convenient and safe to use, and control functions to be performed shall be simple to minimize possible errors. The BHS Contractor shall provide convenient means for emergency system shutdown.
2. Provide adequate means for ensuring the safety of all personnel who have access to the system in the system design.



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3. Provide sufficient safety signage throughout the system.
4. Provide lockable devices such as disconnect switches and lockouts to prevent the accidental activation of those portions of the system shut down for maintenance. These devices shall be located in all areas.
5. Provide equipment and component guards on all drives for conveyors and sortation devices. House all moving parts in personnel areas with guards (such as bearings, return rollers, and return conveyor belts).
6. Provide sufficient work space in all limited access areas
7. Provide audible and visual warning signals along all areas of the system to make apparent any potential hazards to the public, operating and maintenance personnel resulting from moving or about-to-start equipment.
8. Provide protection from falling objects in work areas or aisles located beneath overhead portions of the system with gap pans or netting.
9. Locate conduits and all other electrical components where they shall not be subject to damage by maintenance or operational personnel.
10. Coordinate access provisions for operators so as to minimize obstructions. Locations of control stations and electrical boxes shall be coordinated to support unrestricted access by staff. The provisions of the conveyor supports, drive configurations, personnel guarding and side guards shall allow for maximum operator accessibility.

M. Noise Levels

1. Design, fabricate and install the BHS to limit combined equipment and controlled ambient noise levels to the following allowable maximum requirements. However, the BHS equipment shall not increase the ambient noise level by more than 15 dB (A). In any case, ambient noise levels for the BHS equipment shall not exceed OSHA standards.
2. Design, fabricate and install the BHS to limit combined equipment and controlled ambient noise levels to the following allowable maximums

Noise Level	Ambient
45 dB (A)	In adjacent or nearby office areas (measured at the center of room at a height of 5'-0" above the floor).
65 dB (A)	In public areas, or ceiling above public areas and offices (measured at a number of positions normally occupied by passengers, public and staff).
75 dB (A)	In bagroom and all other associated non-public areas or unoccupied areas.

3. To accommodate noise levels of 65 dB (A) or less (in areas such as the CBRA, OSR room or public areas), the BHS Contractor shall consider the following items for conveyor segments installed in these spaces to minimize noise levels:



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- a. Use low noise PVC belting.
 - b. Use either shaft mounted drives or underslung drives with toothed belts (no chain drives).
 - c. Mount all safety guards with rubber isolation washers between fasteners and the conveyor frame.
 - d. Use bolted return rollers (i.e., no spring loaded return rollers). The use of UHMWPE polyethylene washers shall be placed between the rollers and mounting brackets to reduce side play and noise caused by side play. Provide high quality low noise bearings.
 - e. VFDs shall not be set with a maximum output frequency of greater than 72 Hz. This is to limit the amount of noise generated and difficulties stopping with output frequencies set beyond this limit. Set the VFD carrier frequency as to not increase the motor audible noise level.
 - f. Use vulcanized spliced belting in areas that require reduced noise levels. The conveyor must facilitate the replacement of a clipper lacing for repair/replacement of damaged conveyor belt.
 - g. Add a fire retardant sound damping material to the inside of under guarding to reduce sound levels.
4. Unless otherwise specified the measurements shall be taken at a maximum distance of 5 feet vertically and 5 feet horizontally from noise producing components.
 5. The noise level measurement shall be accomplished utilizing an integrating sound level meter supplied by the BHS Contractor. A qualified person employed by the BHS Contractor shall accomplish measurements and evaluation. The BHS Contractor shall provide a certificate of calibration to the Owner or their representative.
 6. The noise level shall be the Equivalent Continuous Sound Pressure Level measured over a period of one minute or more at each location. In addition, to the overall A-weighted noise level, the Equivalent Continuous Sound Pressure Level shall be measured for each octave frequency band from 125 Hz to 4000 Hz.
 7. Conveyor noise shall not be unduly impulsive. Observing the difference, between the measured Equivalent Continuous Sound Pressure Level and the instantaneous sound pressure level, shall test the impulsiveness of the noise. A component shall be considered unduly impulsive if the differences exceed 3 dB (A).
 8. Conveyor noise shall not be unduly tonal. Tonality shall be determined by observing the difference in level between any A-weighted octave band and each of its adjacent A-weighted octave bands. The sum of the differences shall not exceed 6 dB (A). All octave bands from 125 Hz to 4000 Hz shall comply with this requirement.
 9. Every conveyor component shall be tested. The components shall be tested at full design speed under load conditions.
 10. Where conveyors are located in the ceiling spaces of non-bagroom areas, the noise



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measurements shall be taken after the architectural ceilings are in place.

11. Noise level measurements shall be taken during non-operational hours to ensure passenger conversations or movements do not unduly increase the ambient noise levels in public areas.
12. Measurements shall be taken during a time when the ambient noise levels are at least 6 dB (A) below the conveyor noise level. The ambient noise level shall be determined both before and after the measurement of the components. The ambient noise level shall be determined as follows:
 - a. The BHS equipment shall be turned off.
 - b. All other equipment (i.e., air-conditioning and heating equipment) shall be on and outside noise sources (from aircraft and mobile ground equipment) shall be as normal.
 - c. Noise level readings shall be taken throughout a zone 5 ft vertically and 5 ft horizontally from the BHS equipment using an integrated sound level meter set to the A-weighted network.
 - d. After the ambient noise level has been determined, the BHS equipment shall be turned on and the total noise level shall be measured at the same points throughout the zone that the ambient levels were measured.
13. The BHS Contractor shall provide a written report to the Owner or their representative detailing the results of the noise level measurements.

N. Radio Frequency Interference/ Electro Magnetic Interference (RFI/EMI)

1. Ensure by design and shielding that system equipment shall not create electromagnetic emissions, which can, in any way, cause interference with communications within the airport or between the airport and aircraft or ground support vehicles.
2. Choose all electrical and electronic equipment (including computer and related equipment) to operate without malfunction in the presence of normal electromagnetic emissions generated by other equipment normally installed or used at the airport including but not limited to the aircraft communications bands, high-power radar systems, various electrical motors and controls, power tools, welding equipment, automotive vehicles, ground power units and air handling units. Provide isolation transformers and line suppression units, if required.
3. Radio frequencies, if used for communications or information transmission within the systems, shall be applied for to the relevant Airport and Government Authorities for their designation and assignment.

O. Maintainability, Life & Reliability

1. The requirements set forth in this section are minimum requirements and do not relieve the obligation to provide a system in which all required maintenance tasks can be readily performed.



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2. Design all components so they can be easily disconnected and removed from the equipment without the necessity for extensive disassembly. Design the components for removal and replacement by two (2) staff in a period not to exceed two (2) hours. Be prepared to demonstrate that any maintenance task, not so listed, can be accomplished as described above. Correct any installation, without charge, as required to accomplish this demonstration.
 3. Design the system so that equipment components requiring inspection and servicing are readily accessible. Provide suitable doors for this purpose. Where necessary, provide access holes in frames or guards but keep them to a minimum number and size, and ensure that they do not create protrusions or discontinuities detrimental to the baggage being conveyed.
 4. Design equipment to facilitate maintenance functions in preference to ease of fabrication.
 5. Design equipment such that, whenever possible, assemblies shall not require dismantling in order to troubleshoot, repair or replace assemblies or components of assemblies involved in such servicing procedures.
 6. Affix cover plate attachment hardware to, or hold captive in, the cover plate assemblies.
 7. Provide all electric assemblies, panels, or boxes with the appropriate schematic, enclosed in a clear-faced envelope affixed in a location visible to personnel while servicing such items.
 8. Provide one set of special test instruments and tools for each group of equipment items requiring such special test instruments and tools. These shall be provided in a metal toolbox with identification of the equipment for which the tools shall be used.
 9. Provide a device for measuring conveyor speed and shaft/pulley rotational speed prior to commencement of Acceptance Testing for use by the Owner or their representative, during the Acceptance Testing period.
 10. Provide fixed or mobile ladders, service platforms, lifting lugs or other applicable provisions to ensure easy access to components requiring servicing, either as shown on the specification drawings or as required to assure a safe and efficient system for all personnel who operate, maintain or have access to it.
- P. Standard/Interchangeable Components
1. Minimize the number of different types and makes of components used in the BHS to simplify spare part inventory.
 2. Design all equipment and components to definite standard dimensions, tolerances, and clearances to provide maximum inter-changeability.
 3. Provide like types of equipment from the same manufacturer wherever practicable.
- Q. Lifespan
1. Provide equipment components and items for a system equipment life of a minimum of 15



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years and an operating duty cycle of 18 hours a day, 365 days per year. This provision is a design objective, not a warranty.

2. It is understood that PC based computer equipment may not have the identical hardware available for the full 15 year period (PLC equipment does not fall under this category), as such the BHS Contractor shall submit a list of the estimated spare parts required to maintain the PC based computer hardware for the 15 years of operation for the Owner or their representative review and consideration for a budgetary allowance - include unit price per unit for the estimated spare parts list based on reasonable airline market rates.

R. System Reliability

1. Reliability requirements of the total BHS shall be measured in terms of "System Availability" (A_s).
2. Failure
 - a. A failure is defined as any malfunction of a System component, assembly, or subassembly which stops normal operations. A failure shall be charged against only the one subsystem, which causes that failure. The following shall not be classified as failures:
 - 1.) Malfunctions caused by a failure on the Owner's part (after system acceptance) to properly maintain and operate the System in accordance with recommended procedures.
 - 2.) Malfunctions due to causes outside the System such as but not limited to sabotage or general power outage.
 - 3.) Malfunctions due to baggage jams not caused by failure of a system component, assembly or subassembly unless it is a defective part, a poor installation, or a failure of a component or subassembly to perform its intended function.
 - 4.) Incipient failures, which are detected and repaired without affecting normal operation of the System.
 - 5.) Malfunction of one of a redundant Computer/PLC pair where the repair time does not affect normal operation of the system. However, reliability of redundant computer pairs is defined elsewhere in this specification.
3. Sub-System Availability (A_s)
 - a. Sub-System Availability (A_s) shall be defined by the following equation:

$$A_s = \frac{(ST - RT)}{ST}$$

ST = Scheduled Operating Time: The scheduled time that the BHS is available for baggage processing (normally 18 hours per day).

RT = Repair Time: The interval of time between initiation of repairs due to a failure and return of the BHS to operation.



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- b. Each subsystem of the BHS shall have an availability of not less than 0.995 (99.5%) to be calculated on a monthly basis. However, the maximum allowable downtime in a single operating day shall be no more than 15 minutes on one subsystem; additionally the accumulative downtime for all subsystems shall not exceed 20 minutes.
- c. No more than one failure per month of one of the computers, PLCs, workstations and any other control equipment within of any slave/master pair shall be acceptable.

S. Parts Availability

- 1. Maintain, for immediate delivery, an adequate inventory of spare parts (especially long lead time items) required for routine maintenance of the system. Ensure that critical spare and replacement parts required by the system are made available for a minimum of a fifteen (15) year operational period through the availability of shop and as-built drawings and through the availability of the actual parts. Additionally, ensure the availability of custom or "special" components.
- 2. If the BHS Contractor fails to make such parts available during the fifteen (15) year operation period or should pricing become unreasonably high on a competitive basis, the Owner has the right to permit the use of the project drawings, at their discretion, for fabricating such parts, or having such parts fabricated so as to maintain the specified system.

1.10 STANDARDS AND CONSTRUCTION CODES

A. General

- 1. The design and subsequent installation shall provide adequate safety factors and shall conform to all current standards and codes of the City of Fayetteville, NC or the country of design origin, whichever is more stringent.

B. Construction Codes

- 1. In the event no specific local codes or standards can be identified, the Contractor shall comply with the most recent version, applicable provisions and recommendations of the following:
 - a. American Welding Society (AWS)
 - 1.) D-1.1 Welder Qualifications
 - 2.) AWS-C1.1 Recommended Practice for Resistance Welding in Building Construction
 - 3.) AWS-A2.0 Standard Welding Symbols
 - 4.) D-1-0 Standard welding practice in building construction
 - b. American Gear Manufacturers Association Standards (AGMA)
 - 1.) 6009-A00 Practice for Gear Motors
 - 2.) 6035-A02 Practice for Worm Gear Motors



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c. American National Standards Institute (ANSI)

- 1.) A-1264.1 Safety Code for Floor and Wall Openings, Railing, and Toe Boards
- 2.) B-20.1 Safety Code for Conveyors, Cableways, and Related Equipment
- 3.) B-29.10M Transmission Roller Chains and Sprocket Teeth
- 4.) C-33.1 Safety Standard for Flexible Cord and Fixture Wire
- 5.) Z535 Safety Color Code

d. National Bureau of Standards (NBS)

- 1.) Handbook H28 Screw-Thread Standards

e. National Fire Protection Association (NFPA)

- 1.) NFPA No. 70 National Electrical Code Volume 2, National Fire Code
- 2.) NFPA No. 79 Electrical Standards for Industrial Machinery
- 3.) NFPA No. 80 Standard for Fire Doors and Fire Windows

f. NEC National Electrical Code (most current version)

g. Underwriters Laboratories (UL) Standards (Components shall be labeled appropriately)

- 1.) UL 508 Industrial Controls Equipment
- 2.) UL 508A Industrial Control Panels
- 3.) UL 508C Power Conversion Equipment
- 4.) UL 1998 Software in Programming Components
- 5.) IEC 61508 Functional Safety Standard for Electrical/Electronic/Programmable Electronic (E/E/PES) Safety Related Systems

h. National Electrical Manufacturers Association Standards (NEMA)

- 1.) ICS Industrial Controls and Systems
- 2.) MG1 Motors and Gear Motors

i. American Society for Testing Materials (ASTM)

- 1.) A-36 Structural Steel
- 2.) A-794 Sheets cold rolled
- 3.) A-659 Sheets & Strip - hot rolled
- 4.) A-307 Fasteners (Bolts)
- 5.) A-563 Fasteners (Nuts)
- 6.) F-844 Fasteners (Washers)



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2. All equipment and accessory items furnished and installed under this Contract shall be governed at all times by applicable provisions of federal laws, including but not limited to the revision of the following in effect as of the Contract date:
 - a. Williams-Steiger Occupational Safety and Health Act (OSHA), of 1970, Public Law 91.596, most current version.
 - b. Occupational Safety and Health Administration (OSHA)
 - 1.) 29 CFR Part 1910 Subpart D (Walking-Working Surfaces)
 - 2.) 29 CFR Part 1910 -211 (Definitions)
 - 3.) 29 CFR Part 1910 – 212 (General Industry Standards and Requirements) for machines
 - 4.) 29 CFR Part 1917.48 (Conveyors)
 - 5.) 29 CFR Part 1926.555 (Conveyors, Construction Industry Standards)
 - 6.) 29 CFR Part 1926.1053 (Ladders)
 - c. Office of State Health Planning and Development (OSHDP)
 - d. American Society of Mechanical Engineers (ASME)
 - 1.) ASME B20.1 – 2006 Safety Standards for Conveyors and Related Equipment, and all Addenda up to and including ASME B20.1-2006
 - e. Conveyor Equipment Manufacturers Association (CEMA)
 - 1.) ANSI/CEMA 402-2003 Belt Conveyors
 - 2.) ANSI/CEMA B105.1-2003 Specifications for Welded Steel Conveyor Pulleys with Compression-type Hubs

1.11 WARRANTIES

A. General Warranty

1. Warrant any new BHS equipment for one (1) year against defective parts and labor beginning on the Final Acceptance Date as related to this Project.
2. Warrant all new BHS equipment for three (3) years against design defects beginning on the Final Acceptance Date as related to this Project.
3. Warrant all new BHS software, high level and low level controls for three (3) years against design defects beginning on the Final Acceptance Date as related to this Project.
4. Assign the Owner all warranties for all materials and equipment received from Subcontractors and Suppliers.
5. The BHS Contractor shall not warrant and shall not be liable for design or throughput capability of the relocated/refurbished equipment (e.g., existing conveyor segments



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upstream and downstream of the new conveyor segments associated with the modified lines).

6. Considering the construction program for this project is specified to be performed under a Sequenced Implementation Process, where existing subsystems and related conveyor equipment will either be removed from service, modified, reconfigured or tied-in with new conveyor lines that will be installed and turned over for operational use on an Activity-By-Activity basis, the warranty for the BHS shall begin as follows:
 - a. Upon the Substantial Completion Date of a given Sequence for all BHS related field components, such as motors, gearboxes, bearings, belting, field control components and MCP control components. Submit a certified warranty statement summarizing the type of warranty coverage with the warranty commencement date for that given Sequence and outlining the BHS equipment that has been substantially completed and turned over for operational use.
 - b. Upon the Final Acceptance Date as related to this project for all related BHS Computer Systems and PLC system hardware and software provisions. Submit a certified warranty statement summarizing the type of warranty coverage with the warranty commencement date and an outline of the BHS equipment that will be covered under the warranty.

B. Warranty Exclusion

1. This warranty shall not apply to any defects or inconsistencies, which are attributable to repair, alteration, misuse or abuses by any person other than authorized personnel or Subcontractors. Liability shall be limited to repairing or replacing defective or non-performing part(s) at no cost to the Owner.

C. Warranty Limitation

1. Liability shall be determined in the Contract Agreement and shall also include repairing or replacing defective or non-performing part or parts at no cost to the Owner.

D. Technical Support

1. Provide on-site technical support as defined by the Contract Documents and agreed upon by the Owner or the Engineer. This support shall be by personnel qualified to advise the Owner on training, provisioning, start-up and maintenance of the equipment.
2. The technical representative(s) for warranty support shall be within 6 hours travel distance of Fayetteville Regional Airport, in the City of Fayetteville, State of North Carolina, where the equipment is to be located, as required by the Owner.

E. Royalties and License Fees

1. Pay all royalties and license fees and defend all suits or claims for infringements of any prior or patent rights and save the Owner harmless from liability, expense of loss on account thereof, with respect to any processes, devices, methods, articles, inventions, things or procedures used in the project.



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F. Labor Warranty

1. Warranty support shall be provided as follows:

- a. Provide labor to accomplish any warranty repair work. In the event such labor is not provided in a timely fashion, pay the Owner to accomplish warranty labor repair with its maintenance staff.
- b. The BHS Contractor shall provide labor for work related to design deficiencies.

G. Parts Warranty

1. Terms

- a. Provide a parts warranty which states material and equipment furnished and installed shall be new and free from faults and defects in material, workmanship, detail or incorrect component selection; shall conform to the functional and technical requirements of this Section and Contract Drawings contained herein; shall comply with all laws, statutes, ordinances and codes applicable at the installation site; and shall be suitable for the intended purposes. Excessive wear shall be considered a defect within the provisions hereof.
- b. Parts shall be shipped freight pre-paid to the location specified by the Owner. Failed/malfunctioned parts shall be returned to the BHS Contractor, FOB, within ten (10) days of notification of detection of such failed/malfunctioned parts.

2. Spare Parts

- a. Spare parts for each phase, shall be made available for purchase by the Owner prior to the commissioning of the subsystem. The Owner may, taking the recommendations of the BHS Contractor, purchase such spare parts as it deems necessary, and said parts, shall be stocked on the Airport property. Stock control shall be by the Owner who shall grant reasonable access to the BHS Contractor's warranty service agency during the warranty period. All items withdrawn from stock shall be replaced, regardless of whether the item was purchased by the Owner or the Owner's Maintenance Group directly from the BHS Contractor or from a third party, pursuant to warranty services, within two weeks of such withdrawal.
- b. Ending of the warranty period shall be contingent on the replacement of all stock withdrawn pursuant to warranty services whether the warranty service agency or the Owner accomplished such services. Where the BHS Contractor has cause to believe that an item or items may require stocking pursuant to the terms and conditions of warranty provisions, which item or items the Owner declines to stock, the BHS Contractor shall stock such items separately at no cost to the Owner. In no case shall the absence of appropriate spare parts in the Owner's spare parts stock be construed in any way to abridge or interfere with the responsibilities of the warranty services as defined herein.

H. Design

1. Terms



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- a. Provide a Design Warranty which states that the system, materials, equipment, software and high level and low level controls furnished and installed shall be free from faults and defects in design; shall conform to the functional and technical requirements of this Section and Contract Drawings contained herein; shall comply with all laws, statutes, ordinances and codes applicable at the installation site; and shall be suitable for the intended purposes. Excessive wear shall be considered a defect within the provisions hereof.
2. Design Failure
 - a. In the event a design failure occurs during the warranty period, replace all such components, assemblies or devices utilizing the design in a similar application in which the failure occurs by components, assemblies or devices redesigned to prevent such occurrences at no cost to the Owner. Submit proposed redesign drawings and re-selected component designations to the Owner for their approval. Issue a new warranty period upon the replacement of such redesigned items.
 - b. Components, assemblies or devices shall be considered as design failures if any of the following occurs during the warranty period:
 - 1.) A leakage loss of over 10% of an operating fluid in any hydraulic assembly.
 - 2.) A demand for frequent, unscheduled adjustment or other maintenance action in similar devices.
 - 3.) Failure of a component to perform its specified function or a failure of a component to operate at its specified rate.
 - 4.) Frequent activation of overload protection elements in similar devices.
 - 5.) Loosening of anchoring or attachment provisions on similar devices.
 - 6.) An increasing level of noise being generated by similar devices.
 - 7.) A structural failure due to BHS supports, hangers, or headers.
 - 8.) Inappropriate action of control or sensor elements during operational conditions.
 - 9.) Occurrence of an accident or an imminent safety hazard revealed during operational conditions.
 - 10.) Uncovering of a condition of specification non-compliance or degradation of specified functional requirements during the warranty period.
 - 11.) More than 2 failures on one or more components or assemblies of components of similar construction or design, used in similar devices.
 - 12.) More than 2 unscheduled replacements of an expendable component in similar devices.
 - c. The Owner shall act to resolve any disputes regarding the definition of a design failure in a fair and equitable manner.



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3. Period and Responsibility

- a. If, within three (3) years from the date of Final Acceptance of the work, the work or the system, or any equipment, material or software is found, in any respect, not to conform to the Warranty set forth herein, within forty-eight (48) hours of notification by the Owner, initiate the following series of steps in order to correct the deficiency:
 - 1.) Determine the cause of failure.
 - 2.) Prepare drawings showing recommended design changes and submit to the Owner or their representative.
 - 3.) The Owner or their representative shall comment with a change request or approval.
 - 4.) Make design changes if requested.
 - 5.) After the Owner or their representative has approved the design, all components of the system incorporating the same design deficiency shall be modified as agreed upon by the Owner or their representative.
 - 6.) The Parts Warranty period and the Design Warranty period shall start again for the changed item/system on the date that the design change has been incorporated if the make, manufacture or model is replaced.

END OF PART I -



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PART II - PRODUCT SPECIFICATIONS

2.01 ACCEPTABLE MANUFACTURERS

A. BHS Contractors

1. Subject to compliance with requirements, the following firms are qualified to perform as BHS Contractors for this Project:
 - a. Automatic Systems, Inc., Kansas City, MO
 - b. Diversified Conveyors, Inc., Memphis, TN
 - c. Equipment Erectors, Inc., Somerset, NJ
 - d. Glidepath LLC, Grand Prairie, TX
 - e. Daifuku Airport Technologies, Novi, MI
 - f. Logan Teleflex, Inc., Louisville, KY
 - g. Pteris Global (USA), Inc., Littleton, CO
 - h. Siemens Airport Logistics, DFW Airport, TX
 - i. Five Star Airport Alliance, Salt Lake City, UT
 - j. Vanderlande Industries, Inc., Marietta, GA

B. BHS Controls Subcontractors

1. Subject to compliance with requirements, the following firms are qualified to perform as BHS controls subcontractors for this project:
 - a. Alliant Technologies, Louisville, KY
 - b. Brock Solutions, Kitchener, ON
 - c. Control Touch Systems, Louisville, KY
 - d. Glidepath LLC, Grand Prairie, TX
 - e. Daifuku Airport Technologies, Novi, MI
 - f. Pteris Global (USA), Inc., Littleton, CO
 - g. Siemens Airport Logistics, DFW Airport, TX
 - h. Five Star Airport Alliance, Salt Lake City, UT

C. BHS Equipment

1. In order to establish a minimum standard of quality and reliability, the following manufacturers have been listed for various components of the BHS.
2. This list has been presented to establish this standard and the manufactures on this list shall not be perceived or construed as favored or preferred. This list shall, in no way, preclude other manufacturers, provided that their equipment and components have been reviewed



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by the Owner or their representative and determined to be of equivalent or similar quality, functionality, and reliability. The Owner or their representative's decision in this regard shall be final.

a. For Belting:

- 1.) Ammeraal Beltech
- 2.) B.F. Goodrich
- 3.) Fenner/Dunlop
- 4.) Goodyear Tire and Rubber Co
- 5.) Habasit Belting, LLC
- 6.) Midwest Conveyor Company, Inc. (Ashland Conveyor Products)
- 7.) Morrison Company, Inc.
- 8.) Siegling America, Inc.
- 9.) Sparks Belting Company

b. For Belt Lacing:

- 1.) Clipper Belt Lacer Company

c. For Bearings:

- 1.) Browning (Emerson Power Technologies)
- 2.) Dodge (Baldor Electric Company)
- 3.) Fafnir/The Timken Company
- 4.) Sealmaster/Morse Industrial Corp. (SF, SFT, ST, STH Goldline or Sealmaster Material Handling (MH) Series)
- 5.) SKF Bearing Services Company

d. For Brakes:

- 1.) Dodge ("D" Type) (Baldor Electric Company)
- 2.) Stearns Electric (Rexnord Industries)
- 3.) Warner Electric (Failsafe)

e. For Motorized Pulleys:

- 1.) Rulmeca (Formerly Joki)
- 2.) Van der Graaf (model UMV)

f. For Queue Conveyors:

- 1.) Beumer Glidepath



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- 2.) Daifuku (Webb Design)
- 3.) Diversified Conveyors
- 4.) Equipment Erectors
- 5.) Five Star Airport Alliance
- 6.) Siemens
- 7.) Vanderlande
- g. For Power and Spiral Turns:
 - 1.) Portec, Flo-Master Division
 - 2.) Transnorm (Series TS1500)
 - 3.) PSC Flow-Turn
- h. For Flat Plate Make-Up:
 - 1.) Beumer Glidepath (Glidepath Design)
 - 2.) Daifuku (Webb Design)
 - 3.) Diversified Conveyors
 - 4.) Five Star Airport Alliance
 - 5.) Pteris Global (USA), Inc.
 - 6.) Siemens Airport Logistics
 - 7.) Vanderlande Industries, Inc.
- i. For High Speed Paddle Diverters:
 - 1.) Pteris Global (USA), Inc.,
 - 2.) Siemens Airport Logistics
 - 3.) Vanderlande Industries, Inc.
- j. For Control/Communication Products:
 - 1.) Motor Starters:
 - a.) Allen-Bradley
 - b.) Cutler Hammer
 - c.) Square D (Type S)
 - d.) Telemecanique (TeSYS U-Line Series)
 - 2.) Programmable Logic Controllers (PLCs):
 - a.) Allen-Bradley



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- b.) Siemens
- c.) Telemecanique-Modicon and Quantum series
- 3.) Photoelectric Controls:
 - a.) Allen Bradley
 - b.) Banner Engineering Corp
 - c.) Cutler Hammer
- 4.) Variable Frequency Drives (VFD):
 - a.) ABB (Model ACS 350)
 - b.) Allen Bradley/Rockwell Automation
 - c.) SEW Eurodrive
 - d.) Telemecanique (Altivar Series)
- k. For Motor Control Panels (MCP Cabinets):
 - 1.) EMF Company, Inc
 - 2.) Hoffman Engineering Co.
- l. For Motors:
 - 1.) Baldor
 - 2.) LeRoy Somers (Part of Emerson Motor Technologies)
 - 3.) Reliance Electric (Part of Baldor Electric Company)
 - 4.) SEW Eurodrive
 - 5.) U.S. Motors (Part of Emerson Motor Technologies)
- m. For Reducers (shaft mounted):
 - 1.) Browning (Part of Emerson Power Transmission)
 - 2.) Dodge ("TXT" ABHS Series) (Part of Baldor Electric Company)
 - 3.) Link Belt, Inc.
 - 4.) SEW Eurodrive
 - 5.) Sumitomo
- n. For Reducers (foot-mounted or base-plate mounted):
 - 1.) Link Belt, Inc
 - 2.) Reliance Electric (in-line, helical gear type) (Part of Baldor Electric Company)
 - 3.) SEW Eurodrive



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- 4.) Sumitomo
- 5.) Emerson Power Transmission
- o. For Roller Chains:
 - 1.) Acme
 - 2.) Diamond Chain Company
 - 3.) Dodge
 - 4.) Morse Industrial (part of Bearing Distributors, Inc)
- p. For Rollers and Pulleys:
 - 1.) Precision, Inc
 - 2.) The Chantland Company
- q. For Signaling Devices (audible alarms):
 - 1.) Allen Bradley
 - 2.) Edwards Co. Signaling Products Div.
 - 3.) Federal Signal Corporation
 - 4.) Mallory Company
- r. For Signaling Devices (visual alarms):
 - 1.) Allen Bradley
 - 2.) Cooper Crouse-Hinds
 - 3.) Federal Signal Corporation
- s. For Uninterrupted Power Supply (UPS):
 - 1.) APC
 - 2.) Eaton Powerware
 - 3.) Leibert (Part of Emerson Network Power)
- t. For Draft Curtains:
 - 1.) TRAX Industrial Products
- u. For Powered Security Doors:
 - 1.) Raynor
 - 2.) The Cookson Company
 - 3.) Vigneaux Corporation
- v. For Soft Start Devices:



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- 1.) Allen-Bradley
- 2.) Nordic
- 3.) Reuland Electric
- w. For Power Regulators:
 - 1.) Sola/Hevi-Duty Electric

2.02 MATERIALS

A. General

1. All welding and qualification of welders shall comply with AWS D1.1.
2. All fasteners shall be zinc-plated, cadmium plated or stainless steel. All fasteners shall be locked with lock nuts or lock washers.
3. Use of alternate materials
 - a. Whenever an article or any class of articles, devices or material are specified by the trade name or by the name of any particular patentee, manufacturer, or dealer, or by reference to the catalog of any such patentee, manufacturer or dealer, it shall be taken to mean and specify the articles, devices or materials specified and none other.
 - b. If the BHS Contractor desires to use any articles or materials which he believes are equal in quality, finish and durability, and equally as suitable for the purpose for which intended as the particular articles, devices or materials specified, he shall indicate his desire to the Owner or their representative in writing.
 - c. The articles, devices and materials specified shall not be changed except with the written consent of the Owner or their representative, and the BHS Contractor shall not contract, purchase or cause to be delivered any substitute articles, devices or materials prior to obtaining such consent.

B. Material

1. Structural Steel: ASTM A-36
2. Stainless Steel (Trim): AISC Type 304 with #4 Brush Finish
3. Plywood (FR-S Rated Fire retardant): Interior Type A requirements in AWP Standard C-27.
4. Lumber (FR-S Rated Fire retardant): Interior Type A requirements in AWP Standard C-20
5. Rubber/Neoprene: ASTM D-2000

2.03 FABRICATION

A. General

1. Fabricate equipment-using steel clean and free from rust, rust pits, kinks and sharp bends.



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Use forming methods that will not fracture or otherwise damage the metal. Remove burrs, sharp edges, and sharp corners. Smooth all joints and round all corners. Align joints in components to ensure smooth conveyance of baggage.

2. Holes in metal side guards for photocell beams are to be "punched", not burned, and tapered from the inside (wide) to the outside (narrow).
3. When two sections of conveyor bed meet, these joints shall be chamfered to ensure that there is no step-up condition between bed sections.

2.04 BELT CONVEYORS

A. Belting

1. General

- a. All conveyor belting shall be flame retardant according to ISO 340, DIN 22103, ASTM D-378 and NFT-47108 or equal.
- b. Belt widths shall be 3" less than the between frame (guard) dimension unless otherwise specified. Belt edges must be sealed after being cut to width.
- c. Ensure that no belt slippage occurs in order to meet all tracking performance requirements specified herein.
- d. The actual length of belting installed on each unit shall be included on the system's drawings and in the spare parts list.
- e. All belting shall have a minimum acceptable working tension of 100 pounds per inch of belt.
- f. The BHS Contractor shall ensure all ratings for proposed belting designated for exterior use exceed the local environmental weather conditions.
- g. The BHS Contractor shall submit cut sheets for all types of belting being proposed for this project for review and approval by the Owner or their representative.

2. Conveyors

- a. For level, general purpose baggage handling applications such as load, unload transport and inclines/declines of 7° or less use two ply urethane impregnate, solid woven fabric polyester or bare by bare (if not exposed to the public), top face of 0.02" PVC, smooth (public areas), maximum coefficient of friction of 0.3 with elongation of 1% maximum rated tension. For load conveyors provide belting that is flat lying, roll resistant and cut/wear resistant.
- b. For incline and decline conveyors of greater than 7° use 0.08" PVC two ply urethane impregnate, solid woven fabric polyester or bare by bare, rough top, maximum coefficient of friction of 0.25 with elongation of 1% maximum rated tension.
- c. For incline and decline conveyors or other locations where bag slippage may occur, the use of longitudinal rough top belt may be used. Habasit Trackmate, model 135 LR



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(or approved equivalent), shall be used.

3. Power Turns: Provide belts for power turns suitable for the application, as provided by the power turn manufacturer.
4. Spiral Turns: Provide belts for spiral turns suitable for the application, as provided by the spiral turn manufacturer.
5. HSPDs: Provide belts for HSPDs suitable for the application as provided by the HSPD manufacturer.

B. Belt Splicing

1. Lacing

- a. All belt lacing (except for power turns) shall be of the Clipper “Unibar” type with a minimum #2 hook-type of the size recommended by the belt manufacturer for the belt being used. When cutting belts for proper length, sufficient material shall be allowed for take-up pulleys to be at a maximum of one-half the take-up distance with the belt running.
- b. Belt lacing for power turns shall be of the Clipper type with either #1 or #1A hook-type of the size recommended by the belt manufacturer for the belt being used or as recommended by the power turn manufacturer. When sizing belts for proper length, sufficient material shall be allowed for take-up pulleys to be at a maximum of one-half the take-up distance with the belt running.
- c. Belting and related hardware must be trimmed in a 1" deep “V” notch fashion, lacing connecting pin must be either enlarged by heating lacing connecting pin nylon jacket or bent 90° to prevent lateral movement of the pin.
- d. Belt lacing for applications in 45° merge conveyors shall be of the Clipper brand type of fastener.
- e. Belt lacing connecting pins for the Clipper type-lacing materials shall be of the nylon covered steel cable type of appropriate diameter for the lacing hooks being used.
- f. All rough top belting to be ground smooth within 1" of the cut end to allow proper seating of the belt lacing

2. Vulcanization

- a. The option to vulcanize all belting material instead of utilizing belt lacing must be approved by the Owner or their representative.
- b. All belts shall be supplied as endless, hot-overlap finger splice joints, as per the manufacturer’s requirements. Provisions shall be made within the conveyor frame and side guard’s to allow for future repair due to belt failure. For this purpose, removable side guards shall be provided at an appropriate location to allow for on-site positioning of a hot splice machine.
- c. For power turns, new belting will be spliced prior to installation and installed as per



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manufacture's recommendations.

- d. Provisions must be made to ensure future accessibility of the appropriate power requirements unique to the vulcanizer.
- e. If the Owner approves the use of vulcanization, supply a hot splice machine for the Owner's Maintenance personnel's use at substantial completion of the project.

C. Pulleys

1. General

- a. All shafts shall be designed to CEMA standard No. 402-1992 and all subsequent revisions. Shafts are to be AISI 1018 steel, polished and ground and within tolerances for the associated bearings.
- b. All pulleys are to be dynamically balanced. Rollers of eccentric material, such as standard pipe, are to be dynamically balanced.

c. Run-out:

- 1.) The maximum shaft run-out of all assembled pulleys, shafts and bearings under a no-load condition, measured from the centerline of the bearing to the end of the related shaft furthestmost from the conveyor, shall not exceed .0075" per inch.
- 2.) The maximum run-out of any pulley shell shall not exceed .060".

d. Machining:

1.) Swaged:

- a.) Pulleys shall be 10-gauge (minimum) thickness with 3/8" (minimum) thick end plates.
- b.) End pulleys are to be swaged between centers to create a trapezoidal face with a taper from the pulley end to a minimum 25% of the pulley length thereby having 50% of the pulley flat in the center.

2.) Machined:

- a.) If end pulleys are machined (not swaged) using Schedule 40 pipe, center plates must be made from 1/2" thick steel plate and shall have bored centers to facilitate a slip fit on the shaft.
- b.) Pulleys are to be turned between centers to create the crown or trapezoidal. Pulleys shall be crowned from each outer end to within 1/2" of the centerline leaving 1" straight but turned true to standard thickness required for each pulley application. When welding is involved, turn the assembly after welding to true the weldment and create the crown/trapezoidal.
- c.) The recommended minimum wall thickness after crowning or trapezoidal shall be as follows:



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Pulley Diameter	Minimum Wall Thickness
8-5/8"	5/32"
12-3/4"	7/32"
16"	11/32"
18"	11/32"

- e. Hub plates shall be made from 3/8" (minimum) thick steel plate turned and bored to fit on the shaft or have a taper locking hub arrangement welded in the end plate.
 - f. All pulleys shall be manufactured for high-speed application.
 - g. All bearings shall be supplied pre-lubricated and sealed for life with plugs inserted into the grease fitting bore. Bearings are to be secured to their respective shafts with an approved form (as specified in the submittal procedure) of eccentric or squeeze locking type collar arrangement.
2. Powered Pulleys
- a. Drive pulleys
 - 1.) All drive pulleys for intermediate-type drives shall be lagged with vulcanized lagging of 70 Durometer rating with a minimum thickness of 3/8". Lagging material on individual pulleys shall be compatible with the type of belting used on the associated conveyor. Examples of lagging material are as follows:
 - a.) Minimum 70 durometer carboxiled nitrile
 - b.) Minimum 70 durometer thermo-set urethane
 - 2.) Powered pulleys shall be steel, crown faced, flat faced, or trapezoidal (per the belting manufacturer's recommendation), shall be equipped with taper-lock type hubs with 1-7/16" minimum diameter shafts mounted in eccentric locking-type or squeeze locking type precision and ground flange-type ball-bearing units.
 - 3.) The minimum acceptable belt wrap on drive pulleys shall be 210°.
 - 4.) Drive pulleys for end-type drives must be lagged with a minimum 3/8" thick vulcanized lagging of 70 durometer, again using lagging material compatible with the type of belting used on the associated conveyor. In addition, powered pulleys shall be 6" with taper lock hubs with 1-7/16" minimum diameter 1018 TGP (turned, ground and polished) steel shafts mounted in eccentric locking type precision and ground flange ball bearing units.
 - 5.) Drive pulley and shaft sizes shall be determined by maximum belt pull. The following are provided as examples:
 - a.) Light-Duty: 250 lb. maximum belt pull. Consists of a 6-3/4" minimum diameter drive pulley with a 1-7/16" minimum diameter shaft. Bearings mounted with two bolts can be used with light duty applications.
 - b.) Normal-Duty: 500 lb. maximum belt pull. Consists of an 8-3/4" minimum



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diameter drive pulley with a 1-11/16" minimum diameter shaft. Roller chain, if used, shall not be less than RC - 60. Bearings mounted with two bolts can be used with normal duty applications.

- c.) Intermediate-Duty: 1000 lb. maximum belt pull. Consists of a 10-3/4" minimum diameter drive pulley with a 1-15/16" minimum diameter shaft. Roller chain, if used, shall not be less than RC - 60. Bearings mounted with four bolts are to be used with intermediate duty applications.
- d.) Heavy-duty: 1,500 lb. maximum belt pull. Consists of a 12-3/4" minimum diameter drive pulley with a 2-7/16" minimum diameter shaft. Roller chain, if used, shall not be less than RC - 80. Bearings mounted with four bolts are to be used with heavy-duty applications.

b. Motorized Pulleys

- 1.) The reduction gears and motors associated with power driven pulleys shall be mounted in an oil bath for lubrication and heat dissipation. The design of the pulley shall permit the lubrication oil level to be checked without dismounting or removing the drum motor from the conveyor frame. The lubricant shall be rated for 10,000 hours of life. Gears shall be hardened and ground steel alloy.
- 2.) In addition, drums shall be machine crowned and lagged to facilitate belt tracking. Lagging material on individual motorized pulleys shall be compatible with the type of belting used on the associated conveyor.
- 3.) Power: The power supply shall be connected directly to the starter without the use of slip rings and brushes. The terminal board housing (if used) must be capable of being rotated 180° to facilitate the direction of cable inlet.

3. Non-Powered Pulleys

a. Snub Pulleys

- 1.) Snub pulleys are to be installed on all conveyors at all points where the slack portion (non-load carrying portion) of the conveyor belt makes a change in vertical or horizontal direction. At a minimum, such points of vertical or horizontal change shall include:
 - a.) Points immediately adjacent to head, tail, take up and drive pulleys.
 - b.) Points on the underside of any conveyor where the belt bends vertically or horizontally (nose-over sections).
- 2.) All snub rolls shall be a minimum of 4" in diameter and equipped with fixed (welded) 1-7/16" minimum diameter shafts mounted in eccentric locking-type or squeeze lock type precision and ground flange-type ball-bearing units.
- 3.) Bearings are to be secured to their respective shafts with an approved form (as specified in the submittal procedure) of eccentric or squeeze locking type collar arrangement.



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- 4.) All snub rollers used for belt tracking shall be equipped with jacking bolts to facilitate adjustment. Jacking bolts must be equipped with jam nuts to prevent the jacking bolts from loosening.

b. Take-Up Pulleys

- 1.) All take-up pulleys shall be steel, crown faced, flat faced, or trapezoidal (per the belting manufacturer's recommendation), and at a minimum 4" in diameter. Take-up pulleys are to be equipped with taper-lock type hubs or squeeze lock type and 1-7/16" minimum diameter shafts mounted in eccentric locking-type precision and ground flange-type ball-bearing units. Pulleys must be mounted on threaded take-up devices with steel guides and have a minimum allowable adjustment of 10" (6" on conveyors less than 12' in length).
- 2.) All conveyors shall be provided with take-ups for field adjustment of 2% of the conveyor bed length. Take-ups shall be an integral part of the drive frames on all intermediate-drive conveyors.
- 3.) Automatic take-up devices shall be installed:
 - a.) On all conveyor sections in excess of 60' in length
 - b.) On conveyors which operate outside the building or are subject to extreme temperature and humidity changes.
 - c.) In areas where belts are subject to stretch/shrinkage that will cause weekly adjustment.
- 4.) Spring take-ups are not acceptable. Design of the pulleys shall be subject to by the Owner or their representative's approval.
- 5.) Take-ups used in heavy-duty or high-speed applications shall be a minimum of 6" in diameter with a minimum 1-7/16" diameter shaft and shall otherwise comply with the above specifications.
- 6.) Bearings are to be secured to their respective shafts with an approved form (as specified in the submittal procedure) of eccentric or squeeze locking type collar arrangement.
- 7.) All take-up pulley bearing adjusters are to be chain coupled so that both bearings are tightened and slacked in equal increments. All belt lengths shall be adjusted so that the respective take-up pulley adjustments shall permit a further adjustment of 85% before the belt length needs to be shortened. The 15% maximum adjustment of the take-up pulley adjusters shall have been accomplished prior to Acceptance Inspection and Testing.

c. Head and Tail Pulleys

- 1.) All non-powered head and tail pulleys shall be steel, crown-faced or trapezoidal and equipped with taper-lock type hubs. Pulleys shall be equipped with shafts having a minimum diameter of 1-7/16" mounted with eccentric locking-type



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precision and ground flange type ball bearing units. All head and tail pulleys shall be a minimum of 6" in diameter x #10 gauge wall. In addition, all head and tail pulleys shall be of a single-piece construction having steel end discs attached to the rim by continuous welding.

- 2.) Slider beds shall be arranged to minimize the gap between the end section and the end pulley such that the gap does not exceed 1" with a 1/2" design objective.
- 3.) All head and tail pulleys used for belt tracking shall be equipped with jacking bolts to facilitate adjustment. Jacking bolts are to be equipped with jam nuts to prevent the jacking bolts from loosening.
- 4.) Bearings are to be secured to their respective shafts with an approved form (as specified in the submittal procedure) of eccentric or squeeze locking type collar arrangement.
- 5.) Finger Safety Guards:
 - a.) All end pulley rollers in staffed areas (manual encoding, load conveyors (public and non-public areas), sort pier conveyors, or run out conveyors) shall be narrower than the belt width by a distance not less than two times the difference between the belt width and the between-guides width of the conveyor (usually 6 inches).
 - b.) A securely fastened steel finger guard matching the radius of the end roller shall take up the remaining width on each side of the roller. The BHS Contractor shall ensure that the outer surface of the finger guards are smooth and that the junctions between the finger guards and the slider bed and that between the finger guards and the pulley do not subject the belting to any undue damage or wear. Attachment of the finger guards shall be such that the guards will move with the pulley when it is adjusted, therefore ensuring proper alignment.
 - c.) At the tail end of load belts, pulleys shall also be covered with a removable metal shroud located just above, but not in contact with, the conveyor-belt surface. Where exposed to public view, these pulley shrouds shall be constructed of stainless steel matching that used on their respective conveyors (type 304 stainless steel with #4 brushed satin finish, unless otherwise specified).
 - d.) The BHS Contractor shall submit to the Owner or their representative the proposed finger safety guard design for review and approval.

4. Return Rollers/Idlers

- a. Return rollers shall be constructed from 12-gauge steel and must be full-faced with a minimum 2-1/2" diameter equipped with an 1 1/16" hex axle for belt speeds up to 150 fpm and a minimum of 3-1/2" in diameter with a 1 1/16" hex axle for belt speeds above 150 fpm.



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- b. In locations that require a noise level of 65 dB (A) or less, such as the CBRA, use return rollers/idlers with female threaded spindles attached to the conveyor frame and bolted connections. Do not use spring loaded rollers.
 - c. All hex shaft return idler rollers shall be equipped with sealed, permanently lubricated, caged, semi-precision type ball-bearings. Return idlers shall be located on centers not exceeding 10', with spacing being reduced in areas where belting may drag against the floor or conveyor structure. The shafts shall be mounted to the conveyor bed with adjustable retainers for proper belt tracking.
 - d. Provide two return rollers spaced on 5'-0" centers in each 10'-0" intermediate section from which lateral diversion of baggage takes place. Center the return rollers on the associated pusher or diverter.
 - e. Return rollers must not be used at snub points.
 - f. Provide a minimum of one return roller per 10'-0" section. The position of the return rollers shall assure that the return belt is routed and supported so that it does not contact any stiffening members. Mounting for the end of each return roller shall be adjustable for belt tracking.
 - g. For application where conveyors are exposed to inclement weather, provide a minimum of one return roller every 5'-0" on center on load and transfer belts to help the conveyors start when wet or frozen to the bed. The position of the return rollers shall ensure that the return belt is routed and supported so that it does not contact any stiffening members. Mounting for the end of each return roller shall be adjustable for belt tracking.
 - h. Provide return roller finger guards at all possible return roller mounting positions where accessible by personnel.
5. Tapered Rollers
- a. To facilitate changes of direction up to 15°, 5° tapered rollers having a large end diameter not less than 6" with shaft size not less than 1" shall be installed. The number of required rollers is determined by dividing the angle of directional change by 5.
 - b. Tapered rollers are to be slave driven from the powered tail pulley of the adjacent downstream conveyor. The tail pulley used to drive the tapered roller must be lagged. Lagging material on individual pulleys shall be compatible with the type of belting used on the associated conveyor.
 - c. Tapered roller units are to be installed with conveyor underpans and guards as specified elsewhere.
 - d. To minimize the gap between a tapered roller and the adjoining conveyor, ensure the conveyor end roller is extended a minimum of 1/8" beyond the frame.

D. Drive Assemblies

1. Submit to the Owner or their representative for approval a schedule of all drive assemblies



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showing configuration of motor and reducer assembly. The selection of the drive assembly shall be based on efficiency, low noise, sized for the application, achieves long service life and has low maintenance.

2. End-type drive units may be used for conveyors 25' or less in length, with intermediate drives used for conveyors over 25' long.
3. The configuration of the drive assembly motors and reducers shall be based on a direct shaft mounted speed reducer and gear box design to simplify the installation, and maintenance of the equipment, noise levels, and spare parts considerations. The selection of the drive assembly shall be based on efficiency, low noise, sized for the application, achieves long service life and has low maintenance.
4. The use of a non-direct shaft mounted speed reducer and gear box design shall only be permitted in select locations upon the review and approval of the Owner. All non-direct shaft mounted assemblies should be identified on the shop drawing submittals.
5. For non-reversing conveyors, the drive assembly shall be located towards the head end of the conveyor.
6. For reversing conveyors, the drive assembly shall be located as close to the midpoint of the conveyor as possible.
7. Motors:
 - a. The conveyors shall be driven by AC induction motors (except where motorized pulleys are used). The motors shall conform to AIEE, NEC and NEMA standards. These motors shall be equipped with two-groove minimum, taper-lock type hubs, and "A" or 3VX -belt sheaves.
 - b. Motors shall be sized for maximum load and belt speed requirements under continuous operation (minimum of 1 HP unless approved by the Owner or their representative) and, where applicable, shall be capable of withstanding shock caused by frequent starting and stopping under full load conditions. Motor FLA will be measured with full load during load tests and any motor that draws more than the name plate FLA (after start up in rush current has flattened) must be replaced with a motor of appropriate size that will result in no more than the max name plate FLA during load test.
 - c. Motors shall also be of the constant speed (nominally 1800 RPM), continuous service, and ball-bearing type with a minimum of class "F" insulation. For 2hp motors and smaller class "B" insulation shall apply.
 - d. If overrun is critical to system control operation (i.e., wherever baggage tracking is required), motors shall be equipped with automatically applied brakes to prevent overrun after the motors are de-energized.
 - e. With the exception of "High-Slip" design motors, for applications that require dual drives, and motors that are controlled by "VFDs", all of the BHS motors shall be copper-wound NEMA Design "B" open drip proof or TEFC with Class F insulation, utilize a "T-frame" base, and shall be provided with overload protection in the motor



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control panel. These motors shall have a minimum of 1.15-service factor. High-Slip Motors are required by specification where the use of dual drives is used. These motors shall be copper-wound NEMA Design "D", Class "H" Insulation at 1.0 Service Factor with Class "F" temperature limits. Inverter Duty or Inverter Ready Motors shall be used at "VFD" controlled applications. These motors shall be copper-wound NEMA MG1, Part 31 Rated Design "B", Class "H" Insulation at 1.0 Standard Service Factor with Class "H" temperature limits. All motors shall be of the "high efficiency - low energy" type.

- f. All motors shall meet the following criteria:
 - 1.) Low noise
 - 2.) Removable conveyors (e.g. EDS device in feed and exit conveyors) shall be equipped with heavy-duty quick couplings for electrical connections
 - 3.) Fitted with low noise fan reduction guard or equivalent.
 - g. Motor size selection shall be based on the design load and friction coefficient requirements as described in these specifications. Motor size shall not exceed 7½ HP, unless otherwise approved by the Owner or their representative. Use minimum 1 horsepower motors (unless other specified or approved by the Owner or their representative). All drive motors shall be provided in 1, 1½, 2, 3, 5 or 7½ horsepower. Size conveyor equipment drive motors to permit start-up under full load conditions at the specified frequency of start-up cycles per minute without exceeding a temperature rise of 68°C based on an ambient temperature of 40°C. Provide motors designed for 480 VAC, three phase, 60-Hertz operation.
 - h. C-faced motors (with VFD control) can be utilized. Such usage shall be coordinated with the Owner or their representative.
 - i. Motor mounts shall be equivalent in function to Dodge Type "A" slide motor bases with bolt holes drilled and tapped, or tack-welded nuts under the holes in the top portion of the mounting plate. Use of loose nuts to hold the motor mount is unacceptable. Provide jacking bolts to resist effect of belt or chain pull on foot mounted motors.
 - j. On all belts with frequent start/stop operations, such as indexing belts, all motors shall be continuous-running NEMA-B design, coupled with VFD control arrangement.
 - k. In the case where the conveyor line configuration, related controls and baggage input/processing are directly associated with the EDS or is in a tracking zone, the conveyor shall be equipped with a VFD.
8. Reducers
- a. Shaft-mounted reducers shall be attached with tapered type bushings or full length bore with keyway.
 - b. Reducers shall be sized for a Class II application (minimum). Based on actual motor



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horsepower, the service factor required to obtain an L10 life of 70,000 hours shall be as follows:

- 1.) For reducers utilizing ball bearings the service factor used shall be 2.4
 - 2.) For reducers utilizing roller bearings the service factor used shall be 2.2.
 - c. Reducers shall have adequate provisions for drain, fill, inspection ports and sight gauge. The manufacturer's recommended lubrication shall be attached to the reducer by means of a riveted, or bolted stamped metal tag. All units shall be installed with proper lubrication and vent plugs intact upon start-up of conveyor.
 - d. Reducers used on inclines where roll-back would be critical shall be equipped with "backstop" devices or brake motors.
 - e. All bearings within the reducer shall have a minimum L-10 life of 70,000 hours based on service factor and loading of conveyors, and on the manufacturer's published data showing load rating of each bearing used.
9. General Drive Requirements
- a. Where applicable, all gear reducer-mounting frames shall be fabricated from 1/4" thick steel "C" channels. The mounting frame shall be so designed to allow bolting to both the bottom and sides of the conveyor bed. The mounting frame shall be a totally separate weldment that can be unbolted to allow for installation as either a right or left hand drive. The mounting frame shall span the full width of the conveyor bed and attach to both sides of the bed frame.
 - b. Electro-mechanical brakes, if required, shall be internally mounted. The stopping torque shall be at least equal to the starting torque of the motor.
 - c. The drive unit shall be provided with a factory warranty for 2 years or 15,000 operating hours, whichever is longer.
10. Mounting
- a. C-Faced
 - 1.) In-line foot mounted reducer is an acceptable mounting method.
 - 2.) The C-faced configuration with VFD control used on conveyors capable of continuous stop/start operation (i.e. queues or indexing conveyors) shall be capable of a minimum of 60 continuous start/stop operations per minute in an unloaded condition.
 - b. Foot Mounted or Base-Plate Reducer and Motor Mount
 - 1.) The gear reducer shall be mounted on a fully adjustable mount. To allow for fast, easy motor and gear reducer replacement and adjustment, the mount shall be designed as follows:
 - a.) The mount shall be a two-piece assembly:



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- (1.) The bottom portion can be bolted or welded to the mounting frame (as specified above).
 - (2.) The top portion shall be designed to slide over the bottom portion and be adjustable via a single bolt adjustment. The top of the motor mount shall have boltholes drilled and tapped to accept the layout pattern as the gear reducer mounting feet or the multi-mount feet.
 - b.) Use of tack-welded nuts under the holes in the top portion of the mounting plate shall be acceptable in lieu of tapped holes; however, the use of nuts to hold the motor in place shall not be acceptable.
 - c.) The purpose of this design is to allow replacing the motor by using an extension and properly sized socket from above without having to hold locking nuts.
 - d.) Use of Dodge Type "A" Slide Motor Bases is recommended, or an approved equal, for this application.
 - e.) All drive units shall be equipped with a suitable guard of "clamshell" design with tamper-proof fasteners, and fabricated from a minimum of 16-gauge steel. All guards shall comply with applicable OSHA standards and have an expanded metal-screened window to allow belt inspection without removal of the guard.
11. All drive motors and reducers shall be equipped with drip pans. The drip pan shall be constructed out of minimum 14-gauge steel. The drip pan shall be appropriately mounted such that the pan must be secured in the horizontal attitude and shall not impact maintenance access.
 12. Whenever possible, all drive sprockets and V-belt sheaves shall have a taper-lock type of hub construction, with keyways. When keyways are used, they shall be secured by two sets of screws, one on top of the other to ensure positive locking of keyway. Sprockets shall be steel with a minimum of thirteen Type B form teeth.
 13. Driving and driven sheaves shall be (minimum) two-groove "A" or 3VX section sheaves with taper-lock type hubs.
 14. Roller chain shall be compatible with the torque and horsepower requirements of the application and shall be RC-60 minimum size. The roller chain ends shall be connected with a removable connecting link.
 15. All pulley and sprocket adjustments provided for the purpose of adjusting belt tension, belt tracking, drive chain tension, and drive chain alignment shall incorporate a positive means of adjustment and restraint (i.e., tensioning screws and locking nuts). Slotted holes for mounting bolts shall not in themselves be considered satisfactory.
 16. Chain drive sprockets shall be designed for a sprocket ratio between the driven and drive sprockets as close as possible to 2:1, but not less than 1.5:1 or greater than 2.25:1. The maximum size for driven and drive sprockets shall be 35 and 18 tooth respectively.



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Wherever possible within the standard range of stock Taper lock-type sprockets, hardened tooth sprockets shall be provided.

E. Flexible Couplings

1. Mount coupling hubs to their respective shafts with keys and two setscrews, one of which shall be over the key and the other 90° from the key. When keyways are used, they shall be secured by two sets of screws, one on top of the other to ensure positive locking of keyway. The use of a screw-locking compound in lieu of two – (2) setscrews is acceptable.
2. Select the coupling so as to permit the replacement of internal parts without removal of the motor or reducer.

F. Intermediate Sections

1. Provide conveyor frames capable of supporting a uniform load as specified with supports at a maximum center distance of 10'-0".
2. Construct the slider bed shell of 12-gauge minimum hot rolled steel and designed to present a smooth surface to the belt. The slider bed shall be well braced for rigid construction with the side frames a minimum of 6" x 1-1/2" channel or equivalent. A minimum of 1 1/4" x 1-1/4" x 3/16" angle stiffeners shall be welded to the underside of the slider bed at a maximum center distance of 3'-4" on transport conveyors and 2'-6" centers on load conveyors. Butt-coupled joints shall be provided.
3. When two – (2) sections of slider bed meet, both sections shall have chamfered slider bed lips to ensure that there are no step-up conditions between slider beds.

G. Floor Supports

1. Provide floor supports for all conveyors as part of this project. Locate floor supports at intermediate section splices or within 1'-0" of intermediate section splices at 10'-0" maximum spacing.
2. Supports shall be on 5'-0" centers on loading/unloading conveyors and on 10'-0" maximum centers elsewhere. In all cases, each bed joint shall be supported.
3. All floor supports shall be of an "H" type design (i.e. two legs with a horizontal brace member) with vertical field adjustability of +/- 3". Floor support vertical members shall be constructed of 10 gauge, hot rolled formed steel channel with 10 gauge, hot rolled steel universal foot and head plates.
4. All conveyor floor supports shall be secured to the floor with a minimum of two (2) anchoring devices per leg (e.g., stud expansion anchor bolts).
5. All conveyors shall be adequately sway braced in order to ensure that there is no lateral or longitudinal displacement.
6. All support structure must be designed and installed so that maintenance access to the conveyor components and access to catwalk(s), work areas and drive aisles are not blocked.
7. The location of the floor support shall not impede the installation/removal of the conveyor



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gap pans.

H. Safety Guards

1. Provide and install conveyor underpans on conveyors with clear heights between 18" and 7'-6" above the floor or within an envelope around a catwalk defined as 7'-6" high and 4' wide on either side of such catwalk. Fabricate underpans of either solid sheet metal or expanded metal at least 14 gauge thick and fasten to the conveyor intermediate section. The underpans, regardless of type shall be piano-hinged and provided with tamper proof fasteners for easy maintenance access, with appropriate tools; the pin shall have a lanyard attached to reduce potential of losing the pin. Sheet metal screws will not be accepted.
2. Protect all exposed moving parts of conveyors, such as, but not limited to, pulleys, rollers, lower or return belts, shafts and couplings less than 7'-6" above the floor or within an envelope around a catwalk defined as 7'-6" high and 4' wide on either side of such catwalk. The guards shall be made of sheet metal not less than 14 gauge thick, and secured with tamper proof fasteners for easy maintenance access, with appropriate tools.
3. Install appropriate safety guarding secured with tamper-proof fasteners on all exposed parts associated with the conveyor drive's rotating shaft and direct drive gearbox, in compliance with OSHA Standards 1910.219. Ensure that the proposed safety guarding does not restrict maintenance access and it is easily removable with appropriate tools, as the location requires, for maintenance access.
4. Protect all exposed parts of conveyors, such as, but not limited to, pulleys, rollers, lower or return belts, shafts and couplings within the CBRA with a metal shroud on both sides of the conveyor segment(s) to protect the TSA's staff from the exposed moving parts, dampen the noise generated by the conveyor equipment within the CBRA, and to prevent items from falling under the clear and suspect bag conveyors. The guards shall be made of sheet metal not less than 14 gauge thick, and hinged and pinned for easy maintenance access. Fasten with tamper-proof fasteners with captured nuts or similar means of avoiding losing parts.
5. Enclose all drive chains and belts using sheet metal protection covers at least 16 gauge thick. Hinge the covers at one end for ease of maintenance and size the covers with sufficient clearance to prevent contact to chains and belts. Fasten with tamper-proof fasteners with captured nuts or similar means of avoiding losing parts.
6. Eliminate or round unguarded exposed sharp corners and edges of items such as, but not limited to, support legs, braces and trim, to prevent injury to personnel or damage to their clothing. Locate no overhead steel framework, conveyor part, or support structure less than 8' above any catwalk, ramp or stair tread nose. If due to building constraints, support structure is less than 8', the structure, framework, and supports shall be encased in padding, identified with safety marking (yellow/black striped tape) and a prominently positioned low overhead warning sign.
7. Install tamper proof fastened bearing covers on all exposed rotating shafts in workstation areas and in all maintenance areas with catwalks. Workstation areas shall, at a minimum,



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include, sort devices/conveyors, load conveyors, CBRA work areas and EDS work areas. Install appropriate safety guarding on all exposed parts associated with the conveyor drive's rotating shaft and direct drive gearbox, in compliance with OSHA Standards 1910.219. Ensure that the proposed safety guarding does not restrict maintenance access and it is easily removable with appropriate tools, as the location requires, for maintenance access.

8. Install tamper proof fastened finger guards on all Return/Idler Rollers on conveyors not equipped with underpans.
9. For conveyors in areas with a maximum noise level of 65 db (A) or less (such as the CBRAs), mount all guards with rubber isolation washers or strips (as applicable) between sideguards and the conveyor frame to minimize noise levels.
10. Gap pans must be provided and installed on all conveyor-to-conveyor junction points or transfer locations, where there is any likelihood of small objects falling to the floor, mezzanine or catwalk. Gap pans must be solid sheet metal not less than 12 gauge, unless otherwise approved by the Owner or their representative, with minimum 2-inch high sides on the edges. The gap pan must be no wider than the conveyor width and a minimum of 18 inches long. Mounting must be such as to permit easy lowering and removal for cleaning.
11. Drive pans shall be provided and installed on all conveyor drive sections. Drive pans must be solid sheet metal. They shall be no wider than the conveyor and associated catwalk width, and no longer than the drive section.
12. All gearbox assemblies shall be equipped with drip pans. The drip pans shall be fitted with drain plugs to assist with clean up. Drip pans shall be solid sheet metal, not less than 12 gauge, unless otherwise approved by the Owner or their representative, with minimum 3/4" high sides on all four edges. The drip pan shall be a bolt-mounted unit of the gearbox assembly.
13. Provide safety guards and signage adjacent to the pinch points associated to High Speed Paddle Diverters.
14. Breakaway End Cap Safety Guard
 - a. Provide a safe and reliable breakaway end cap safety guard on all run out conveyors that will immediately stop the conveyor and prevent injury to personnel and damage to baggage in the event that a person or part thereof or a bag gets lodged between the conveyor belt and the end cap.
 - b. The design of the end cap safety guard shall not cause undue nuisance alarms during ordinary operation. Activation of the end cap interlock must annunciate an alarm on the Panelview display.
 - c. When resetting the end cap interlock device, the operator must go through the normal subsystem startup procedure following all safety starting procedures.
 - d. Construct the end cap for public areas of stainless steel to match ticket counter stainless steel finish; in all non-public areas, paint the end cap safety yellow to comply with all



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safety requirements.

15. Refer to “Head and Tail Pulleys” section of this specification for details on end pulley finger safety guards.

I. Side Guards

1. Provide side guards the full length of both sides of all conveyors except at points that baggage is loaded or removed.
2. Provide hinged or removable sections only where overhead clearance restricts access for clearing jams. Design hinged or removable side guards to permit rapid removal (removable without tools). The design must preserve rigidity and alignment equivalent to fixed side guards. The Owner or their representative must approve all locations where hinged or removable sections are to be used.
3. Side guards shall be minimum 12-gauge hot rolled steel, integral to the slider bed. Side guards shall incorporate a formed 90° edge turned away from the conveyor and a formed 90° edge turned down to eliminate sharp edges. There shall be no gap between the side guard and bed section that can cause jams or baggage tags to be snagged/ripped off.
4. Use type 304 stainless steel with #4 brushed satin finish uniform throughout passenger areas (such as but not limited to claims, check-in, or curbside) and through penetrations into non-public areas. Stainless steel in public areas shall incorporate smooth flush edge seams. Radius type edges are not acceptable.
5. All stainless steel back guards in public areas such as ticket counter, curbside, and over size load belts shall incorporate stiffening supports that are attached to the conveyor frame by means of a welded or bolted connection. The stiffening supports shall be attached to the stainless back guarding by means of a keyholed slot in the support and a welded stud on the back guarding.
6. Use cold rolled or hot rolled low carbon steel galvanized or hot dip, primed and painted on both surfaces in areas exposed to the weather.
7. Use cold rolled or hot rolled low carbon steel primed and painted on both surfaces in all interior areas.
8. Provide side guards with vertical stiffeners a maximum of 40" on center for transport conveyors and 30" on center for load conveyors. Make the stiffeners from steel angle at least 1-1/4" by 1-1/4" by 3/16".
9. Provide 30° transition panels between side and back guards of different heights.
10. Conveyor Side Guard Heights:
 - a. Unless otherwise specified on drawings, construct conveyor side guards for this project to the following heights:

Conveyor Type	Side Guard Height
Check-in Take-away Back Guards	21"



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Transport Conveyors	12"
Incline/Decline conveyor Side Guards	12"
Decline-fed Power Turns (flat or spiral)	21"
Power Turns (flat)	12"
Power Turns (spiral)	12"
Take Away Conveyor Side Guard directly opposite a pusher/diverter or 45 degree merge	21"
45 Degree Merge Side Guards	12"
EDS Device In-Feed and Exit Conveyor (operator side)	4"

11. Provide holes 1.5" in diameter located either 2.5" or 3" from the top of the belt to the center of the hole through side guides for photocell beams as required. Punch the holes with a dimple away from baggage flow to minimize the possibility of snagging a bag and causing a jam. Deburr all photocell holes so that they are free of sharp edges and burrs.
12. Provide removable side guards at locations where pusher diverters or 45°merges shall be installed at a later date.
13. Mounting of any mechanical or electrical equipment on the outside radius side guard of power turns is not accepted since it restricts maintenance access to the outer perimeter chain or guide bearings of the turn belt.
14. Provide marking of CBIS conveyor sideguards as specified in Part 3 of these specifications.

J. Break-Over

1. Provide break-overs wherever conveyors follow a convex curve.
2. Vertical or horizontal to vertical bends shall be constructed in the same manner as slider bed conveyor sections. The bed shall have a 10'-0" radius break-over slider bed to effect a smooth change in belt direction.
3. For return belt idling, vertical horizontal to vertical bends shall be equipped with a snubber pulley to ensure that the return belt does not extend below the conveyor frame.

K. Bearings

1. All bearings shall be pre-lubricated, self-aligning, anti-friction and sealed for the specified life of the bearing. Lubrication fittings shall be removed (removal to be approved by the Owner or their representative) at the time of installation or at the factory and replaced with appropriate plugs.
2. All bearings shall have a minimum L-10 life of 70,000 hours based on service factor and loading of conveyors, and on the manufacturer's published data showing load rating of each bearing used.
3. All bearings shall be surface-mounted flange bearings attached to the outside of the conveyor bed.



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4. Bearings are to be equipped with an eccentric or squeeze locking type collar arrangement to secure the bearing to the related shaft.
5. All bearings and exposed shaft ends at load conveyors, unload conveyors, ETD work areas and EDS work areas shall be covered with bearing covers.

L. Hardware

1. Provide zinc plated or otherwise treated fasteners. Use washers, lock washers and nuts.
2. All fasteners in public areas are to be made of stainless steel and are described elsewhere in these specifications.

M. Straight Belt Conveyor

1. Construct transport, queue, load, unload, incline and decline conveyors of components as specified previously.
2. Design each baggage handling belt conveyor with a length to width ratio less than 2.5 with special tracking provisions to ensure positive belt tracking.
3. The maximum length of a straight belt conveyor shall be 60' unless otherwise shown in the contract drawings.
4. In the case where the conveyor line configuration, related controls and baggage input/processing are directly associated with the EDS or is in a tracking zone, the conveyor shall be equipped with a VFD.

N. Ticket Counter Take-Away Conveyors

1. The end pulleys of the ticket counter take-away conveyors shall be such that there are no exposed gaps between the pulley and slider bed, nor shall it constrict the continuous gap between the belt edge and the guard (refer to "Head and Tail Pulleys" section of this specification for details on end pulley finger safety guards).
2. Bearings shall be installed on adjustable brackets.
3. Take-up and snub rollers shall be easily accessible and adjustable for belt tracking.
4. Bearings shall be pre-lubricated (grease-packed) and sealed for life.
5. The drive unit shall be of the center drive type.
6. All equipment with exposed surfaces visible to the public shall be covered with type 304 stainless steel with a #4 brushed satin finish uniform throughout, unless otherwise specified by the Architect or the Owner. Stainless steel in public areas shall incorporate smooth flush edge seams. Radius type edges are not acceptable.

O. CBRA Load and Unload Conveyors

1. The end pulleys of the suspect bag queue conveyors and the clear bag conveyors in the CBRAs shall be such that there are no exposed gaps between the pulley and slider bed, nor shall it constrict the continuous gap between the belt edge and the guard (refer to "Head



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and Tail Pulleys” section of this specification for details on end pulley finger safety guards).

2. Bearings shall be installed on adjustable brackets.
3. Take-up and snub rollers shall be easily accessible and adjustable for belt tracking.
4. Bearings shall be pre-lubricated (grease-packed) and sealed for life.
5. The drive unit shall be of the center drive type.
6. All Load and Unload conveyor segments within the CBRAs shall be covered with a painted steel shrouding, uniform throughout on both sides of the conveyor segment. Additionally, on the work aisle sides of the conveyor segments, provide an 8” high x 4” wide toekick throughout the length of the conveyor segment(s), as illustrated in the contract documents. Construct shrouding toekicks with 1/4" x 4" minimum steel flat stock and install so as to leave no gaps and with a ground smooth painted finish similar to the shrouding.
7. Provide a fire retardant sound damping material to the inside face of all conveyor shrouds to reduce sound levels and configure the conveyor segment drive components (e.g. - gear box, motor and the like) for all load and unload conveyors within CBRA to accommodate a 4" wide (max.) shrouding on the operator's side of the conveyor segment.

P. Power Turns

1. All power turns shall be provided with a four (4) foot inside radius for standard conveyors and five (5) foot inside radius for oversize conveyors, unless noted on the contract drawings. All power turn support structures are to be of metal construction. Power turn shafts shall be 1-7/16" diameter 1018 TGP (turned, ground and polished) steel.
2. The conveyor system layout shall be designed to permit maximum radius power turns of 180° for flat power turns.
3. Ensure that the outside circumference side guard shall remain readily removable for maintenance. Ensure that no conduit is fastened to it.
4. To minimize the gap between a power turn and straight conveyor, ensure the end rollers (both power turn and straight conveyor) are extended to gain a maximum gap of 1" between the faces of the belts.
5. Design the power turn conveyor so that trained maintenance personnel can easily replace belts.
6. Belt speed shall be measured on belt centerline.
7. Drive assemblies, bearings, and pulleys shall be designed as per straight conveyors detailed within this section of the specification.
8. If a power turn is installed prior to a 45-degree merge conveyor, the turn shall be equipped with a VFD so that baggage queuing can be achieved on the turn.
9. In the case where the conveyor line configuration, related controls and baggage



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input/processing are directly associated with the EDS or is in a tracking zone, the turn shall be equipped with a VFD.

Q. Spiral Turns

1. All spiral turns shall be provided with a four (4) foot inside radius for standard conveyors and five (5) foot inside radius for oversize conveyors, unless noted on the contract drawings. All spiral turn support structures are to be of metal construction. Spiral turn shafts shall be 1-7/16" diameter 1018 TGP (turned, ground and polished) steel.
2. The conveyor system layout shall be designed to permit maximum radius spiral turns of 225° where the rate of incline or decline is less than or equal to 24" in 90°.
3. Match side guard height with adjacent conveyors where rate of rise or fall is less than 12" per 90°. Provide 21" high side guards for other spiral turns with a greater degree of rise or fall.
4. Ensure that the outside circumference side guard shall remain readily removable for maintenance. Ensure that no conduit is fastened to it.
5. To minimize the gap between the spiral power turn and an adjoining straight conveyor, ensure the end rollers (both spiral power turn and straight conveyor) are extended to gain a maximum gap of 1" between the faces of the belts.
6. Limit rise or fall to a maximum rate of 24" in 90°.
7. Belt speed shall be measured on belt centerline.
8. If an "S" spiral power turn configuration is incorporated in the project design, provide a "gap brush" between the power turns to fill the gap.
9. Design the spiral power turn conveyor so that trained maintenance personnel can easily replace belts.
10. Drive assemblies, bearings, and pulleys shall be designed as per straight conveyors detailed within this section of the specification.
11. In the case where the conveyor line configuration, related controls and baggage input/processing are directly associated with the EDS or is in a tracking zone, the turn shall be equipped with a VFD.

R. Queue Conveyors

1. Provide queue conveyors of the manufacturers approved design capable of sustaining continuous stop/start operation at thirty – (30) cycles per minute under loaded conditions, without compromising a 60 bag per minute minimum processing rate for the associated subsystem in which the queue conveyor is installed.
2. Design the queue conveyors so that trained maintenance personnel can easily accomplish belt tracking.
3. Design of the queue conveyor shall be so that adjustments to belt tracking should only be



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required at a maximum of once every thirty- (30) days.

4. Design, manufacture and installation of queue conveyors shall be in accordance with the design specifications of transport conveyors.
5. In the case where the conveyor line configuration, related controls and baggage input/processing are directly associated with the EDS or is in a tracking zone, the conveyor shall be equipped with a VFD.
6. As the CBRA is a manned area and bags will be handled/removed from their respective queue conveyors by their operators, the end pulleys of all Suspect Bag (SB) subsystems queue conveyors shall be such that there are no exposed gaps between the pulley and slider bed nor shall it constrict the continuous gap between the belt edge and the guard (refer to "Head and Tail Pulleys" section of this specification for details on end pulley finger safety guards).

2.05 FLAT PLATE MAKE-UP DEVICES

A. General

1. Flat plate devices shall be constructed of articulating, heavy duty, metal crescent-shaped plates forming a continuous rotating flat surface.

B. Dimensions

1. The usable plate width for flat plate devices shall be between 32" and 35" (plate width will be dependent on the flat plate manufacture selected).
 - a. The height of flat plate devices shall be as follows unless otherwise specified or shown on the Contract Drawings:
 - 1.) Make-up devices: 29 to 33"

C. Load Rating

1. All flat plate devices shall be capable of supporting a minimum dynamic load of 85 lb. per linear foot and a single concentrated static load of 200 pounds.

D. Operating Speeds

1. Device operating speeds for flat plate devices shall be 90 fpm.
2. Flat plate devices shall be capable of accepting a baggage input of thirty – (30) bags per minute.

E. Drives

1. The drive shall consist of a heavy-duty roller chain driven by a motor through a gear reducer. The motors and speed reducer assembly shall be connected using double grooved sheaves and matched V-belts. Drives shall be designed such that the speed reducer drives an endless chain equipped with a minimum of twelve heat treated dogs which shall engage drive pins in the main chain. The chain must engage at least two carrier assemblies at all times. The drive chain must be self-aligning and supported throughout its length.



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2. Drives shall be provided with an appropriately sized soft-start controller.
3. The design of the drive circuitry shall be such that the drive motor safety disconnect switch will also open the control circuitry of the device whenever the disconnect switch is turned off. Whenever the disconnect switch is turned back on, it shall be required to reactivate the appropriate device start controls, thus allowing the drive motor start-up to be controlled by the soft start controller.
4. A minimum of two drive units, are required for all baggage make up applications due to redundancy requirements. The device shall be designed and configured such that if one of the drive units should fail, the device shall continue to operate at 100% capacity including the ability to start-up under full load conditions with the remaining drive unit. Easy access and means for disconnecting failed drive unit shall be provided to allow for system maintenance with a minimum of time and effort. Drive design and motor applications must provide for the potential of variations in "actual" motor speeds so that the drive motors are equally loaded. The motor used in the dual drive units is to be of the "high slip" design type.
5. High-Slip Motors are required by specification where the use of dual drive units is used. These motors shall be copper-wound NEMA Design "D", Class "H" Insulation at 1.0 Service Factor with Class "F" temperature limits. Inverter Duty or Inverter Ready Motors shall be used at "VFD" controlled applications. These motors shall be copper-wound NEMA MG1, Part 31 Rated Design "B", Class "H" Insulation at 1.0 Standard Service Factor with Class "H" temperature limits. All motors shall be of the "high efficiency - low energy" type.
6. For ease of drive synchronization, variable frequency controllers are acceptable.
7. The device drive and idler shaft sprockets must be restrained through the use of double setscrews to prevent any lateral movement of the sprockets on the respective shafts. Setscrews alone are not sufficient.
8. Drives shall be designed for operation from a 480 VAC, 3-phase, 60 Hz power source. The drive shall be sized to permit start-up under full load conditions.
9. One 120 VAC, single-phase, 60 Hz duplex outlet shall be provided as a maintenance outlet in the general vicinity of each drive assembly.
10. The BHS control circuitry must be designed to ensure that the flat plate device is running at full speed prior to the start-up of any feed conveyors.
11. Install in close proximity to one of the drive units a control station with a Maint/Auto switch and a jog pushbutton for use by maintenance personnel only. When the switch is in the maintenance position, the device can move (jog) in the forward direction only when the jog pushbutton is held in.

F. Pallet/Flight Assemblies

1. All pallets consisting of 5/16" thick steel plates shall be provided. These steel plates must have a black urethane coating.



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2. Gaps between adjacent pallets of the device shall not exceed 1/8".
3. Elevation differences between adjacent pallets shall not exceed 1/16".
4. All exposed mounting screws shall be counter sunk.

G. Frame and Pallet Support System

1. A support system and guide for the chain and pallets constructed of standard modular assemblies bolted together shall be provided. The track space must be fabricated from rolled or formed structural steel and shall form an integral part of the support structure. The structural supports for the tracks shall be spaced at a maximum of 5' on center. Pallets must be supported by a minimum of two rows of polyurethane tired ball bearing wheels. Leveling screws located at the base of each frame module shall allow for easy adjustment of the assembly. Leveling screws should provide a minimum elevation adjustment of 1".
2. Once the structure of the device has been installed and properly aligned, all track joints and cam follower guide rail joints shall be welded and ground smooth to assure that the related track and guide surfaces are smooth and without vertical and horizontal differences.
3. The design of the flat plate device shall incorporate a means of expansion of the device to offset any wear in the main link bushings/connecting link pins. At a minimum, this shall include the following provisions:
 - a. Overlapping design of the cam follower guide track so that the cam follower surface is always in contact with some portion of the guide track at the expansion joint.
 - b. Heavy duty jacking bolt arrangement to assist in expanding the device when needed.

H. Finish and Trim

1. Baggage Make-Up Applications
 - a. All steel trim elements of flat pallet devices that are located in the make-up area shall be painted. As an alternative, a powder coat finish may be applied electrostatically to said surfaces. All painted steel trim elements must be properly aligned both vertically and horizontally. Butt joints of adjacent painted steel trim elements must provide a smooth surface. Sharp edges on any of the painted steel trim elements as well as voids between adjacent element joints are not acceptable. In addition, all radii of trim elements must match.
 - b. Finger Guards
 - 1.) A finger guard consisting of 6 inch, minimum 12-gauge formed channel or angle side rails shall be installed. The 6 inch total width of the finger guard shall overlap the plates by 3 inches and shall overlap the outer radius of the turn when the plate is bent at a 90 degree turn. The gap between the pallets and the finger guard shall not exceed 3/32". The vertical and horizontal alignment of the adjacent butt joints of the finger guards must not be misaligned nor is there to be any gap between the adjacent guards.



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- 2.) Special attention is to be given to the design, manufacture and installation of the inner and outer perimeter finger guards as well as the vertical front face skirting at the expansion point of the flat pallet device.
- 3.) The design, manufacture and installation of the perimeter finger guards at the device expansion points must assure that they do not create a snag point. To further reduce the potential of snagging baggage at these expansion joint locations, the finger guards are to be designed and installed in an overlapping manner. The overlapping finger guards are to be welded and ground smooth on the upstream end of each expansion joint location.

c. Side Guards

- 1.) Inner perimeter side guards shall be provided for the entire inner perimeter of flat plate devices used for baggage make-up applications to prevent baggage from falling into the center of the device.
- 2.) Vertical side guards used as inner perimeter side guards shall be constructed of minimum 12-gauge steel. The inner perimeter side guards are to be 21" high with vertical stiffening bracing constructed of a minimum angle size of 1-1/4" x 1-1/4" x 3/16". The vertical stiffening bracing is to be located on a maximum center spacing of 2' - 6".
- 3.) Design and installation of the inner perimeter side guards must not restrict maintenance access to the flat pallet device or any other conveyor equipment.
- 4.) Any openings that are required in the inner perimeter side guards for photocells or their related reflectors are to be a maximum diameter of 1-1/2". These openings are to be punched with a dimple away from the flow of baggage to minimize the possibility of snags.
- 5.) Where the tip chute feeds onto the flat plate device, provide sufficient outer perimeter side guarding (nominally 6" high by 4' long, flared at the charge end (to prevent bag jams)) so that baggage does not fall off the device when they exit the discharge end of the tip chute.

d. Other Control Functions

- 1.) Ensure control logic is programmed so that any bag feeding onto the tip chute shall not discharge on top of a bag already on the flat plate unit.

2.06 EXPLOSIVE DETECTION SYSTEM – EDS (Reveal CT-80DR)

A. TSA Equipment Responsibility

1. The EDS equipment will be supplied and installed by the TSA. Additionally, the EDS internal system wiring, networking and controls shall be provided by the TSA's Contractor.

B. BHS Contractor Responsibility

1. Provide all power, data and communication lines, and to coordinate the details of all



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required communication and signal interfaces (e.g., EDS machine status and control, bag loading and unloading, and bag status), between the EDS machines and the BHS with the TSA's EDS equipment supplier and the Owner in order to successfully accomplish the intended operation described herein. Details of the available signals and data, along with the required cabling between the two systems, are typically covered in the EDS supplier's Integration Guide for the respective EDS machine(s); take on the responsibility to request for a copy through the Owner. Provide all necessary control cabling, along with the communication and signal interfaces, between the EDS equipment and the BHS consistent with the EDS supplier's requirements. Furthermore, provide an additional 30% of cabling conductors between the EDS equipment and the BHS, as coordinated with the EDS Supplier and the Owner, to accommodate future functions. In all cases, provide any conduits and wiring between the BHS and the EDS systems (e.g., EDS machines) that are required for these interfaces (hard-wired I/O, data interface cabling and software driven), to include the termination of the required I/O and data interface cabling as coordinated with and supervised by the EDS Supplier.

2. Coordinate the placement of the EDS equipment, in its final location, with the EDS supplier and ensure proper alignment/positioning with the respective conveyor line.
3. Assume responsibility for the EDS integration with the BHS.
4. Assume responsibility for the site acceptance testing of the integrated system, which shall be performed between the TSA's EDS provider and the BHS Contractor.
5. The conveyor segments including their associated components and related support system upstream as well as downstream of the EDS machines shall be designed and installed so as to allow the easy removal of these conveyor segments, to gain access to their respective subsystem EDS machine for the removal of the unit/sections, through the EDS egress paths, for initial installation, major repairs and replacements. Provide quick disconnect cables/fittings for these conveyor segments and their associated components, along with caster wheels and floor locking pins on the respective conveyor's floor support legs, to assist in the removal/maneuvering of the In-Line CBIS conveyor segments. Provide details in the shop drawing submittal for review.

C. General

1. The following information is for reference only. Contact the EDS device provider to request the necessary documents that would be required for coordination, interface, and installation purposes; documents such as but not limited to: Technical Specifications, Installation Guidelines/Manual, BHS Integration Guide, BHS Interface Manual, and EDS testing guidelines.
2. Input/Output Conveyor Speed – as per manufacturers recommendations
3. Removable/Flared Side Guards
 - a. The side guards of the conveyor system before and after the CT-80 should be easily removable, to allow maintenance access and removal of the CT-80 infeed, transit, and exit conveyors.



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4. PE Signal and PE location

- a. The PE (photoeye) signals from the end of the external infeed conveyor and the end of the external exit conveyor must be wired directly to the CT-80 PLC. The location of the PE at the end of these belts is critical. It is recommended that an adjustment be provided to vary the position of these PEs in order to optimize the system commissioning.

5. Insert/Remove Station

- a. The orientation and alignment of test bag for daily calibration is critical. The CT-80 provides a special “Insert Mode” to allow this function. To utilize this function, the BHS contractor must provide an externally mounted key switch and re-start button must be mounted and wired back to the CT-80.

6. Minimum Bag Spacing

- a. A minimum bag spacing of 8 inches is required to overcome PEC de-bounce times and to allow bag acceleration and deceleration control.

7. Baggage Holding Mode For Operator Inspection

- a. The Reveal CT-80 can be operated in two modes.
 - 1.) Hold Outside
 - 2.) Hold Inside
- b. Hold outside mode:
 - 1.) The operator reviews images and other data at the console to render final decision, while the bag being reviewed is traveling along the conveyor to the decision point.
- c. Hold inside mode:
 - 1.) Alarmed bags are held in the scanner until an operator reaches a final decision. Cleared bags are ejected from the scanner automatically.

8. Bag Presentation

- a. Bag presentation immediately upstream of the CT-80 device is critical to successful bag scanning. Therefore the BHS contractor shall be required to provide a means of centering/positioning bags prior to entrance into the CT-80 device.
- b. The method by which the centering of the bag shall be accomplished shall be clearly illustrated/identified in the design. The BHS contractor shall be required to submit for review any “non standard” equipment designs as outlined in Part I of this project specification.

9. Description of Integrated Mode

- a. The BHS transports a bag to the queuing conveyor at the entrance to the CT-80 and sets the Queue Bag Waiting signal to TRUE. The CT-80, when finished scanning



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previous bags and no longer has a bag in tunnel, sets the Ready For Bag signal to True. When both of these signals are TRUE, the CT-80 begins moving its main conveyor to take in the bag, and the BHS sends the bag into the tunnel. When the bag blocks the CT-80 input photocell, the CT-80 sets the Ready For Bag signal to False, and applies the last received bag ID to the bag. In the absence of an airport bag ID, the CT-80 generates a unique 14-digit bag ID based on serial number and a bag counter. The CT-80 scans the bag and, if necessary, takes CT slices and then renders either a CLEAR or REJECT decision. The CT-80 then sends its decision along with the bag ID to the BHS through a serial port. When the bag has finished scanning, the CT-80 sets the Ready for Exit signal to True, and sets either the Clear or Reject signal to TRUE, depending on the status of the bag.

- b. Depending on the configuration, the CT-80 then transports the bag to the BHS, or keeps it in the tunnel or on the outfeed conveyor while waiting for the BVS decision.
 - 1.) In “Wait for BVS Decision” configuration, the CT-80 keeps the bag in the tunnel, or on the outfeed conveyor, until a screener makes a decision on whether the bag is cleared or alarmed. When the CT-80 receives a decision, it transports the bag onto the BHS.
- c. Regardless of the status of the BHS, the CT-80 is ready to load the next bag in the queue if there are no bags being held in the tunnel. When transporting the bag to the BHS, the BHS must first set the Exit Queue Conveyor Ready signal to True. If the Exit Queue Conveyor Ready signal is True, and the Ready for Exit signal is True, the CT-80 will send the bag out of the tunnel, and the BHS will accept the bag.

2.07 MISCELLANEOUS MECHANICAL EQUIPMENT

A. Catwalks

- 1. Provide as a minimum, the maintenance catwalks as located on the Contract Drawings or as required to ensure safe access for all personnel who operate, maintain or have access to the BHS. The BHS Contractor shall be responsible to coordinate with the Architect, the Owner or their representative to confirm the final number and locations for all maintenance catwalks, crossovers and walkways.
- 2. Design, provide and install maintenance catwalks and access ladders required to allow easy access to the outbound CT-80DR devices by TSA agents who are responsible to both test the EDS devices and clear bag jams within the devices. The BHS Contractor as part of the submittal processes shall provide to the TSA and Owner the design of the catwalk and access ladders for review and approval.
- 3. Coordinate access provisions for TSA operators so as to minimize obstructions. Locations of control stations and electrical boxes are to be coordinated to support unrestricted access by TSA staff to the input/output EDS interface positions. The provisions of the conveyor supports; drive configurations, personnel guarding and side guards shall allow for maximum TSA operator accessibility.
- 4. Include personnel protection at all catwalks to ensure that any potential injury is



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minimized. This includes swing gates or off-sets at access locations per OSHA standards 1910.23, padding, rounded corners, smooth welds, deburred surfaces and any other measures as may be necessary.

5. Attach all catwalks to the support structure, whether using decking of either sheet steel using stitch welds every 24" or use open steel grating (Ry-Weld 19W4 or approved equal), or as dictated by OSHA standards. The BHS Contractor shall coordinate the type of catwalk deck (solid or open grate) with the Owner or their representative and the Project Architect to ensure fire code/protection measures and lighting considerations are complied with.
6. Design catwalks to provide adequate space for operating and maintenance personnel.
7. Design structure to limit the deflection to 1/360 of the unsupported span length, under a concentrated 300-pound load.
8. Design all catwalks capable of supporting a minimum uniformly distributed live load of 40 pounds per square foot and a dead load of 25 pounds per square foot (total load of 65 pounds per square foot). The use of pan type catwalks constructed of #12 gauge hot rolled steel is acceptable.
9. Notch the decking where needed to clear obstructions. Add angle clips as required to maintain adequate support of notched structure.
10. Where lengths of decking are butted end to end, ensure that the joint falls on a structural cross member.
11. Securely weld all pieces of decking to the catwalk frame and all structural cross members.
12. Any catwalks with inclines of up to 8° will be equipped with an anti-skid walking surface. Catwalks with inclines of more than 8° will be equipped with steps as well as the anti-skid material.
13. Provide steps at all locations where there is an elevation change in excess of 8". Paint the step "yellow".
14. Minimum catwalk width shall be nominally 36" with a 3" gap between the conveyor and the catwalk.
15. Unless otherwise noted on the drawings, the top of catwalk shall be installed 8" below the top of belt at the intermediate section of the conveyor (between drive sections) and 15" below the top of belt at the drive sections.
16. Design and installation of access into the conveyor catwalk areas shall not be less than a 36" wide by 44" high, clear access envelope, to allow fire fighters with breathing apparatus enough room to climb up to and access the catwalk area.

B. Toeboards

1. Provide toeboards on both sides of all catwalks and ramps 24" or more above the finished floor except where adjacent equipment or building structure provides the required function. Construct toeboards of 1/4" x 4" minimum steel flat stock and install so as to leave no gap



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between the access way walking surface and the lower edge of the toeboard. It is acceptable to use # 12 gauge rolled steel 4" high toeboard. Securely weld toeboards to vertical handrail posts and to the access way support structure.

2. Design toeboards in accordance with OSHA standards.

C. Stairs

1. Provide as a minimum the stairs as located on the Contract Drawings or as required to ensure safe access for all personnel who operate, maintain or have access to the BHS. Coordinate with the Architect, the Owner or their representative to confirm the final number and locations for all stairs/ladders.
2. Design stairs to the following specifications or per local code if more stringent:
 - a. Treads:
 - 1.) Minimum of 10" deep
 - 2.) Non-skid upper surface
 - 3.) Extend front edge of tread over rear edge of lower tread a maximum of 1-1/4".
 - b. Risers:
 - 1.) 8" (maximum)
 - 2.) Equal in height in any one flight within 1/8"
 - c. Angle between stringer and horizontal - 38° (maximum)
 - d. Provide catwalks as required so that intermediate flights do not exceed 15 steps.
 - e. Provide protective measures (i.e. swing gate or offset) at the top of stairs.
3. Design stairs in accordance with OSHA standards, section 1910.24 and 1910.23.
4. Provide stairs with handrails from top to bottom in accordance with OSHA sections 1926.500 and 1926.501.
5. Handrails shall be painted "yellow".

D. Handrails

1. Provide handrails around all catwalks more than 24" above the adjacent floor and on all stairways. Design handrails to withstand a minimum load of 200 lbs. applied in any direction at any point on the top rail. Vertical support posts shall be spaced not more than 8' on centers. Make handrails continuous.
2. Design all handrails to consist of a top rail with one intermediate rail positioned halfway between the top of the walking surface and the top of the top rail as per OSHA code of Federal Regulation Part 1926.500
3. In areas of restricted clearance (vertically or horizontally), make intermediate rails spanning across conveyor drive locations removable for drive maintenance access.



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4. Close all open handrail ends, vertical or horizontal, by welding a metal cap.
5. Grind smooth all handrail welds.
6. Handrails shall be painted “yellow”.

E. Maintenance Ladder

1. Vertical Fixed Maintenance Ladders

- a. Provide fixed, 90-degree ladders to reach catwalks as shown on the Contract Drawings. Provide additional maintenance ladders as required to ensure safe access for all personnel who operate, maintain or have access to the BHS. The BHS Contractor shall coordinate with the Architect, the Owner or their representative to confirm the final number and locations for all maintenance access ladders.
- b. Design ladders to meet or exceed OSHA standards, section 1910.27 and 1910.23.
- c. All fixed ladders shall be of steel construction as specified elsewhere in this document.
- d. The distance between rungs shall be no more than 12 in. and shall be uniform throughout the height of the ladder. All rungs shall have a minimum diameter of 3/4 in. and shall withstand a 400-pound load when in use. All rungs shall be a minimum of 24 in. wide. The live loads imposed by personnel occupying the ladder shall be considered to be concentrated at such points as shall cause the maximum stress in the structural member being considered.
- e. Grind smooth all rough surfaces and edges.
- f. Side rails shall be of such cross section as to afford adequate gripping surface without sharp edges or burrs.
- g. Allow a minimum of 4 in. between the back of the ladder and the nearest permanent object. Allow a minimum of 30 in. between the front of the ladder and the nearest permanent object. Allow 16 in. from the center of the ladder to the nearest object on each side. The step-across distance from the nearest ladder edge to the nearest equipment or structure edge shall be a minimum of 2-1/2 in. and shall not exceed 12 in.
- h. Provide both a safety cage and safety chain at the top of all ladders.
- i. Provide fixed vertical ladders with handrails from top to bottom in accordance with OSHA section 1926.500 and 1926.501.
- j. Paint all fixed vertical ladders in “yellow”.

2. Ship's Ladders

- a. Provide fixed maintenance ship's ladders to access catwalks as shown on the Contract Drawings. Provide additional maintenance ladders as required to ensure safe access for all personnel who operate, maintain or have access to the BHS. The BHS Contractor shall coordinate with the Architect, the Owner or their representative to confirm the



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final number and locations for all ladders.

- b. Design ladders to meet or exceed OSHA standards, section 1910.27 and 1910.23.
 - c. Provide serrated modified steel treads a minimum of 6 in. by 3.0 pounds per linear foot channel 24in. long (unless noted otherwise in the Typical Details for Catwalk Access and Ladder Details in the Contract Drawings) covered with non-skid safety tread finish. The live loads imposed by personnel occupying the ladder shall be considered to be concentrated at such points as shall cause the maximum stress in the structural member being considered.
 - d. Provide steel stringers using minimum 7 in. by 4.72 pounds per foot channel.
 - e. Design ladder so that the angle between the stringer and the floor is not less than 60 degrees and not more than 65 degrees.
 - f. Make the distance between treads a maximum of 12 in. The distance between treads shall be uniform throughout the height of the ladder.
 - g. Provide handrails on both sides using 1-1/4 in. by 1-1/4 in. by 1/8 in. aluminum tubing.
 - h. Provide protective measures (i.e. swing gate or off-set) at the top of stairs.
 - i. Grind smooth all rough surfaces and edges.
 - j. All ship's ladders shall be of steel construction as specified elsewhere in this document.
 - k. Provide ship's ladders with handrails from top to bottom in accordance with OSHA section 1926.500 and 1926.501.
 - l. Paint all ship's ladders in "yellow".
3. Swing Down Aluminum Ladders
- a. Provide Swing Down Aluminum Ladders to access catwalks as shown on the Contract Drawings. The landing or top of the ladder should be adjacent to the associated catwalk not a part of it. Provide additional maintenance ladders as required to ensure safe access for all personnel who operate, maintain or have access to the BHS. The BHS Contractor shall coordinate with the Architect, the Owner or their representative to confirm the final number and locations for all ladders.
 - b. Swing down ladders are to be of Type 1A, 300 pound capacity extra heavy-duty aluminum construction.
 - c. Provide 1-5/8 in. serrated aluminum "D" rungs hydraulically double crimped in place. The live loads imposed by personnel occupying the ladder shall be considered to be concentrated at such points as will cause the maximum stress in the structural member being considered.
 - d. Provide 3-inch wide I-beam side rails.
 - e. Design ladder so that the angle between the side rails and the floor is not less than 60° and not more than 65°.



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- f. Make the distance between treads a maximum of 12 in. on center. The distance between treads shall be uniform throughout the height of the ladder.
- g. Provide lifting mechanism, counter balance, and pulleys to hold ladder in the up position when not in use. The ladder should be stable either in the up or down position due to the counter weight without requiring any tie off or similar.
- h. Provide protective measures (i.e. swing gate or off-set) at the top of the ladder.
- i. Design ladders to meet or exceed OSHA standards, section 1910.26 and 1910.23.
- j. Grind smooth all rough surfaces and edges.
- k. Provide swing down aluminum ladders with handrails from top to bottom in accordance with OSHA section 1926.500 and 1926.501.
- l. Provide swing down aluminum ladders with a small pull cord and counterbalance that is set up so that at no time is a force more than 2- lbs required to either lift up, pull down or stop the ladder in mid motion. If such balance can't be achieved, gas springs can be used as "assist" mechanisms to achieve the maximum required force requirement, but counterbalance will still be required.
- m. Swing Down Ladder Advisory/Warning Beacon
 - 1.) Furnish a failsafe interlock with associated swing down ladder. Provide the following equipment/controls:
 - a.) An Amber rotating beacon as a swing down ladder warning in the vicinity of each swing down ladder that will be visible to tug and cart drivers entering the immediate area of the respective ladder.
 - b.) Activation of the beacon shall occur as the swing down ladder is traveling from the full up position to the full down position and be maintained while in the down position.
 - c.) Deactivation of the beacon will occur when the swing down ladder is in the full up position.

F. Security Door (Powered)

- 1. The mechanical and electrical installation, power and control of rolling shutter, slat-type, between-jamb-mounted and interior-face-mounted security doors, shall include as a minimum, the following features:
 - a. Electric Operator with 480 VAC, 3 phase, 60-hertz motor provided by the door manufacturer.
 - b. Electrical or pneumatic bottom edge strip for automatic return to open position upon contact. A photocell or proximity switch shall be used in conjunction with the bottom edge strip for detecting a bag under the door.
 - c. The door is to be equipped with an externally mounted limit switch, photocell or



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proximity switch to sense door position connected to PLC input. The limit, photocell or proximity switch must be mounted in such a manner so that the "fully open" position of the door is sensed. If the door is sensed, by the limit switch, photocell or proximity switch not be in the fully open position, the associated conveyor shall be stopped if running or shall not be permitted to start if the conveyor was not already running. Note that this limit switch, photocell or proximity switch is in addition to those limit switches provided with the door operator if the door is powered.

- d. The BHS Contractor shall provide all stainless steel trim elements (around door opening) for those security doors located in public view. The BHS Contractor shall coordinate the trim element requirements with the Architect, the Owner or their representative.
- e. All security doors that are directly associated with the BHS shall be installed perpendicular to the conveyor centerline. The BHS Contractor shall coordinate installation of the security door(s) with other contracts.
- f. The design of the security door control system is described in the BHS "System Control Requirements" section of this specification (Part 3).

G. CBIS Directional Input Device (DID)

1. Bag presentation immediately upstream of the EDS device is critical to both successful bag scanning and in the reduction of jams at the EDS device entrance conveyor, to achieve this provide Directional Input Devices (DIDs). The DID shall position baggage such that there is less than 0.1% bag jams at the EDS device(s) entrance conveyor verses the number of total originating bags inducted into the system (e.g. total of number of jams shall not exceed 20 (combined for all EDS devices installed) per 20,000 originating bags).
2. The function of the DID is to position or rotate baggage (to present the bag in the correct orientation) into the center of the conveyor prior to the entrance of the EDS device. The typical location of the DID is illustrated in the Contract Drawings.
3. If the DID is installed within a section of conveyors where bag tracking is a critical operation, the DID shall be designed and constructed in such a manner so as to not cause tracked baggage to move out the tracking window during the centering operation.
4. Special care must be taken in the DID design and installation to ensure baggage on the device shall not be damaged or snagged. Note that the design, manufacture and installation of the DID must be such to ensure that the device is heavy-duty and shall withstand the abusive environment of a high volume baggage operation.
5. Submit the method by which the centering of the bag will be accomplished to the Owner or their representative for review and approval.
6. Submit for review any "non-standard" equipment designs as outlined in Part I of this project specification.

H. Chutes and Slides



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1. Construct chutes and slides of minimum 10 gauge electro-galvanized or stainless steel with welded joints, formed and reinforced as required to resist deforming from the effects of high speed pushers or manual loading. Remove rough spots and scale by grinding or filing to prevent snagging of baggage or tags.
2. In the event that joints must occur in the slide surface the upper sheet shall be lapped over the lower sheet (in the direction of baggage movement).
3. Design to allow a dynamic load of 50 pounds per square foot over the entire slide surface. No local deformation shall occur with a concentrated load of 150 pounds per square inch at any point on the slide.
4. Provide and install full-length side guards on both sides of all slides. Such guards shall be a minimum of 12" high above the slide surface with a rolled or formed top edge, a minimum of 3/4" thick, to afford stiffness to the guard panel.
5. Fasten side guard to the slide with bolts or by welding. Protrusions will not be permitted on the inside surface of the guard. Employ vertical stiffening support brackets a maximum of 2' on center on the outside of the side guards.
6. The charge end of the chute or slide shall be mounted so that is 1" below the adjacent belt height of the associated mainline conveyor.
7. Chute side guards or slide surfaces shall not deform or unduly deflect as a result of baggage impact caused by high-speed diversion.

I. Draft Curtains

1. Provide draft curtains at all wall and floor penetrations between conditioned and non-conditioned spaces, tempered and non-conditioned spaces, and between conditioned and tempered spaces.
2. Construct the draft curtains with two staggered layers of black 8" wide anti-static vinyl (PVC) strips. Each strip shall be 0.080" (minimum) thick at center and include a 0.120" (minimum) thick beaded outer edges, installed with a 50% overlap (i.e., staggered strip layers) to create a barrier between the two spaces for dust and temperature control.
3. Provide stainless steel fascia in public areas.

J. High Speed Paddle Diverter (HSPD)

1. The function of the high-speed paddle diverter is to selectively transfer baggage across the main sort conveyors onto the designated sortation device using either a transverse or linear motion.
2. Each high-speed paddle diverter shall be capable of sorting baggage at a sustained rate of 60 items per minute (upgradeable to 80 bags per minute).
3. The high-speed paddle diverter must be capable of sorting all types of normal baggage, including but not limited to golf bags, by imparting a smooth controlled impact on baggage, ensuring that damage does not occur to the items from impact, jamming, snagging or falling



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to the floor.

4. The design, manufacture, and installation of the high-speed paddle diverter must conform to all sections of this specification as appropriate. Note that the design, manufacture and installation of the high-speed paddle diverter must be such to ensure that the device is heavy duty and shall withstand the abusive environment of a high volume BHS operation.
5. The high-speed paddle diverter must be designed and installed so that the high-speed paddle diverter powered faced paddle(s) always returns to the exact same home position, with no variation in the home position. Additionally, the return of the HSPD paddle to the home position must not influence the bag travel on the adjacent downstream conveyor, where it may cause bags to mis-track; for example, in the case of high-speed diversion of bags from the main line onto a 45° merge input belt, the HSPD must not affect the bag travel after the bag has been diverted and the paddle(s) returns to home position.
6. Design the high-speed paddle diverter so that trained maintenance personnel can easily replace the powered faced paddle belts.
7. Design the high-speed conveyor and the take away conveyor such that there is a 3" drop from the HSPD conveyor to the take away conveyor. The transition plate shall be provided with rollers to aid in the bag transition to the take away conveyor.
8. Ensure sufficient sway bracing in both directions and vibration isolation on all supports.
9. Provide each HSPD with one Safety Disconnect switch to control both the clutch/brake or VFD and motor. The 3 phase Motor Safety Disconnect Switch shall also be used to interrupt the feed and neutral circuit to any externally powered electric clutch/brake or VFD device. The following describes how this shall be accomplished:
 - a. Provide 120 Volt AC power to the line side auxiliary contact in the Motor Safety Disconnect Switch (located at the motor) from the MCP.
 - b. Wire from the load side of the auxiliary contact of the Motor Safety Disconnect Switch (located at the motor) to the terminal strip in the respective MCP.
 - c. At the respective MCP, run two (2) parallel wires from the MCP terminal strip to the following:
 - 1.) One parallel wire from the terminal strip to the PLC input to indicate that the Motor Safety Disconnect Switch (located at the motor) is in the "ON" or "OFF" position.
 - 2.) The other parallel wire shall be the input voltage either for the DC power supply that will supply DC power to the associated motor clutch/brake or for supplying power to the VFD.
10. The primary line (conveyor line that the HSPD is installed on) conveyor belting shall be "bare by bare" with low COF.
11. Provide adequate safety guards for each HSPD, between manned areas (e.g., maintenance catwalks) and the HSPDs paddles. The HSPD safety guards shall be easily removable and



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shall mount on the top of the HSPD and adjacent conveyor side guards to provide a physical barrier between the manned areas and the HSPD paddles. Fabricate the HSPD safety guards with expanded metal, at least 12 gauge thick, and incorporate a formed 90° edge turned away from the guard face and another 90° edge turned down to eliminate sharp edges (i.e., similar to a conveyor side guard configuration).

12. The design of the HSPD control system is described in the Special Requirements section of this specification (Part 3).
13. A qualified manufacturer shall fabricate high-speed paddle diverter, with previous installations in BHS applications. Final approval of the qualified manufacturer shall be at the discretion of the Owner or their representative.

K. Stainless Steel Turning Cone

1. A large diameter stainless steel turning cone or other mechanism shall be provided at the discharge end of the CL1-02 conveyor to facilitate the right angle transfer of baggage onto the CL2 Clear Bag Line. The Owner or their representative, prior to manufacture, shall review the design of this baggage guide mechanism and a working prototype shall be manufactured for review prior to final production. Degradation of system performance, such as but not limited to baggage jams or tracking problems shall not be acceptable as a result of failure of the bag guide device(s) to perform their intended function. Performance will be reviewed during testing

L. Counterweight Slide (Tip Chute)

1. Construct the slide to swing up when contacted by a bag being conveyed on the lower conveyor.
2. Provide an adjustable down stop so that the slide can be set to stop at a maximum of 1" above the conveyor belt or a flat plate tread.
3. Construct the slide of a sheet metal surface attached to a frame to provide a rigid, lightweight assembly.
4. Mount a pivot shaft in self-aligning bearings grease packed for life with spring loaded contact seals.
5. Curve the slide so that the bottom of the slide is parallel to the conveyor belt or flat plate tread preventing exiting bags from digging into the belt or tread.
6. Provide the counterweight with a screw adjustment in order to ensure satisfactory operation. The slide shall be counter-weighted to the down position.
7. Provide a minimum 2" drop between the tail pulley of the feed conveyor and the slide. Ensure baggage does not jam or snag at the transition.
8. Slide angle shall not exceed 30°.
9. Prior to start of final design of the counterweight slide, build a prototype of the proposed design and demonstrate satisfactory operation to the Owner or his representative. Do not



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start final design without the Owner or his representative's written approval. This requirement can be waived by providing verification of successful construction and implementation of the proposed design at three previous project locations.

10. Fully guard the tip chute and its counter-balance weights to protect operating personnel as required by OSHA -Section 1910. Apply primer and then one coat of "yellow" paint to all guarding that are not exposed to the weather (e.g., within the bag room). Guarding that is exposed to the weather shall be hot-dip galvanized.
11. Provide sufficient outer perimeter side guarding (nominally 6" high by 4' long, flared at the charge end) on flat plate make-up devices so that baggage does not fall off the device when they exit the discharge end of the tip chute.
12. Provide sufficient guarding around the tip chute so that regardless of position, baggage diverted by a high-speed pusher cannot leave the confines of the chute area without exiting at the discharge end of the chute.
13. Provide sufficient bed, side guard, and other guarding rigidity so that impact of baggage diverted by high-speed pushers does not deform or unduly deflect said items.
14. Provide an integral speed brake curtain with the counter-weight slide.
15. Provide sufficient dampening of tip chute to avoid excessive down force and any resulting noise levels.

2.08 SPECIAL MECHANICAL EQUIPMENT REQUIREMENTS

A. General

1. Certain portions of this project require the modification, interfacing with, removal and demolition of existing conveyor equipment as shown on the Contract Drawings. Accomplishment of this work shall have to be carefully coordinated with the ongoing operations of the airlines associated with the existing baggage system in the building area.
2. Conduct a thorough field check of the existing conveyors and their relationship within the existing system as well as their relationship with the configuration of the specified system.
3. Ensure that the design and installation of all conveyor equipment provides maximum access for operation and maintenance personnel.

B. Baggage Over-height Restriction Bars

1. Over-height restriction bars shall be installed on all conveyors equipped with overheight detection photocells, at the appropriate height to restrict passage of baggage exceeding the maximum bag height requirements. In all cases, the overheight bar support structure may be used for mounting of the overheight detection photocell. In public areas, the overheight restriction bar shall be installed on the non-public side of the associated fire/security door.

2.09 ELECTRICAL TECHNICAL REQUIREMENTS

A. Electrical Service to be Provided by the BHS Contractor



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1. Power for the various subsystems shall be provided at locations shown on the Contract Drawings by the Owner's Electrical Contractor. Each power distribution point (PDP) shall consist of cable in an appropriately sized junction box (supplied and installed by the Owner's Electrical Contractor) connected at its source to an appropriately sized circuit breaker located at the building substation panel. The drop shall terminate with approximately 20' of coiled cable. The full load ampacity rating (FLA) shall be as indicated on the contract drawings (it shall be the BHS Contractors responsibility to verify the FLA requirements and notify the Owner or their representative of any increase/decrease). Supply power shall be 480 volts, 3 phase, and 60 hertz. Verify and advise the Owner and Engineer that the ampacity at each PDP is sufficient for the requirements of the system.
2. Provide and install all mains cable required from nominated Power Distribution Points (PDP) to the various BHS Distribution Boards and onward to the MCPs as necessary to meet requirements of the specification. The BHS Contractor shall be responsible for all electrical work "downstream" of the PDP locations including the BHS distribution boards, MCP and all other cabling in between. Size feeders from the power drops at 1.25 times the minimum NEC (or applicable local code) permitted size for the full-load amperage required. The BHS Contractor shall be responsible for all power connections from the various MCPs to all other BHS equipment including providing power to screening machines.
3. Provide and install all services, feeders and disconnect switches for branch circuits to each control panel, with separate circuits for each subsystem as specified and provide and install all panel boxes, wireways, conduits, conductors, transformers, breakers/fuses, and any other equipment and materials required to complete the electrical power distribution for the operation of the system. Refer to NEC Article 300 for wiring methods.
4. The amperage shown for each PDP in the subcontract drawings shall be confirmed by the bidder in his bid submission. The BHS Contractor shall, during the engineering phase, provide detailed power calculations for review and approval by the Owner or their representative in an effort to reduce the PDP amperage provided and thereby reduce the power provided to the system. Coordinate the detailed power requirements including any reductions with the Owner or their representative.
5. Provide separate circuits for controlling programmable logic controllers (PLCs) and powered fire/security doors. Note that these circuits shall originate within the respective MCP.
6. Calculate the electrical power supply requirements on the basis of total connected load with a diversity factor. Size the conductors to ensure that the voltage drop does not exceed 3% at the farthest outlet of power, heating and lighting loads, or combinations of such loads. Also ensure that the voltage drop does not exceed 5% at the farthest outlet for both feeders and branch circuits.
7. Provide 120 volt, single phase, and 60-Hertz power for operation of the BHS control circuits.
8. Obtain the control power at each MCP by means of a transformer connected to the load



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side of the 480 volt input power.

9. All baggage systems that use programmable controllers shall be equipped with the appropriate number and size of power regulators to ensure that the power for the respective programmable controllers is properly conditioned. Regulators are to be of the type manufactured by the Sola Corporation (or approved equivalent).
10. All electrical components, devices, accessories, and equipment shall be listed, labeled and identified as suitable for use intended by testing agency acceptable to authorities having jurisdiction. This shall include MCPs and any control panels/cabinets, whether factory or contractor fabricated.
11. Provide a power distribution panel (including all necessary equipment e.g. circuit breakers) located adjacent to each of the x-ray and EDS machines. Power to these screening machines shall be taken from the same source powering the MCP that controls the conveyor line that the screening machine is in. The x-ray and EDS contractor shall obtain power for their machines from these panels and shall be responsible for cabling between the panels and their machines. Coordinate with the x-ray and EDS suppliers to finalize the power requirement for the screening machines.

B. Raceways

1. General

- a. Enclose all power and control wiring, including low-voltage wiring, in Rigid Metal Conduit (RMC), Electrical Metallic Tubing (EMT), Liquid Tight Flexible Metal Conduit or wireways. Intermediate Metal Conduit (IMC) is not acceptable.
- b. Horizontal runs of conduit shall not be supported by power turns, their safeguards, or by any side guard that is designated to be removable for the purpose of maintenance access. Rack such horizontal runs and support them from the building roof or mezzanine steel in locations not interfering with the BHS, maintenance areas, or catwalk areas.
- c. Install drops to motors or other devices adjacent to the nearest available equipment or building column. Mezzanine supported equipment may be electrically fed from below the mezzanine from racked conduit supported below.
- d. Avoid conduit runs on the floor. Provide minimum clearance of 6" below horizontal conduit to the floor. The Owner or their representative must approve exceptions to the above.
- e. RMC and EMT Conduit runs must be mounted so as not to restrict maintenance access to the BHS equipment, conveyors and system/conveyor components that required servicing.
- f. Conduit runs must not be run or mounted on outside guards or perimeter chain guards of power turns.
- g. Do not run communication, low voltage (less than 30 volts), or DC control wires in the



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same conduit, wireway or panduit with power wires.

- h. It is acceptable to run 120 VAC minimum control wire and 480 VAC maximum power wire in the same conduit, wireway or panduit provided it is in conformance with local codes and VFD manufacturer's guidelines, as applicable.
 - i. It is acceptable to run shielded 90 VDC clutch brake control wire and 480 VAC maximum power wire in the same conduit, wireway or panduit provided it is in conformance with local codes and VFD manufacturer's guidelines in lieu of running these clutch brake DC control wires in a separate conduit or wireway.
2. Rigid Metal Conduit (RMC)
- a. Conform to all aspects of NEC Article 344 for RMC (or applicable local code).
 - b. Use a minimum 3/4" for all wiring.
 - c. Run all conduits parallel or at right angles to structural members and equipment.
 - d. Do not run conduits underground or in floor slabs unless provided for that purpose by the Building Contractor.
 - e. In public areas, make conduit runs inconspicuous by running under cover plates, behind conveyors or otherwise concealed from public view.
 - f. In non-public areas, run exposed conduit in protected locations to prevent damage by moving vehicles, equipment or maintenance personnel.
 - g. Use Rigid Metal Conduit in all areas of the BHS installation that are at elevations less than 8'-0" above the buildings local finished floor and in all areas that are exposed to vehicular traffic and possible damage by operating or maintenance personnel.
 - h. Use malleable iron or steel threaded fittings.
 - i. Include gaskets and covers for all fittings.
 - j. Use standard threaded couplings at all conduit joints.
 - k. Ensure that the ends of the conduit are cut square, reamed and joined butt-tight.
 - l. Electro-galvanize all conduit, elbows, fittings, couplings and nipples.
 - m. Make changes to conduit size only at pull boxes, distribution panels, or branches to motors. Do not use reducers for in-line reduction of conduit size.
 - n. Do not run communication, low voltage (less than 30 volts), or DC control wires in the same conduit with power wires.
 - o. It is acceptable to run 120 VAC minimum control wire and 480 VAC maximum power wire in the same conduit or wireway provided it is in conformance with local codes and VFD manufacturer's guidelines, as applicable.
 - p. It is acceptable to run shielded 90 VDC clutch brake control wire and 480 VAC maximum power wire in the same conduit or wireway provided it is in conformance



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with local codes and VFD manufacturer's guidelines in lieu of running these clutch brake DC control wires in a separate conduit or wireway.

- q. Remote control, signaling and power limited circuits shall be installed in compliance with NEC Article 725, (or applicable local code) as applicable.
 - r. Support conduit at intervals not to exceed 10'-0". Every individual conduit section must be supported. Install conduit supported from building walls with a clearance of not less than 1/4" from the wall to ensure against the accumulation of dirt and moisture behind the conduit, using one-hole malleable iron clamps and clamp backs. For parallel conduit runs provide trapeze hangers or wall brackets fabricated from preformed channel with conduit clamps. Make anchors in concrete of the expansion shield type. Limit conduit run on a given conveyor to that, which is required for that particular conveyor or directly adjacent (downstream/upstream) to that particular conveyor.
 - s. Ensure that metallic and non-metallic motor disconnect boxes, clutch/brake safety disconnect boxes and control stations, outlet boxes, junction boxes, pull boxes and cover plates are compatible with the RMC conduit used and conform to the National Electrical Code (or applicable local code) for minimum wiring space requirements and material thickness. Provide all boxes with screw fastened covers. Use NEMA 12 enclosures for interior equipment and NEMA 4 for all exterior equipment. BHS contractor shall only use metal boxes; non-metal boxes shall not be used.
 - t. Appropriately sized insulated bushings and jumpers shall be installed on all conduits and conduit fittings that enter metallic or non-metallic MCP(s), outlet boxes, disconnects, or j-box/pull box(s).
3. Electrical Metallic Tubing (EMT)
- a. Apply the above requirements for Rigid Metal Conduit to EMT except as noted below:
 - 1.) Use rain and concrete type compression fittings with steel compression nuts.
 - 2.) Use insulated throat type connectors with case hardened nuts.
 - 3.) Use minimum size tubing of 3/4" diameter.
 - 4.) Use EMT only in areas at elevations greater than 8' above the buildings local finished floor or in areas not exposed to vehicular traffic or possible damage by operating and maintenance personnel.
 - 5.) Appropriately sized insulated bushings and jumpers shall be installed on all conduits and conduit fittings that enter metallic or non-metallic MCP(s), outlet boxes, control stations, disconnects, or j-box/pull box(s).
 - 6.) Ensure that motor disconnect boxes, clutch/brake safety disconnect boxes and control stations, outlet boxes, junction boxes, pull boxes and cover plates are compatible with the EMT used and conform to the National Electrical Code (or applicable local code) for minimum wiring space requirements and material thickness. Provide all boxes with screw fastened covers. Use NEMA 12



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enclosures for interior equipment and NEMA 4 for all exterior equipment.

- b. Conform to all aspects of the more stringent between this specification and NEC Articles 300 and 358 for EMT (or applicable local code).
- 4. Flexible Metal Conduit
 - a. Conform to all aspects of the more stringent between this specification and NEC Articles 300 and 348 (or applicable local code) for flexible metal conduit and fittings.
 - b. Use liquid-tight flexible metal conduit for connection to motors, photocells, limit switches or any device, which may be subject to vibrations or require adjustment after installation. The use of non- liquid-tight flexible metal conduit such as “green field” is not acceptable.
 - c. Do not exceed 3' in length.
 - d. Every section of flexible metal conduit must be clamped/supported.
 - e. Appropriately sized insulated bushings and jumpers shall be installed on all conduits and conduit fittings that enter metallic or non-metallic MCP(s), outlet boxes, control stations, disconnects, or j-box/pull box(s).
 - f. Use minimum 1/2" for power wire.
 - g. Use minimum 1/2" for control wire.
- 5. Wireways
 - a. Wireways may be used in place of rigid conduit provided the application conforms to the requirements of National Electric Code Articles 376 and 378 (or applicable local code).
 - b. Use wireways with hinged, solid covers.
 - c. Position wireways to permit access with the equipment fully operational.
 - d. Do not run communication, low voltage (less than 30 volts), or DC control wires in the same wireway with power wires.
 - e. It is acceptable to run shielded 90 VDC clutch brake control wire and 480 VAC maximum power wire in the same wireway provided it is in conformance with local codes and VFD manufacturer's guidelines in lieu of running these clutch brake DC control wires in a separate conduit or wireway.
 - f. Fasten covers using captive screws.
 - g. Do not use wireways in areas subjected to vehicular traffic.
 - h. Do not use terminal strips in wireways.
 - i. Use lay-in type wireways to avoid the necessity of threading wires through end connectors.



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C. Wire and Cable

1. General

- a. Use stranded copper conductors of appropriate gauge, Type THHN or approved equal, with insulation rated for 600 volts. Use type XHHW only if required by code or the governing Owner prohibits the use of PVC insulation. Conform to all aspects of the more stringent between this specification and NEC or applicable local code.
- b. Connect pre-wired electrical devices to terminal blocks mounted in junction boxes adjacent to the devices.
- c. Do not use blade connectors (such as but not limited to fork or ring style) for connections.
- d. It is acceptable to use multi-conductor cable for connecting portable electronic equipment. Refer to National Electrical Code (or applicable local code) for requirements on multi-conductor use.
- e. Tag control and power circuit conductors with "machine" printed identification numbers at both ends of the wire. Tag method shall be of the sleeve or other permanent type submitted to and approved by the Owner or their representative. The use of multiple tags to create a single tag is not acceptable.
- f. Keep all wires on reels while being pulled. Do not allow wires to contact the ground or floor.

2. Minimum wire size

- a. Power #12 gauge
- b. Control #14 gauge
- c. PLC I/O #16 gauge (Connections between I/O modules and terminal strips inside MCPs)
- d. Communication Circuits #18 gauge

3. Splicing

- a. Splicing of 480VAC power wiring is unacceptable, except for interim BHS conditions when performed below. All 480VAC wire pulls shall be from the MCP to the device (e.g. from MCP to the individual motor safety disconnect).
- b. Splices are acceptable when parallel type connections are used for "hot" and "neutral" control wires (e.g. power wire for photocells, and e-stop circuits within a subsystem).
- c. Do not splice signal wires between I/O panel and component.
- d. Terminate control wires on terminal strips or on screw connectors at each component only.
- e. In conjunction with the provision of a Junction Box for each interim BHS conveyor



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line, at the interface junction point between existing and temporary (not part of the final works) conveyor segments, it is permitted to provide splicing between field components and the MCPs. Splice the existing wiring within new Junction Boxes (segregating AC wiring from DC wiring), using appropriate screw connection terminal blocks, as specified elsewhere in this document for all wiring within the referenced conduits. The ends of all wire strands (both temporary and existing splice points) shall be soldered (i.e., tinning the wire), to reduce the chance of corrosion of the wires and to assure proper wire connections at the terminal strips. Use Allen-Bradley “CA1L” terminal blocks or approved equal for all wire splices related to this work. Label/tag all wires at the Junction Box splice points with “Machine” printed identification numbers at both ends of the wire. Tag method shall be of the sleeve or other permanent type submitted to and approved by the Owner. The use of multiple tags to create a single tag is not acceptable.

4. Spare Conductors

- a. Provide a minimum of 5% spare conductors in all conduit home runs, with a minimum of two spare control wires and one spare power wire.
- b. Coil all spare conductors allowing sufficient length to permit future connection.
- c. Tag spare conductors as required above, i.e., each spare conductor is to be identified as a spare with its own unique wire identification number and field termination location.

5. Wiring Identification

- a. Color code all electric wire and cable as follows:

1.) MCP Power Wiring: Line Side

- a.) Apply the following to all MCP power wiring from source to line and load side of Main Disconnect fuses for MCPs. Verify color-coding of phase conductors on the line side to ensure compatibility with normal electrical supply available at the airport. Terminate the neutral, if applicable, at the terminal board:

Item	Wire Color
Phase A (480 VAC)	Brown
Phase B (480 VAC)	Orange
Phase C (480 VAC)	Yellow
Neutral	Grey
Mechanical Ground	Green

2.) BHS Field Components Power and Control Wiring: Load Side

- a.) Apply the following to power and control wiring from the load side of fuses in MCPs to all devices that are powered and controlled from the respective MCP



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as follows:

Item	Wire Color
Power (To Motors and Control Transformers)	Either: (delete those not applicable) 1. Black (with labeled ends indicating L1, L2 and L3 referring to their respective phases) and the Brown, Orange and Yellow colored wires of the 3 phases from the MCP 2. Run numbered, colored insulation (Brown, Orange and Yellow) wires to match phases. 3. Match existing conditions 4. As dictated by local codes.
AC Control:	Red
DC Control:	Blue
AC Neutral:	White
Mech. Ground	Green

- b.) Submit to the Owner or their representative for review and approval the wire color method to be employed for this project.

D. Grounding

1. Ground all electrical equipment to building ground mat by a dedicated equipment-grounding conductor installed in accordance with the applicable codes. Obtain from the appropriate airport authorities, local codes or the Owner's Electrical Contractor the extent and type of grounding, wiring method and points of connection required.
2. Appropriately sized insulated bushings shall be installed on all conduits and conduit fittings that enter and exit the MCP or j-box/pull box.
3. Include a green 600V insulated copper ground conductor in each conduit (raceway).
4. Refer to National Electrical Code Article 348 (or applicable local code) for flexible metal conduit grounding requirements.
5. Refer to National Electrical Code Article 250 (or applicable local code) to determine grounding conductor requirements and sizes.

E. Support

1. Mount conduit supported from building wall using uni-strut type mounting channels to provide clearance to the wall.
2. Do not weld conduit to structural members.
3. Avoid conduit runs to the floor. Provide minimum clearance of 6" between horizontal



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conduit and the floor and do not allow runs to cross any walk or access aisles.

4. Support cordsets running to items such as, but not limited to, photocells and shaft encoders with cable mounting clips only. The cordset shall not be supported/secured with plastic wire ties.

F. Boxes

1. Provide outlet boxes, junction boxes, pull boxes and cover plates compatible with the conduit used. Provide boxes with screw fastened covers. Use NEMA 4 for all exterior equipment and NEMA 12 for interior equipment.
2. Conform to NEC Article 314 (or applicable local code) for minimum requirements for outlet boxes, junction boxes, pull boxes and cover plates.
3. Appropriately sized waterproof bushings/seals shall be installed on all conduits and conduit fittings that enter/exit the box(s).
4. Unused openings in junction boxes, raceways, cabinets, and pull boxes shall be effectively closed to afford protection substantially equivalent to the wall of the equipment.

2.10 ELECTRICAL COMPONENTS

A. Wiring Devices

1. Provide full size oil-tight operators.
2. As much as possible, use the same type sensors (such as but not limited to photocells and limit switches) to minimize the number and type of spares. Select sensors with the same mounting system wherever practical.
3. Use plug-in type electrical components wherever available. Do not use blade connectors (such as but not limited to fork or ring style).

B. Control Devices/Stations

1. Control Device Locations
 - a. Control Stations and Control Devices shall be located as specified herein. The location of the Control Stations and Control Devices is to be such as to provide maximum possible access to the Devices for servicing of the devices. For example, all Jam Detector and Head End Sensor Photocell devices are to be mounted so that they are accessible from catwalks adjacent to conveyors. In certain areas, protective guarding may be required to protect the Control Stations and Control Devices. However, the design and installation of this protective guarding must not prevent quick access to the control devices for adjustment, servicing or replacements.
 - b. The location, mounting and guarding of control stations and control devices must not in any manner restrict the access and servicing of any mechanical components of the BHS.
2. Control Device Mounting



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- a. The mounting of Control Stations and Control Devices, shall comply with the basic requirements established in the Contract Drawings and as noted in the following:

1.) Control Stations in Public View

- a.) All Control Stations located in the view of the public shall be flush mounted with stainless steel cover plates. Such stainless steel cover plates must be secured to the adjacent wall or conveyor trim member with either Truss or Oval Head Phillips stainless steel machine screws of appropriate size. Control stations located in the view of the public shall not be mounted on the top surface of the conveyor front cladding. Pan Head screws are not acceptable.
- b.) All Control Stations located in the view of the public at load conveyors (i.e. ticket counter conveyor control stations) shall be mounted flush to the adjacent wall in a location that someone operating the Control Device shall not have to lean over the conveyor to access it (either upstream or downstream of the load conveyor). E-stop Control Devices shall be mounted inside the stainless steel trim shrouding above the toe plate. A one (1) inch hole shall be provided in the face of the stainless steel shrouding to actuate the E-Stop and a hole on the underside of the face (above the toeplate) shall be provided to reset the E-Stop. Note that the design, manufacture and installation of the stainless steel shrouding on the collection conveyor must reflect these requirements.

2.) Control Stations in Non-Public View

- a.) All Control Stations located on load conveyors in non-public view shall be mounted on the horizontal portion of a Control Station mounting assembly bridging the load conveyor. This assembly shall be located and built so as to also act as an Over-Height Photocell Mount and Bag Restraint. Consider the "chording effect" of baggage at the discharge end of a horizontal load conveyor feeding onto an incline conveyor when determining the location of such an assembly. The vertical element of the assembly may also be used for the mounting and protection of head end photocells, if applicable.
- b.) All Control Stations located on Flat Plate make up device in non-public view shall be mounted on a Control Station mounting assembly. Design, manufacture and installation of the Control Station mounting assembly for racetrack applications must be such as to provide a "solid", well braced mounting for the related Control Station and Control Devices. Note also that the Control Station mounting assembly must provide a minimum vertical bag clearance of 36" above the surface of the racetrack device. See contract drawings for specific details.

3.) Control Devices

- a.) All photocells shall be mounted in a vertical attitude with the LED photocell status indicator clearly visible to operation and maintenance personnel from the side of the associated conveyor or conveyor equipment. Photocells that



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are used for jam detection; baggage tracking, and the like are to be mounted so that the center of the photocell beam is 2-1/2" from the top surface of the conveyor belt.

- b.) Limit switches that are used to sense the position of security doors shall be mounted as an external unit to the door adjacent to the track of the door so that the switch can detect when the door is in the fully open position.
- c.) Indicating lamps, other than those associated with MCPs, are to be located as required to properly alert personnel.
- d.) Shaft encoders used for determining conveyor speed must be directly coupled to either the head or tail pulley of the associated conveyor. Use of tension loaded friction drive types of shaft encoders is not acceptable.
- e.) Start-up warning alarms (i.e., audible and visual) shall be located at strategic locations to alert operations and maintenance personnel of the imminent start-up of conveyor equipment. As a minimum provide start-up alarms at baggage input areas, on top of the MCPs and along the conveyor line right-of-ways (e.g., ceiling supported or mezzanine mounted conveyors.). Audible/Visual Fault Warning and Start-up Alarms may utilize the same control devices. However, the audible and visual indications shall differentiate between the two separate functions.
- f.) Fault warning alarms (i.e., audible and visual) shall be appropriately located to alert operations and maintenance personnel of conveyor subsystem fault conditions. As a minimum provide fault alarms on top of the MCPs. Audible/Visual Fault Warning and Start-up Alarms may utilize the same control devices. However, the audible and visual indications shall differentiate between the two separate functions.
- g.) System Start-up and Fault Indication Rotating Beacons: System start-up and fault indication beacons, with amber globes, shall be located on top of the MCPs, at the baggage input areas and along the conveyor right-of-ways (e.g., ceiling supported or mezzanine mounted conveyor equipment) and mounted on the wall at the over size door between the CBRA and the outbound bagroom as indicated on drawing B3.00.02 detail 1.
- h.) Emergency Stop Switch Rotating Beacons: Emergency Stop Switch beacon with red rotating globe shall be mounted on top of the associated subsystem MCP.

3. Types of Control Devices

- a. Push-Button Switches: All Momentary Contact Push-Button switches shall be of the Allen Bradley Series 800T type (or Square D 9001K series, or equivalent as reviewed and approved by the Owner or their representative). The color coding for the Push-Buttons shall be as follows:



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Function	Color
Start/Re-Start (non-public locations)	Green (flush head)
Normal Stop (non-public locations)	Red (flush head)
Alarm Silence (non-public locations)	Yellow (flush head)
Lamp Test (non-public locations)	Gray (flush head)
Jam Reset (non-public locations)	Orange (flush head)
Others (non-public locations)	Black (flush head)

- b. Illuminated Push-Button Switches: All Illuminated momentary contact push-button switches shall be of the Allen Bradley 800T - PA16 type switch with guards (or Square D 9001K series, or equivalent as reviewed and approved by the Owner or their representative). The color coding for the Push-Buttons shall be as follows:

Function	Color
Start (for initial start up conditions at public areas)	Green
Jam Reset	Amber
Emergency Stop Reset	Red
Over-Height/Over-Length Reset	White

- c. Emergency Stop Push-Button Switches: All Emergency Stop push-button switches shall be of the Maintained Contact, "Push to Stop" Illuminated Red Mushroom Head switch, Allen Bradley 800T - FXP16RA1 type (or Square D 9001K Series, or equivalent as reviewed and approved by the Owner or their representative). Note that the Emergency Stop push-button switches must be equipped with a manual lockout clip manufactured by the switch manufacturer for locking the switch in the "conveyor off" position.
- d. Selector Switches: All Selector Switches shall be of the appropriate series based on the application, as specified, and of the Allen Bradley 800T type switch (or Square D 9001K Series, or equivalent as reviewed and approved by the Owner or their representative).
- e. Key Operated Switches
- 1.) "Off/On Function" and "Start Function" Key operated Switches for application in Public Areas shall be of the type manufactured by the Best Lock Company (or Square D 9001K Series with Best Lock Company core, or equivalent as reviewed and approved by the Owner or their representative) but must use a six-pin lock cylinder and core. The Owner will provide the final Operational Core. The Construction Core, normally supplied with the lock, must be removed before the project will be accepted. The switch must provide a spring loaded center return.



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- 2.) Key operated Switches for all functions other than the "Off/On Function" and "Start Function" in Public Areas shall be Allen Bradley type 800T, (or Square D 9001K Series, or equivalent as reviewed and approved by the Owner or their representative).
- f. Non-Status Map Emergency Stop Switch Indicator Lamps: Certain Baggage Handling Systems shall require the installation of Emergency Stop Switch indicator Lamps external to the related adjacent to lanyard operated Emergency Stop Switches. Such Indicator Lamps are to be of the type manufactured by Crouse - Hinds, Cat. #BDA - 15GP, (or equivalent as reviewed and approved by the Owner or their representative) with Red Globes.
- g. Audible Warning Alarms
 - 1.) Start-Up Warning Alarms for mounting at Ticket Counter Control station locations shall be of the Sonalert device as manufactured by Mallory Company Stock #64F278 Type SC250E, or Allen-Bradley DEC/DEP Series alarm 855P-B10DEC22 for continuous tone or 855P-B10DEP22 for pulsing tone, to be determined by the Owner (or equivalent as reviewed and approved by the Owner or their representative). For those Control Stations located in higher ambient noise locations, an alarm of appropriate higher frequency and dB rating shall be used (or equivalent as reviewed and approved by the Owner or their representative). Selection must be made based on actual survey of the location.
 - 2.) Start-Up Warning Alarms for other locations shall be of appropriate frequency and volume levels for the application location (such as baggage make-up areas, outbound transport line areas, and inbound claim areas (public)). Such Audible Warning Alarms shall be as follows:
 - a.) Baggage Make-up Areas: Edwards Bell #340-6N5. Allen-Bradley 855H Series horn, Catalog Number 855H-BA10CD. Federal Bell #46-500-WB (or equivalent as reviewed and approved by the Owner or their representative).
 - 3.) Audible Fault Warning Alarms shall be of a horn type of appropriate frequency and volume level for the application location (such as baggage make-up areas, and outbound transport line areas). Such Audible Fault Warning Alarms shall be as manufactured by Edwards Horn #876-N5, Allen-Bradley 855H Series horn, with Amber Beacon Catalog Number 855H-BCA10CDR5 or without Beacon 855H-BA10CD, or Federal Vibratone Horn #350-WB (or equivalent as reviewed and approved by the Owner or their representative).
- h. Audible/Visual Combination Alarms: Combination alarms for start-up or fault warnings mounted to MCPs, EDS machines, or elsewhere as approved by the Owner or their representative, may be Allen-Bradley 855E Series with 120 VAC control.
- i. Limit or Proximity Switches: Provide precision oil tight plug-in type limit switches with contacts rated for a minimum of 10 amperes continuous duty at 120 volts A.C. Limit switches that are used to sense the position of fire/security doors are to be



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mounted as an external unit to the door adjacent to the track of the door so that the switch can detect when the door is in the fully open position.

- 1.) Systems that will require the application of lanyard activated safety switches for either subsystem or system Emergency Stop Switches. Such Safety Switches must be of the "manual re-settable" type with padlock attachment as manufactured by Rees, Cat. #04944 - xxx, Conveyor Components Corporation, (or equivalent as reviewed and approved by the Owner or their representative).
- 2.) Emergency stop lanyard operated limit switches and their associated lanyard cables are to be mounted along the catwalk or above the conveyor mounted on the stanchions associated to the conveyor.
- 3.) Lanyard cables are to be color coded as follows:
 - a.) E-Stop Lanyard Red
- j. Motor Safety Disconnect Switches
 - 1.) Provide motor safety disconnect switches of the 3-pole, heavy-duty type, horsepower rated and non-fusible with a quick-make and quick-break operating mechanism and a means of padlocking the switch in the OFF position.
 - 2.) Provide a N.O. auxiliary contact for connection to a PLC input.
 - 3.) Motor safety disconnect switches for motors equipped with soft start devices must have an auxiliary N.O. contact interlocked with the associated emergency stop circuit.
 - 4.) Each Motor safety disconnect switch shall be identified with a permanently attached white phenolic plate, engraved with black characters, providing the identification of the conveyor with which the motor is associated. Dymo - type labels are not acceptable. Attaching the ID plate to the safety disconnect door is acceptable.
 - 5.) Use NEMA 12 enclosures for interior equipment and NEMA 4 for exterior equipment.
 - 6.) Clutch/Brake
 - a.) The 3 phase Motor Safety Disconnect is also to be used to interrupt the feed and neutral circuit to any externally powered electric clutch/brake device. The following describes how this shall be accomplished:
 - (1.) Provide 120 Volt AC power to the line side auxiliary contact in the Motor Safety Disconnect Switch (located at the motor) from the MCP.
 - (2.) Wire from the load side of the auxiliary contact of the Motor Safety Disconnect Switch (located at the motor) to the terminal strip in the respective MCP.
 - (3.) At the respective MCP, run two (2) parallel wires from the MCP terminal



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strip to the following:

- (a.) One parallel wire from the terminal strip to the PLC input to indicate that the Motor Safety Disconnect Switch (located at the motor) is in the "ON" or "OFF" position.
- (b.) The other parallel wire shall be the input voltage for the DC power supply that will supply DC power to the associated motor clutch/brake.

k. Security Door Safety Disconnect Switches

- 1.) Provide safety disconnect switches of the 3-pole, heavy-duty type, horsepower rated and non-fusible with a quick-make and quick-break operating mechanism and a means of padlocking the switch in the OFF position.
- 2.) Provide a N.O. auxiliary contact for connection to a PLC input.
- 3.) Each Fire/Security Door safety disconnect switch shall be identified with a permanently attached white phenolic plate, engraved with black characters, providing the identification of the door the disconnect is associated with. Dymo - type labels are not acceptable.
- 4.) Use NEMA 12 enclosures for interior equipment and NEMA 4 for exterior equipment.

l. Relays: Use general-purpose industrial, panel-mounted relays with convertible contacts rated at 10 amperes continuous current at 120 volts A.C. Ensure that all relays are capable of manual operation.

m. Timers: Provide solid state, motor driven timers or utilize timer functions by PLC logic. All timers are to be mounted within the appropriate MCP. Use of timer devices within photocells is not acceptable.

n. Magnetic Motor Starters (NEMA)

- 1.) All motor control equipment shall comply with NEMA Standard ICS-1, ICS-2, UL publication 845 and other applicable standards of NEMA, UL, IEEE, ANSI, NEC and National Electrical Safety Code (or applicable local codes).
- 2.) Provide a separate magnetic motor starter unit for each motor drive section.
- 3.) Provide one auxiliary contact on each starter and wire to a PLC input module.
- 4.) Use size "0" starters for motors of 5 HP and below and size "1" for those above 5 HP. All starters are to be equipped with:
 - a.) Thermal overload protection on all poles.
 - b.) Overload relays of the manual reset type.
 - c.) Control voltage of 120 volts.



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- d.) Electrical and mechanical interlocks where required for reversing applications.
- e.) Open type for panel mounting.
- f.) NEMA 12 enclosure for general-purpose application.
- g.) NEMA 4 for weatherproof application.
- o. Magnetic Motor Starters (IEC)
 - 1.) In lieu of NEMA starters and fuses, IEC rated contactors are acceptable.
 - 2.) IEC starters shall comply by IEC, UL, CSA and VDE standards. NEC article 430 shall apply for group motor installation.
 - 3.) Provide a separate IEC motor starter for each motor drive section.
 - 4.) Provide one auxiliary contact on each starter and wire to PLC input module. Provide monitoring of tripped condition on the Touch Screen Terminal. Provide visible trip indication on the IEC starter
 - 5.) The IEC rated contactors are to be sized one rating higher than recommended by the manufacture.
 - 6.) IEC starters shall be selected by motor full load current and the motor service factor.
 - 7.) Provide IEC with lockout provision.
 - 8.) Be provided with thermal overload protection on all poles.
 - 9.) Provide overload relays of the manual reset type (unless they are already within the IEC motor starter).
- p. Combination Magnetic Motor Starters
 - 1.) In addition to the requirements listed for magnetic starters, equip each combination magnetic starter, if specified, with:
 - a.) An adjustable instantaneous trip circuit breaker interlocked with the enclosure cover with provisions for padlocking the disconnect switch in the "Off" position.
 - b.) An enclosure door capable of being opened only with disconnect switch in the "Off" position.
- q. Overload Heaters
 - 1.) Size overload heaters for each starter in accordance with the full load current rating shown on the actual nameplate of each manufacturers selection tables.
 - 2.) Each individual motor starter should be equipped with overload heaters.
 - 3.) Provide a N.O. auxiliary contact for each overload relay for connection to a PLC input.



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- 4.) Enunciate individual overload failure on the Touch Screen Terminal fault reporting system.

r. Soft Start Devices

- 1.) Provide a soft start device for all drive units within any flat plate/slope pallet baggage make-up as recommended by the manufacturer. The use of a VFD device instead of a soft start device is acceptable.
- 2.) Provide an electrical/electronic soft start device with adjustable starting curve from 0 to 10 seconds for any conveyor drive equipped with a 7-1/2 horsepower motor or larger.
- 3.) Ensure that the electrical control circuitry design provides that the soft start device is always used whenever the associated drive motor(s) are started, regardless of start condition; i.e., regardless if drive motors are started with a control sequence or with activation of the related motor safety disconnect switch.
- 4.) The approved soft start devices, noted in the acceptable manufacturers listing, must be sized for the specific application.

s. Electric Brakes

- 1.) Provide brakes on all incline conveyors and decline conveyors, if not equipped with a VFD, and for any other conveyors where coasting of the conveyor would be detrimental to the operation of the baggage system.
- 2.) Provide an electric brake for decline conveyors that are equipped with a VFD. Wire the brake separately from the Variable Frequency Drive power source to prevent conveyor coasting.
- 3.) Provide dry friction, spring set, solenoid release type brakes integral with the drive motor.
- 4.) Incorporate automatic adjustment of brake disk wear or provide a brake, which requires minimal adjustment.
- 5.) Select the brake to be capable of cycling as required by the conveyor application under full load with no excessive wear.
- 6.) Choose brakes to have a minimum torque rating equal to the starting torque of the motor.
- 7.) Motor brakes that are installed on the end bell of the motors are to be equipped with an external means of "manual release" that would permit maintenance personnel to operate the motor in case of a failure of the brake.
- 8.) Conveyors furnished with a clutch/brake assembly shall be provided with a "Warner Electric" MCS-103-1 power supply (or approved equal) with one torque control, to allow the brake and clutch to be operated separately or both units on at a time. This unit shall be located in the respective MCP.



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t. Variable Frequency Drives (VFD)

- 1.) A programmable Variable Frequency Device (VFD) shall be utilized to control the operation of three-phase induction AC motors for queue, power turns, merge conveyors and all conveyors in all bag tracking zones (sortation and EDS) where coasting of the conveyor would be detrimental to the operation of the baggage system. Dynamic braking shall be provided for all conveyors within the CBIS bag tracking zones.
- 2.) For incline conveyors, on which bags are being tracked, that are equipped with a Variable Frequency Drive unit “anti-roll back” provisions shall be provided on the associated gear box to prevent conveyor coasting.
- 3.) Provide an electric brake, wired separately from the Variable Frequency Drive power source, for decline conveyors, on which bags are being tracked, to prevent conveyor coasting.
- 4.) Type of VFD utilized shall be UL listed and IEC compliant.
- 5.) Provide a means of dissipating drive shaft voltages and bearing currents to ground for all conveyors which are provided with a VFD to prevent premature bearing failures.
- 6.) VFDs shall be typically installed within the respective Motor Control Panel (MCP). To conserve MCP space the BHS Contractor can propose to install the VFD remotely at the drive unit, the Owner or their representative must approve this type of configuration.
- 7.) Provide the ability to program and monitor all drive parameters. Provide programming devices with pre-programmed parameters for various types of VFD programs (e.g. standard queue, merge) to allow simple downloading of such programs when replacement or reprogramming of a VFD is required.
- 8.) Provide a local keypad control for start, stop, speed reference and reverse functions.
- 9.) Provide dynamic braking resistors where required for faster stopping.
- 10.) VFDs shall be capable of permitting the appropriate number of engagement cycles per minute for the specific application under full load with no objectionable heating, overload tripping or other VFD faults. BHS Contractor shall factor this when designing the system and provide VFDs and dynamic braking resistors of a larger power rating if required to meet the application’s requirements.
- 11.) The BHS Contractor shall factor in heat dissipation when designing the MCP and if excessive heat is anticipated from the braking resistors, then mount them in a separate NEMA 12 (for interior equipment) or NEMA 4 (for exterior equipment) rated panel.
- 12.) When using VFDs, VFD rated shielded cable needs to be used. Use Belden, O’flex



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or equivalent cable. The shield should be connected to both the motor and the PE (Potential Earth) ground on the AC drive.

- 13.) For cable length of 50 ft. or more between the drive and motor, a minimum of 1 additional amp needs to be added to the drive rating to handle cable-charging current. For Cable greater than 100 ft in length, a minimum of 2 amps need to be added to the drive rating for cable charging current.
- 14.) If the transformer which is powering the MCP or MCC is greater than 10 times the drive rating, an input line reactor shall be provided for each AC drive.
- 15.) Enunciate all individual variable frequency drive (VFD) failures on the fault reporting system. Automatic resetting of certain faults shall be permitted; however, all such faults shall be enunciated and logged regardless of whether or not they have been automatically reset.
- 16.) The BHS Contractor shall submit to the Owner or their representative catalog cuts of the type of VFD proposed for review and approval.

u. Photocells (Photoelectric Sensors)

- 1.) Provide photocells of the self-contained, retro-reflective type using an infrared modulated light source with sensitivity adjustment and LED status indicator that is readily visible. Retro-reflective type photocells are to be used for applications where the distance between the photocell and the reflector is less than 10'.
- 2.) Photocell applications that require a scan distance of 10' or greater are to use a separate transmitter and receiver rather than the single retro-reflective photocell.
- 3.) Use photocells with quick disconnect cable for ease of replacement; the cable shall be UL recognized, 18AWG; one-piece molded design and be highly visible.
- 4.) Due to wiring constraints and noise on low voltage lines generating false triggers, DC type photocells are not permitted.
- 5.) Mount photocells to structural members or side guards using an adjustable bracket as supplied by the photocell manufacturer so that the photocell is mounted in a vertical, not horizontal, attitude. Alignment and status LEDs shall be easily visible for maintenance personnel. All sensors and cabling shall be firmly anchored and protected from equipment and personnel impact and from random forces imposed by maintenance personnel servicing the equipment or staff working in the area. Mounting and protection devices shall inhibit tampering with sensors and their setting by non-maintenance personnel.
- 6.) Photocell mountings are to be directly attached to the conveyor structure as required. Use of shims between the conveyor structure and the photocell mountings is not acceptable. No penetrations through the side guards or attachment by means of magnets or other non-permanent attachment methods shall be permitted for photocell mountings or mounting brackets.



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- 7.) Hex head 1/4" - 20 bolts of appropriate length and related 1/4" - 20 hardware (flat washers, lock washers and nuts) are to be used for the mounting of the photocells. Use of round head bolts is not acceptable.
- 8.) Mount reflectors to side guards using brackets providing both vertical and rotational adjustment. No penetrations through the side guards shall be permitted for reflector bracket mounting.
- 9.) Where holes through side guards are required, the holes shall be a maximum of 1.5" in diameter and located so that the center of the photocell beam is 2.5" above the conveyor belt. The holes in the side guards shall be dimpled away from baggage flow to minimize the possibility of snagging a bag and causing a jam. Oblong openings in the conveyor side guards are not acceptable.
- 10.) Only one side guard opening per photocell and one side guard opening per related photocell reflector would be accepted. Any unused photocell/reflector openings in the side guards must be properly filled with a welded circular blank, ground smooth and properly painted.
- 11.) Locate photocells on the side of a conveyor having the lesser chance of contact by operating personnel. Guard photocells if susceptible to personnel contact. The photocells are to be located on the catwalk side of conveyors to ensure maintenance access.
- 12.) Do not attach the white phenolic plate photocell device ID plate to the plug-in type photocell or its wired base. Mount the ID plate on the side guard adjacent to the photocell.
- 13.) Provide photocells as required by the functional needs of the BHS. Photocells shall indicate a reliable life of over 10 million cycles, and be repetitive and unaffected by environmental conditions such as vibration, rain, humidity, cold, heat, dust and sunlight. Provisions shall be made to effectively accomplish the sensing of any of the typical types of airline baggage and packages. Photocell installation shall minimize vibration and shall provide protection for both the sensor and its associated wiring. Specifically, care shall be exhibited in the mounting of the photocell and its control wiring to minimize the hazard of damage from the moving of baggage, contact with associated components or by personnel working on or in the vicinity of the system.
- 14.) Use liquid-tight flexible metal conduit for connection of photocells to minimize vibration and shall provide protection for both the sensor and its associated wiring.
- 15.) The BHS Contractor shall supply cordsets of an appropriate length to connect to photocells such that there is no greater than 12" of excess cable length remaining. The excess cable shall be coiled and secured to the associated conveyor with the use of cable mounting clips. The BHS Contractor shall not use plastic cable ties to secure the cordset.



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- 16.) Photocells shall not be subject to interference from standard communication systems employed at the airport location due to airport and airline radio ground communications, ground to aircraft communications, aircraft to aircraft communications or any form of radar equipment operation.
- 17.) For applications that require critical fail-safe operation (e.g. for EDS Applications), the following components must be used:
 - a.) Develop and program PLC logic to ensure that the PLCs are continuously crosschecking outputs from the photocells. The purpose of this code is to ensure failsafe operation of photocells, photocell output wiring, I/O cards, I/O racks, PLC communications, and PLCs themselves. This code shall be written in such a manner that the system will stop appropriate conveyors and alert personnel in the event that the photocell, I/O card, I/O rack, any communication cable or wire breaks, or PLC failure occurs. This code should also include programming to account for long baggage or multiple bags that may appear overlength due to the absence of baggage gaps (stop conveyors if a bag length exceeds the maximum system bag length). In addition, implement software programming filters to prevent erroneous conveyor stoppage due to the distance between photocell mounting locations and bag straps (that may instantaneously break the photocell beam). All applications must be submitted for review and acceptance to the Owner or their Representative prior to installation.
 - b.) (For applications requiring throughput of 10 bags per minute or less) – Allen-Bradley Area Access Control (AAC) units may be used. Catalog number 440L-T4F90018-Q for Transmitter and 440L-R4F90018-Q for Receiver.
 - c.) (For applications requiring throughput of greater than 10 bags per minute) – Allen-Bradley Safety Light Curtain units may be used. Catalog number 440L-P4D0300-N for this Point of Operation Control unit.
 - d.) As an option to (b.) or (c.) above: redundant Allen-Bradley Series 9000 transmitted beam photoelectric sensors with a diagnostic output may be provided. Implement PLC safety controls to prevent unintended use in case of a failure.

v. Shaft Encoders

- 1.) Shaft encoders used for determining conveyor speed must be directly coupled to either the head or tail pulley of the associated conveyor and shall be of appropriate industrial type.
- 2.) Install appropriate safety guarding on all exposed parts associated with the conveyor drive's rotating shaft and direct drive gearbox, in compliance with OSHA Standards 1910.219. Ensure that the proposed safety guarding does not restrict maintenance access and it is easily removable, as the location requires, for maintenance access. Submit shaft encoder attachment and guarding details to the



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Owner or their representative for approval.

- 3.) Use of tension loaded friction drive types of shaft encoders is not acceptable.
- 4.) The BHS Contractor shall supply cordsets of an appropriate length to connect to shaft encoders such that there is no greater than 12" of excess cable length remaining. The excess cable shall be coiled and secured to the associated conveyor with the use of cable mounting clips. The BHS Contractor shall not use plastic cable ties to secure the cordset.
- 5.) Ensure the shaft encoder model chosen is applicable to meet the subsystem tracking criteria based on conveyor belt speed/resolution required (i.e. shaft encoders utilized for tracking within an EDS system (slow speed tracking area) may be a different model compared to those required for sortation system tracking (high speed tracking area)). Submit to the Owner or their representative, the manufacturer's data for the proposed shaft encoder(s) for approval.

C. Electrical Device Identification

1. The electrical control stations, their related control devices, field wired control devices shall be identified with a permanently attached white phenolic plate, engraved with black characters, providing the identification of the control station or control device. Dymo-type labels are not acceptable. Do not attach the white phenolic plate to any field device that can be easily replaced due to failure ((i.e. plug-in type photocell or its wired base) as this would also require the removal and reattachment of the ID plate), attach the plate to the side guard or non-removable structure adjacent to the device.
2. The electrical control stations, their related control devices, field wired control devices and the electrical control devices mounted within the BHS related motor control panels (MCPs) shall use the following device identification format and designations. The format and identification that are used in this specification are to be used throughout the BHS project and are to appear on the designated equipment and the entire project related documentation.

a. Control Stations

- 1.) Control Stations shall be identified with the prefix CS followed by the actual Conveyor or BHS Equipment Identification Number to which the Control Station is related. For example, CS/TC1-6 identifies a Control Station located on Ticket Counter Subsystem #1 related Conveyor #6. Note that when there is more than one Control Station associated with a Conveyor or BHS Device, alpha designators will also be used. For example, CS/TC1-6A, CS/TC1-6B, CS/TC1-6C signifies that Ticket Counter, Subsystem #1 related Conveyor #6 has three Control Stations. The "A" prefix identifies the Station related to the charge end of the Conveyor while the last or highest letter indicates the Station closest to the discharge end of the Conveyor.
- 2.) Each Control Station shall be identified with a permanently attached white phenolic plate, engraved with black characters, providing the identification of the Control Station. Dymo- type labels are not acceptable.



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b. Control Station Devices

1.) Control Station Devices shall be identified as follows:

Control Station Device	Identification
Start Re-Start Push-Button	SPB
Normal Stop Push-Button	PBS
Emergency Stop Push-Button	EPB
Reset Push-Button	RPB
Selector Switch	SSW
Key Operated Switch	KSW
Sonalert Warning Device	ALM
Bag Advance Switch	BAS
Alert Light Reset	LPB
Reverse Start/Re-Start Push-Button	PBR
Lamp Test Push-Button	TPB
a.) Alarm Silence Push-Button	APB
b.) Door Close Push-Button	CPB
c.) Door Open Push-Button	OPB
d.) Forward Jog Push-Button	JFB
e.) Reverse Jog Push-Button	JRB
f.) Jog Push-Button	JPB
g.) Jog Selector Switch	JSW
h.) Colored Indicator Light (the first letter of the lamp color will appear instead of the underscore)	LT_

- 2.) For example: The designation CS/TC1-6/RPB identifies a Reset Push-Button in the Control Station located at Ticket Counter Conveyor TC1-6.
- 3.) Note that the above Control Station Device designations are to appear on all electrical drawings, including wiring and schematics.
- 4.) Control Station Control Devices (push-buttons, pilot lights, switches and audible alarms) identification descriptors shall be clearly identified by permanently attached white phenolic plates, engraved with black characters, except emergency stop devices which are to be red with white letters, showing their operational



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relationships to the system(s) or subsystem(s).

- 5.) All e-stop pushbuttons shall clearly indicate all conveyors affected by that e-stop (i.e.: TC1-1/TC1-8 indicates that the E-stop will stop conveyors TC1-1 through TC1-8). Dymo - type labels are not acceptable.
- 6.) All Jam reset pushbuttons shall indicate the conveyor segments, which are controlled by that jam reset control station.
- 7.) Control Station Control Device Function I.D. Tags must be positioned for ease of reading. Align the tag's legend so that it is legible (oriented) from the operator's access side of the control station.

c. Field Wired Control Devices

- 1.) Photocells shall be identified as PE followed by the Identification of the Baggage Handling Device or Conveyor on which the Photocell is mounted. For example: PE/TX1-6 identifies a Photocell located on Transfer Conveyor TX1-6.
- 2.) Limit Switches shall be identified as LS followed by the identification of the Baggage Handling Device or Conveyor to which the Limit Switch is related. For example: LS/TC1-2 identifies a Limit Switch on Ticket Counter Conveyor TC1-2.
- 3.) Warning Alarms shall be identified as WA followed by the Identification of the Baggage Handling Device or Conveyor to which the Warning Alarm is related. Lights shall be identified as LT followed by the identification of the Baggage Handling Device or Conveyor on which the light is mounted. For example: LT/OS1-1 identifies a light located adjacent or mounted on Oversize Bag Conveyor OS1-1.
- 4.) Hour meters shall be identified as HM followed by the identification of MCP to which the hour meter is related. For example: HM/MCP-1 identifies an hour meter on motor control panel MCP-1.
- 5.) Manual Encoding Consoles shall be identified as EC followed by the identification of the Baggage System Conveyor to which the Console is related. For example: EC/ME1-25 identifies a manual-encoding console related to Manual Encoding Conveyor ME1-25.
- 6.) Bag Status Displays shall be identified as BSD followed by the identification of the Baggage System Conveyor to which the Console is related. For example: BSD/AL1-25 identifies a bag status display related to Suspect Bag Conveyor AL1-25
- 7.) Emergency Stop Lanyards shall be identified as EL followed by the identification of the Baggage System Conveyor on which the Emergency Stop Lanyard Limit Switch is mounted. For example: EL/ML1-2 identifies an Emergency Stop lanyard related to Mainline Conveyor ML1-2.



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- 8.) Shaft Encoders shall be identified as SE followed by the identification of the Baggage System Conveyor on which the Shaft Encoder is mounted. For example: SE/ML1-2 identifies a Shaft Encoder mounted on Mainline Conveyor ML1-2.
- 9.) Security Card Readers shall be identified as SR followed by the identification of the Baggage System Conveyor to which the Security Card Reader is related. For example: SR/TC1-1 identifies a security card reader related to Ticket Counter Conveyor TC1-1.
- 10.) Motor Safety Disconnect Switches shall be identified as “MSD” followed by the identification of the Baggage System Conveyor to which the Motor Safety Disconnect Switch is related. For example: MSD/TC1-09 identifies a Motor Safety Disconnect Switch related to Ticket Counter Conveyor TC1-09.
- 11.) Field Wired Control Devices (Security Card Readers, Photocells, Limit Switches, and Bag Status Displays) are to be clearly identified by permanently attached white phenolic plates, engraved with black characters with the control device I.D. Dymo type labels are not acceptable.
- 12.) All field installed Junction Boxes are to be provided with white phenolic plates engraved with black characters. The I.D. tags are to be located, so as to be easily read from the adjacent maintenance access areas. The I.D. tags must be consistent with the associated subsystem identifications noted on the wiring schematics. For example the second junction box from MCP-TC1 would be “JB/TC1-02”.

d. Control Devices within Motor Control Panels and Workstations

- 1.) The identification of control devices and components such as relays, timers, transformers, power supplies, overloads, fuses, and PLCs within motor control panels must be identified with I.D. tags.
- 2.) The I.D. tags must be constructed of a white phenolic plate engraved with black characters. Dymo type labels are not acceptable. The I.D. tags must be located so that they can be easily read when the related motor control panel is opened.
- 3.) The I.D. tags are not to be mounted on the covers of the Panduit wireways within the related cabinet or control panel.
- 4.) The I.D. tags for motor starters must contain the conveyor I.D. For example: The motor starter I.D. tag for conveyor TC1-1 would be “TC1-1M”.

2.11 MOTOR CONTROL PANELS (MCP)

A. General

1. All control equipment for the newly installed conveyors shall be housed within new motor control panel(s) for the associated subsystems. Ensure adequate capacity within the panel(s) for all necessary control devices.
2. Provide motor control panels that are UL listed employing NEMA 12 enclosures with fully gasketed doors for interior use or NEMA 4 enclosures for exterior located MCP(s) (or



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- applicable local codes). MCP-CL1/MU1 shall be NEMA 4.
3. The MCP shall include a fusible disconnect switch (with Class J or R fuses) or molded-case circuit breaker for the incoming power supply. Additionally the fused disconnect switch for the MCP shall have the following features:
 - a. Flange enclosure construction where the external handle, connecting bar/cable and disconnect switch are always connected regardless if the MCP door is open or closed.
 - b. Provides a quick make / quick break design.
 - c. Provides an indication at the circuit breaker or the fusible disconnect switch inside the MCP that the disconnect is in the ON or OFF position.
 - d. Provides a color coded external handle which shall provide visual indication external to the MCP if the disconnect switch is in the ON or OFF position.
 - e. Provides the ability for the external handle to be padlocked in the OFF position for to support Lock-out / Tag-out requirements
 - f. Provides a mechanical interlock to prevent the disconnect switch from being moved to the ON position unless the mechanical interlock is operated.
 - g. Provides a mechanical interlock with the motor control panel door to prevent the motor control panel door from being opened with the disconnect switch in the ON position. The disconnect switch mechanical interlock to the door must have a manual over ride provision to permit the opening the door by qualified personnel using appropriate tools with the disconnect switch in the ON position.
 4. Provide a plexiglass Safety Shield with standoffs (or similar suitable finger-safe protection provisions) over the fuses / circuit breaker for the incoming 480v.
 5. The exterior of the MCP must be painted. The interior of the panel or cabinet including the mounting panel shall be painted white.
 6. Ensure that all Motor Control equipment complies with NEMA Standard ICS-1, ICS-2, UL publication 845 and other applicable standards of NEMA, UL, IEEE, ANSI and National Electrical Safety Codes (or applicable local codes).
 7. Provide thermostatically controlled cooling fans or air conditioning units within the MCP cabinet to monitor and prevent internal temperatures from exceeding 125°F or component environmental limits, whichever is less based on an ambient temperature of 100°F (configurable). Provide replaceable or cleanable filters on the intake vents. Configure, through appropriate controls functionality, the cooling equipment to run when the respective MCP internal temperature reaches 100°F and provide an audible and textual alarm at the Touch Screen Terminal applicable when the temperature exceeds 130°F (configurable).
 8. Provide integral MCP air conditioning units should they be required to prevent the internal temperature of the MCP from reaching 125°F. Provide and install condensing unit drain tubes to the nearest drainage line and coordinate hookup of same with building contractor.



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9. Prior to the installation of overload heaters on the controllers, submit a motor schedule listing motor horsepower, voltage, phase, source of feed, circuit breaker size, disconnect size, conduit and wire size and overload heater size selected to be used.
10. Base interrupting rating of all circuit breakers, fused disconnect switches, motor control centers, and panel boards on short circuit calculations and ensure they are compatible and coordinate with base contract equipment. Refer to National Electrical Code Articles 110 and 430 (or local applicable code) to determine short circuit and overload requirements.
11. Mount fuses or circuit breakers for each magnetic starter directly above the magnetic starter.
12. A laminated card showing motor schedule with horsepower, fuse size and heater size shall be affixed to the inside of the MCP door.
13. The working space in front of the MCP panel shall be a minimum of 36". In all cases, the workspace shall permit at least 90 degree opening of the MCP doors. Refer to National Electrical Code Article 110 (or local applicable code) to determine working space requirements.
14. For any MCPs that are not located on a raised curb or raised floor, provide a concrete or galvanized steel plinth, pedestal, legs or similar means to raise the MCP a minimum of 4 inches above the floor to minimize the possibility of any ground water damage to the MCPs located outside of the BHS control room.
15. Appropriately sized waterproof bushings/seals shall be installed on all conduits and conduit fittings that enter/exit the Motor Control Panel(s).

B. Installation Requirements

1. Comply with the following design and installation requirements:
 - a. Wire the line side of fuses or circuit breakers to a line side terminal strip for their incoming supply.
 - b. Wire the load side of the magnetic starter to a load side terminal strip for the outgoing load.
 - c. Connect all control wires to terminal strips designated for control wiring.
 - d. Make vertical runs of power and control wiring within the panel on either or both of the right or left sides of the backboard.
 - e. Run horizontal runs of power and control wiring between the horizontal rows of starter/fuse block units.
 - f. Enclose all vertical and horizontal wiring in "Panduit" - brand plastic wireways.
 - g. Make minimal wire runs to and from these wireways only to the nearest adjacent fuse block starter or terminal block.
 - h. Use of "latching relays" is not acceptable.



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- i. Use of “alternating relays” is not acceptable.
- j. Any “plug in” type device such as a relay, IEC starters or clutch/brake power supply must be equipped with a spring clip type restraint to prevent the “plug in” device from becoming loose in its socket.
- k. Splicing of control or power wiring within any MCP is not acceptable. All internal and external “field” wiring must be terminated on the appropriate MCP terminal strips.
- l. Appropriate sized waterproof bushings shall be installed on all conduits or conduit fittings that enter the related MCP.
- m. All fuses will be of the appropriate type and size of the FRN or FRS dual element type.

C. Panel Identification

1. Each Motor Control Panel must be identified with an I.D. Tag mounted on the outside face of the Panel Door to the immediate left of the MCP Main Disconnect. The Tag shall identify:
 - a. MCP Designation
 - b. Related Baggage Subsystem
 - c. Related Conveyors or Devices Controlled by the MCP
2. Provide a permanently attached white phenolic plate, engraved with black lines and characters of the subsystem layout, on the door face of each new and existing modified BHS Motor Control Panel, illustrating a graphic representation of the respective subsystem. Orientation of the graphic representation shall be the same as the actual subsystem. The MCP layout map shall be consistent with the Graphic Display of the panelview equipment, which shall monitor the faults of the entire reconfigured baggage handling system.
3. The I.D. Tag shall be secured to the MCP door surface with a minimum of four rivets combined with an appropriate adhesive. Large tags shall require a minimum of four rivets, one for each corner of the tag.

D. Shop Drawings

1. Submit shop drawings to show:
 - a. General Layouts of new subsystem MCPs
 - b. Power, wiring and schematic diagrams
 - c. Outline and wiring diagrams of all special devices
 - d. Manufacturer’s data for all components

E. Utility Outlet

1. In each enclosure or cabinet include a minimum of one appropriately fused grounded duplex receptacle utility outlet meeting locally applicable standards of 120 volt, 20-ampere capacity conveniently located within the panel.



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2. The outlet is to be fed from the line side of the MCP (supplied by others unless otherwise noted) so that the outlet power will remain on regardless of the condition of the MCP.
3. The hot wire providing power to the outlet shall be yellow. All terminations of this wire shall be guarded in order to protect personnel from accidental contact. Mount a warning on the outside of the panel, next to the disconnect switch stating: "CAUTION - THIS CONTROL CABINET CONTAINS YELLOW WIRES WHICH WILL REMAIN "HOT" WHEN THE DISCONNECT SWITCH IS TURNED OFF."

F. Lighting

1. Equip each enclosure or cabinet with an appropriately fused fluorescent lamp extending at least three quarters of the width of the panel. Operate the lamp by a switch located inside the enclosure on the latch side of the primary door so that the light becomes illuminated whenever the enclosure or cabinet door has been opened.
2. The lamp(s) is to be fed from the line side of the MCP, (supplied by others unless otherwise noted) so that the fluorescent lamp will remain on regardless of the condition of the MCP.
3. The hot wire providing power to the lamp shall be yellow. All terminations of this wire shall be guarded in order to protect personnel from accidental contact. Mount a warning on the outside of the panel, next to the disconnect switch stating: "CAUTION - THIS CONTROL CABINET CONTAINS YELLOW WIRES WHICH WILL REMAIN "HOT" WHEN THE DISCONNECT SWITCH IS TURNED OFF."

G. Control Devices

1. General

- b. All MCPs are to be equipped with the following control devices regardless of the type of status monitoring being employed:

1.) System Ready Indication Lamp

- a.) The MCP shall be equipped with a Green Indicator Lamp, which shall become illuminated to indicate that the system is ready for start-up and no faults are indicated on the Touch Screen Terminal or MCP.

2.) MCP Re-Start Push-Button Switch

- a.) A green momentary contact start push-button switch is to be provided for each system or subsystem that is controlled from the MCP. The MCP Re-Start Push-Button Switch shall not be able to start the subsystem from a non-operational mode. It shall only be able to Re-Start the subsystem if the MCP fault has been cleared.

3.) MCP Emergency Stop Push-Button Switch

- a.) Each MCP shall be equipped with a red illuminated maintained contact mushroom head push-button switch for each system or subsystem controlled from the MCP.



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4.) Jam Indication

- a.) Amber Indicator Lamp shall be used to indicate a Jam condition. The Jam Indicator Lamp shall become illuminated whenever a Jam Detector within the subsystem has sensed a Jam Condition. The Indicator Lamp shall remain illuminated until the Jam Condition has been corrected.

5.) Motor Overload Indication

- a.) Blue Indicator Lamp shall be used to indicate Device or Conveyor Groups in which one or more Motor Overloads have tripped. The Motor Overload Blue Indicator Lamp shall become illuminated whenever a Motor Overload Condition develops and shall remain illuminated until the tripped Overload has been reset.

6.) Alarms

- a.) Start-Up/Fault Warning Alarm(s): Each MCP shall be equipped with one amber rotating beacon and one audible horn to indicate imminent subsystem start-up or faults (such as but not limited to jams and motor overloads). The design of the control circuitry shall be such so that multiple faults will always activate the audible and visual alarms; i.e., if a jam condition has activated the fault alarms and the alarm silence push-button has been depressed but the actual fault has not yet been corrected, a second fault occurring after the alarm has been silenced shall again activate the alarm.
- b.) Emergency Stop Warning Alarm(s): Each MCP shall be equipped with one red rotating beacon and one audible horn to indicate an Emergency Stop situation in the subsystem.

7.) Alarm Silence Push-Button Switch

- a.) Each MCP shall be equipped with a yellow momentary contact “Alarm Silence” push-button switch. Activating the Alarm Silence Push-Button shall silence the Audible Warning Alarm. However, the appropriate Indicator Lamp shall continue to be illuminated until the Fault Condition (such as but not limited to jam, motor overload, and e-stop.) has been corrected.

H. System Status

1. Touch Screen Terminal

- a. Supply, install and program Touch Screen Terminal such as an “Allen Bradley”, family of “PanelView” terminals (or equivalent as approved by the Owner or their representative).
- b. The Touch Screen Terminal shall be installed (locations) as indicated on the contract drawing B6.00.02 One on the front face of MCP/CL1-MU1 and one on the outside of the CBRA wall within the CBIS area. The Touch Screen Terminal shall be constructed as a NEMA 4 rating (outdoor) or NEMA 12 for indoor use.



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- c. The Touch Screen Terminal shall be capable of accurately and clearly depict the entire BHS. The terminal shall be configured to display system status as described below, in both text and pictorial format. Submit to the Owner or their representative their functional design for approval.
- d. The graphics portion of the terminal shall display, in real time, dynamic pictorial format, the operational status of the conveyors and make up devices that are connected to the system PLCs. Framed icons and specific conveyor I.D.s representing conveyor sections shall change color according to the following scheme. This shall immediately highlight problem areas so that the problems that arise may be corrected in the minimum amount of time:

Condition	Color
Normal Operation – Conveyor Drive On/Running	Green
Normal Operation – Conveyor Drive Off/Timed Out	Black
Conveyor stopped due to “Cascading”	Magenta
Conveyor Full Condition	White
Emergency Stop Actuation	Red
Overlength/Overheight Condition	Flashing White
Motor Overload	Blue
VFD Fault	Flashing Blue
Shaft Encoder Fault	Cyan
Conveyor Jam Condition	Yellow
HSPD Fail at Home Condition	Yellow
HSPD Failed Extended Condition	Yellow
Push All	Flashing Green
Vertical Sort Conveyor Failed Up	Yellow
Vertical Sort Conveyor Failed Down	Yellow
PLC Communication Loss (Individual Components)	Red
Equipment Out of Service	Brown
Fire Alarm	Flashing Red
Over Temperature	Flashing Red
EDS Device Failure	Red



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BHS/EDS Fault	Flashing Red

- e. The textual portion of the terminal shall display, in color coded text format, the operational status of the conveyors and make up device that are connected to the system PLCs. The terminal provides color indications of a predetermined fixed area of the system. The text portion of the terminal shall not interfere with the graphical display area. The textual portion of the terminal shall automatically scroll to show the most current fault. The textual display must also have a scroll back function to display faults that have scrolled off the display. The condition and the specific conveyor I.D representing the conveyor sections and system devices change color according to the following scheme. This shall immediately highlight problem areas so that the problems that arise may be corrected in the minimum amount of time:

Condition	Color	Text Displayed
Normal Operation – Conveyor Drive On	Green	Running
Normal Operation – Conveyor Drive Off	Black	Timed Out
Conveyor stopped due to “Cascading”	Magenta	Cascade Stopped
Conveyor Full Condition	White	Full
Emergency Stop Actuation	Red	E-Stopped
Overlength/Overheight Condition	Flashing White	Oversize
Motor Overload	Blue	Overload
VFD Fault	Flashing Blue	VFD Fault
Shaft Encoder Fault	Cyan	Shaft Encoder Fault
Conveyor Jam Condition	Yellow	Jam
HSPD Fail at Home Condition	Yellow	Failed Home
HSPD Failed Extended Condition	Yellow	Failed Extended
Divert All	Green	Divert All
Vertical Sort Conveyor Failed Up	Yellow	Failed Up
Vertical Sort Conveyor Failed Down	Yellow	Failed Down
EDS Device Failure	Red	EDS Failure
BHS/EDS Fault	Red	Interface Fault
PLC Communication Loss (Individual	Red	Communication Error



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Components)		
Equipment Out of Service	Brown	Out of Service
Fire Alarm	Red	Fire Alarm
Over Temperature	Red	Over Temperature
Missing Bag Jam	Yellow	Missing Bag Jam

- f. The Touch Screen Terminal shall be connected to an audio/visual alarm, which will be activated when a system alarm is triggered (i.e. jam condition or E-stop).
- g. Provide the Touch Screen Terminal with EPROM or similar to provide memory backup.

2.12 BHS/CBIS PC-TYPE COMPUTER TERMINAL WORKSTATIONS

A. General Design Requirements

1. Supply, install and program one (1) PC-type Computer Terminal Workstation with associated HMI monitors and fault diagnostics displays. The PC-type Computer Terminal Workstation shall consist of, as a minimum, a Windows operating system PC with two (2) 21" monitors and appropriate Graphics Card to support a minimum resolution of 1920x1080, CD-RW/DVD + RW, 250 GB Hard Drive, 4096 MB RAM, an audible alarm with both an alarm silence and a means to Enable/disable this feature. Provide FactoryTalk View SE client software plus all software to support the functions associated with the use as a fault monitoring diagnostics and reporting computer terminal, the hardware of which shall also include the capacity to support the installation of necessary software applications for future reporting functions that shall be reviewed and coordinated with the Owner or their representative during the Contractor's engineering phase.
2. The PC-type Computer Terminal Workstation shall be installed in a NEMA 12 rated Hoffmann Proline Computer Workstation enclosure, Catalog Number PGLD1686CWS, or approved equal, which shall also include a keyboard, and an Upper Front Window Door that shall allow the display to be visible with the door(s) closed. The final location of the workstation shall be coordinated with the Owner. The PC-type Computer Terminal Workstation shall be programmed to monitor the system status and have the capability to serve three (3) the following primary functions, as follows:
 - a. Data base processing.
 - b. Monitoring of system status.
 - c. Statistical information storage.
3. The workstations shall provide the following functionality:
 - a. Graphics and text displays, including the ability to zoom-in to selective areas of outbound BHS subsystem equipment.
 - b. Capability to change the controls functionality of the HSPD and the conveyor segment



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operation through the specified user level password access, for controls functions such as divert all, inhibit the operation of conveyor equipment and the like; all of which shall be reviewed and coordinated with the Owner, the TSA and their representatives.

- c. Provide read access to the daily alarm logs. This access shall also allow the user to save the alarm log data to a CSV (Comma Separated Variable) file, onto a CD/DVD and Hard Drive in the remote workstation. The workstation shall also be provided with a copy of Microsoft Excel.
4. The PC-type Computer Terminal Workstation shall be password protected and require login to perform any functions other than view the display (i.e., anything to do with the alarm logs).
5. The BHS PC-type Computer Terminal Workstation shall be capable of accurately and clearly depicting the entire BHS and CBIS. The terminal(s) shall be configured to display system status as described below, in both text and pictorial format. Submit to the Owner or their Representative the functional design for approval.
6. The graphics portion of the terminals shall display, in real time, dynamic pictorial format, the operational status of all conveyor segments and make up device that are connected to the Baggage Handling PLC system. Framed icons and specific conveyor I.Ds representing conveyor sections shall change color according to the following scheme. This shall immediately highlight problem areas so that the problems that arise may be corrected in the minimum amount of time:

Condition	Color
Normal Operation – Conveyor Drive On/Running	Green
Normal Operation – Conveyor Drive Off/Timed Out	Black
Conveyor stopped due to “Cascading”	Magenta
Conveyor Full Condition	White
Emergency Stop Actuation	Red
Over-Length/Over-Height Condition	Flashing White
Motor Overload	Blue
VFD Fault	Flashing Blue
Shaft Encoder Fault	Cyan
Conveyor Jam Condition	Yellow
Diverter Fail at Home Condition	Yellow
Diverter Failed Extended Condition	Yellow
Divert All	Flashing Green
PLC Communication Loss (Individual Components)	Red
Equipment Out of Service	Brown



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Condition	Color
Over Temperature	Flashing Red
Fire Alarm	Flashing Red
EDS Machine Failure	Red
BHS/EDS Fault	Flashing Red
Data Communication Error	Yellow
Added Bag Fault	Yellow
End Safety Cap Activated	Red
Normal Operation – Conveyor Drive On/Running	Green
Normal Operation – Conveyor Drive Off/Timed Out	Black
Conveyor stopped due to “Cascading”	Magenta
Conveyor Full Condition	White
Emergency Stop Actuation	Red
Overlength/Overheight Condition	Flashing White
Motor Overload	Blue
VFD Fault	Flashing Blue
Shaft Encoder Fault	Cyan
Conveyor Jam Condition	Yellow
Diverter Fail at Home Condition	Yellow
Diverter Failed Extended Condition	Yellow
Divert All	Flashing Green
PLC Communication Loss (Individual Components)	Red
Equipment Out of Service	Brown
Over Temperature	Flashing Red
Fire Alarm	Flashing Red
EDS Machine Failure	Red
BHS/EDS Fault	Flashing Red
Data Communication Error	Yellow
Added Bag Fault	Yellow
End Safety Cap Activated	Red

- The textual portion of the terminals shall display, in color coded text format, the operational status of the conveyor segments and make up device that are connected to the Baggage Handling PLC system. The terminals shall provide color indications of a predetermined fixed area of the system. The text portion of the terminal shall not interfere with the graphical display area. The textual portion of the terminal shall automatically scroll to show the most current fault. The textual display shall also have a scroll back function to display



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faults that have scrolled off the display. The condition and the specific conveyor I.D representing the conveyor sections and system devices shall change color according to the following scheme. This shall immediately highlight problem areas so that the problems that arise may be corrected in the minimum amount of time:

Condition	Color	Text Displayed
Normal Operation – Conveyor Drive On/Running	Green	Running
Normal Operation – Conveyor Drive Off/Timed out	Black	Timed Out
Conveyor stopped due to “Cascading”	Magenta	Cascade Stopped
Conveyor Full Condition	White	Full
Emergency Stop Actuation	Red	E-Stopped
Overlength/Overheight Condition	Flashing White	Oddsize
Motor Overload	Blue	Overload
VFD Fault	Flashing Blue	VFD Fault
Shaft Encoder Fault	Cyan	Shaft Encoder Fault
Conveyor Jam Condition	Yellow	Jam
Diverter Fail at Home Condition	Yellow	Failed Home
Diverter Failed Extended Condition	Yellow	Failed Extended
Divert All	Green	Push All
EDS Machine Failure	Red	EDS Failure
BHS/EDS Fault	Red	BHS/EDS Fault
Data Communication Error	Yellow	Communication Error
PLC Communication Loss (Individual Components)	Red	Communication Loss
Equipment Out of Service	Brown	Out of Service
Fire Alarm	Red	Fire Alarm
Over Temperature	Red	Over Temperature
Missing Bag Jam	Yellow	Missing Bag Jam
Added Bag Fault	Yellow	Added Bag Fault



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Condition	Color	Text Displayed
End Safety Cap Activated	Red	End Safety Cap Activated

8. The BHS PC-type Computer Terminal Workstations shall be connected to an audio/visual alarm, which will be activated when a system alarm is triggered (i.e. jam condition or E-stop and the like).
9. Provide the PC-type Computer Terminal Workstations with EPROM or similar to provide memory backup.
10. Thermostatically controlled cooling fans
 - a. Provide thermostatically controlled cooling fans within the workstation enclosure to monitor and prevent internal temperatures from exceeding component environmental limits that are sized based on an ambient temperature of 100° F (configurable). Provide replaceable or cleanable filters on the intake vents. Configure, through appropriate controls functionality, the cooling fans to run when the pre-set ambient temperature is exceeded. The workstation enclosure over-temperature (e.g., 120° F) shall be monitored by its respective computer terminal. When the workstation enclosure temperature exceeds the pre-set limit (which shall be configurable) a distinct alarm message shall be displayed on the workstation graphics and text display. Provide separate circuits for the power and control of the cooling fans; note that these circuits shall originate within the respective workstation. As an option, and at no additional cost to the project, the Contractor may propose the use of an integral workstation air conditioning unit to prevent the internal temperature of the workstation enclosure from reaching 120°F; should this option be provided, install condensing unit drain tubes to the nearest drainage line, as coordinated with the Owner or their Representative.
11. Printers
 - a. All printed messages shall be date and time stamped. Fault Alarm messages are to provide date and time of occurrence and date and topic of fault clear. Reports are to provide date and time of printing. All times shall be given in military time, e.g., one o'clock in the afternoon shall be printed as 13:00:00.
 - b. Provide a high-speed laser printer for each Workstation to print reports.
 - c. Provide a local means of troubleshooting faults at each printer.
 - d. A means to manually clear the printer queue (buffer) shall be provided.
 - e. All dates printed out shall be in the order of Month/Day/Year.
 - f. Submit to the Owner or their Representative the proposed printer(s) manufacturer's literature for review and approval
12. Reporting



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- a. Provide the statistical information gathering and report generation capability to display and print certain defined information considered essential to the successful operation of the system.
- b. Provide six (6) levels of usernames with password protection against unauthorized access to the system:

Level	User	Access
Level 1	Handling Agent	Ability to view, print and achieve reports regarding passenger and flights handled by the agent logged on
Level 2	Operator	Access to normal operational modes
Level 3	System Engineer	Access to all operational modes
Level 4	System Manager	Access to all operational modes plus ability to change software
Level 5	System Administrator	Access to all operational modes plus ability to change software and assign user names and passwords
Level TSA	TSA Manager	Access to all TSA only operational modes

- c. Provide a standard "Report Generator" to permit compilation of additional statistical reports or to modify existing reports. Requires Level 4 and 5 protections for use of this function.
- d. Employ a user-friendly Human Machine Interface (HMI) with menu-driven routines to permit access to the system.
- e. The type of fault diagnostics and reporting functions that shall be employed for this project shall have the functionality (to be user friendly) to allow the Owner to easily modify/generate/develop Operational and Maintenance reports to meet their own needs.
- f. Provide ability to view all reports on screen as well as in printed format or file format (CSV and PDF).
- g. Provide ability to save, in buffer storage, and print on a first-in, first-out basis up to 20-flight closeout Reports or end of day reports in the event the printer is busy at any given time.



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- h. Provide ability to produce daily, hourly, weekly, monthly, quarterly, and annual reports as well as reports based on a user defined interval.
 - i. Provide a means to reset all non-SSI statistics and counters. This shall be accessible at levels 3, 4 and 5.
 - j. Provide a means to reset all SSI statistics and counters. This shall be accessible at level TSA.
 - k. Provide the capability to archive all records of statistical data on DVD (tape or CD-ROM is acceptable if required by the Owner).
- 13. Outline of BHS/CBIS reporting to be provided
 - a. Security sensitive information (SSI) such as the following EDS and ETD performance parameters / items shall only be released to TSA Manager Users (i.e., Level TSA):
 - 1.) Screening Alarm %
 - 2.) Time To Decision
 - 3.) EDS Alarm Rates
 - 4.) OSR Alarm Rates
 - 5.) ETD Alarm Rates
 - b. Generate the following reports:
 - 1.) EDS ID Report: Printout of all PLC ID numbers during the operational period.
 - 2.) Immediate Equipment Malfunction and Correction Report: Automatic printout upon detection of each equipment malfunction and each subsequent correction.
 - 3.) Equipment Operational Summary: Printout, by subsystem, of diverter and photocell statistics and summary of individual device malfunctions printed in Equipment Malfunction and Correction Report.
 - 4.) Computer and PLC Status Report: Print out of which computer is on-line/offline and the computer status as well as which PLC is online/offline and the PLC status.
 - 5.) Load Balancing Report: Printout of individual subsystem loading for the operational period. Time interval for current throughput figures is selectable from 1 minute to 24 hours.
 - 6.) EDS Report: Print out of which EDS machine (by EDS Serial Number and EDS Conveyor ID) is on-line/offline and the machine status.
 - 7.) Day End Report: Printout of throughputs and outputs. Automatically printed at the end of the operation period. Also provide a means to print report on demand or at selectable intervals.
 - 8.) Bag Data Consisting of the following items:



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- a.) BHS Tracking ID Number for each bag (Shared by BHS and EDS).
 - b.) Bag Type (OOG or in-spec).
 - c.) Screened by EDS Machine with machine Serial Number.
 - d.) Time Stamped when entering into the EDS machine or time Stamped when OOG bags are identified.
 - e.) Level 2 Screening Status.
 - f.) Time Stamped at Level 2 Screening Decision. Note: Not all EDS machines have the capability to time stamp at both Level 1 and decisions - Confirm with EDS OEM.
 - g.) Time Stamped when removed from the subsystem for ETD.
 - h.) Time Stamped when re-inserted.
 - i.) CBRA ETD Screening Station Number.
- 9.) EDS Statistics Consisting of the following items:
- a.) Number of Bags Alarmed by Specific EDS Machine.
 - b.) Number of Bags Cleared by Specific EDS Machine.
 - c.) EDS Machine Faults (if known).
 - d.) EDS Machine Hours of Operation.
 - e.) Start Time of Operation.
 - f.) Start Time of Fault.
 - g.) End Time of Fault.
 - h.) End Time of Operation.
- 10.) Critical Tracking PEC Consisting of the following items:
- a.) Bag ID.
 - b.) Bag Disposition.
 - c.) Time, in hours: minutes: seconds.
 - d.) Totals for each disposition type.
- 11.) PEC Tracking Statistics Consisting of the following items:
- a.) Total number of bags seen at each PEC.
 - b.) Total number of missing bags at each PEC.
 - c.) Total number of unknown bags at each PEC.
 - d.) Total number of jams at each PEC.



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e.) Total number of missing bag jams at each PEC.

12.) Daily Report Standards per PGDS, Appendix A: Consisting of the following items:

- a.) Daily CBIS Summary Report.
- b.) Daily CBIS Bag Volume Report.
- c.) CBIS Executive Summary Report.
- d.) PEC Tracking Reports for all PECs within the security tracking zone which include:
 - (1.) Total Bag Count
 - (2.) Total Missing Bag Count
 - (3.) Total Unknown Bag Count
 - (4.) Total Purged Bag Count

2.13 CONTROL SYSTEM DESIGN

A. General Design Requirements

1. This control system specification is intended to define the overall functional requirements of the system. The BHS Contractor is responsible for the definitive architecture and design which shall be subject to review and approval by the Owner or their representative.
2. The Outbound conveyor subsystems shall be controlled by centralized programmable logic controllers (PLCs) configured in a Warm back-up mode. The outbound system status will be monitored by the Panelview/Touchscreen Terminals mounted in the front face of the new MCP's.
3. Submittal of the proposal shall acknowledge the functional intent of the control system specification. Understanding the design shall be the result of modifications/refinements to the minimum requirements established herein. These changes shall not be the basis for increased cost requests.
4. Submit for the Owner or their representative's review and approval, a comprehensive and detailed system description. This description shall include full details of operational procedures and control system provisions associated with the BHS, including but not limited to the following:
 - a. Control system development and implementation master schedule
 - b. Schedule of system hardware employed (main elements)
 - c. Interfaces to EDS devices
 - d. Start-up/shutdown procedures
 - e. Description of conveyor control logic outlined by subsystem



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- f. Data input and output routines (i.e., management/maintenance information systems)
 - g. Automatic operational/maintenance/defect/status routines (including format)
 - h. Audio/Visual indications
 - i. Control station layouts/functions/operations
 - j. Fall-back/Anti-grid lock procedures
 - k. Redundancy schematics/provisions
 - l. Power supply requirements (including UPS schematics/redundancy and layout)
 - m. BHS Computer operator interface routines
 - n. Typical programming blocks
 - o. Proposed overall system architectural diagram clearly identifying the controls system with respective data communication highways; at a minimum all system PLCs with functions of each clearly identified UPS', Hubs (Ethernet, serial), Drivers, and all associated components (i.e., tachometer boxes, photocells, multiplexers), Panelview Displays and proposed networking.
5. The BHS Contractor shall be available to attend all meetings as required and will actively project manage the BHS design, design review process, and documentation process. The BHS Contractor shall also be required to attend a minimum of two mandated control system meetings at the job site or the Owner's office to review the Control System Functional Specifications and Electrical Control System design. Submit material to be reviewed at the meetings at least two weeks prior to the meetings. The control system meetings attendance will include as a minimum representatives from the BHS Contractor, the General Contractor, CM and the Owner or their representative. The meetings shall review the following discussion items:
- a. Design Considerations - Meeting 1
 - 1.) Review BHS PC-type Computer Terminal Workstations and system architecture (including UPS requirements and heat load generated for local area), system fault monitoring, and report functionality.
 - 2.) PLCs including Redundancy requirements
 - 3.) Power Requirements and MCP sizes
 - 4.) BHS Interface Requirements
 - a.) Hardware Requirements
 - b.) Software Requirements
 - c.) Software applications
 - d.) BHS/EDS Security Systems Interface Requirements



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- e.) Security Door and Security Card Swipe Interfaces
- f.) Production/Testing Schedule
- b. Design Review - Meeting 2
 - 1.) Updates to previous meeting
 - 2.) General Control Logic per Subsystem
 - a.) Start-up/Shutdown Procedures
 - b.) Jam Detection and “Restart” Procedures
 - c.) Cascade Operation
 - d.) Emergency Stop and “Restart” Procedures
 - e.) Audio/visual indications and locations
 - f.) Security Door and Security Card Swipe Procedures
 - g.) SS conveyor subsystem Baggage Flow Balancing
 - h.) CBIS Fallback Procedures
 - i.) General Control Logic per Subsystem
 - 3.) SS Subsystems.
 - a.) Positive Bag Tracking requirements throughout the CBIS.
 - b.) EDS Subsystem Startup/shut down procedures
 - c.) Test Mode
 - d.) Insert Mode
 - e.) Bag ID# Assignment and hand overs between BHS/EDS
 - f.) Fail safe measures and fault handling between EDS machine and unclear bag transition points
 - g.) SS1 and SS2 Security Shunt Conveyor Subsystem prioritization and Baggage Flow Balancing
 - h.) EDS Reports
 - i.) DID design
 - j.) Panelview/Touch Screen Terminal functionality
- c. Design Consideration – Meeting 3
 - 1.) Updates to previous meeting
 - 2.) PC-type Computer Terminal Workstation Maintenance Diagnostics Review
 - a.) Review Sample Screens



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- 3.) PC-type Computer Terminal Workstation Reporting Functions
 - a.) Review report format to be developed.
 - (1.) Sample Reports
 - b.) Reporting functions and requirements to be provided.
 - c.) Problem Resolution
 - 4.) Final review of BHS/EDS interface
 - 5.) Final review of other required interfaces (e.g., Terminal Security Access Control Systems).
 - 6.) Electrical System Drawings Review
6. Control System Elements
 - a. The control system shall comprise (as a minimum) the following elements:
 - 1.) Communications highways
 - 2.) Local Area Networks (LANs)
 - 3.) Subsystem MCPs
 - 4.) Programmable Logic Controllers (PLCs), which control the BHS by communicating with the device, level equipment (such as but not limited to photocells, motor starters, and encoders)
 - 5.) Remote I/O located in the subsystem MCPs.
 7. Hardware: All control systems hardware for the BHS PLC systems, and associated purchased software shall be supplied by manufacturers whose products are supported locally, and can demonstrate a minimum of five (5) years' experience in providing control systems for conveyor systems of similar size. The Owner or their representative must approve any equipment that does not meet this requirement.
 8. Control System Elements
 - a. The control system (comprised of the Computer and PLC system Controls) shall comprise (as a minimum) the following elements:
 - b. The following elements are considered to be a part of the High Level Controls:
 - 1.) PC-type Computer Terminal Workstation, which shall allow for the following functions:
 - a.) Automatic switching to the alternate redundant PC-type Computer Terminal Workstation.
 - b.) Collect and store data from the field PLCs to include in reports and status displays at the BHS workstation.



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- c.) Software program(s) as required to accomplish the functions specified herein.
- d.) Video Display Units (VDU) for data output.
- e.) High-speed laser printers.
- f.) Communication modems.
- g.) Transfer switches/interface modules/selector switches.
- 2.) Communications highways.
- 3.) Local Area Networks (LANs)
- c. The control system shall also comprise (as a minimum) the following elements, which are considered to be a part of the Low Level Network:
 - 1.) Subsystem Motor Control Panels
 - 2.) Programmable Logic Controllers (PLCs), which shall control the outbound BHS/CBIS by communicating with the system devices, level equipment (such as but not limited to photocells, motor starters, encoders, and the like)
 - 3.) Remote I/O located in the subsystem MCPs
- 9. Hardware: All control system hardware for the BHS Computers and PLC's and their related systems, and associated purchased software shall be supplied by manufacturers whose products are supported locally, and can demonstrate a minimum of five (5) years of experience in providing control systems for conveyor systems of similar size. The Owner must approve any equipment that does not meet this requirement.
- 10. Computer/Controls Electrical Supply
 - a. The supplied computer/control systems and equipment shall be compatible with, and operate reliably and effectively with, the normal electrical supply typically available. The equipment shall not be unduly sensitive to fluctuations in supply voltage which may vary by plus or minus ten percent (10%) of nominal values. Electrical power supply filters/conditioners and regulators shall be supplied for all equipment, which cannot meet the specifications stipulated.
 - b. All BHS Computers, BDD, and all PLCs for and the BHS/CBIS subsystems for which baggage tracking is required shall employ an Uninterruptible Power Supply (UPS) system(s) capable of storing data for a minimum period of two (2) hours should a power outage occur. All tracking data shall be stored in the PLCs during a power outage so that when power is restored and the conveyors begin running again, baggage will be sent to the appropriate output.
 - 1.) Provide power to the equipment utilizing UPS(s) via the BHS related 120 VAC Power Distribution Panel (PDP). Provide all power hardware (e.g. conduit and wiring) from the dedicated BHS 120 VAC PDP to the UPS and onto the receptacles (including all receptacles) for the BHS related equipment. Coordinate all BHS electrical requirements with Division 16 (Electrical).



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11. System Design Parameters

- a. The system design shall pay particular attention to the following requirements (listed in random order):
 - 1.) High storage capacity upstream of merge points and EDS machine to absorb input peaks without system saturation.
 - 2.) Energy conservation
 - 3.) Satisfactory environment
 - 4.) Operational flexibility
 - 5.) Component and system reliability (including back-up provisions)
 - 6.) High storage capacity upstream of merge points to absorb input peaks without system saturation.
 - 7.) Multiple flow paths (e.g., TC2 takeaway conveyor reversibility function) to permit continued operations despite equipment failure or momentary peaks.

12. Environment: All communication and equipment must be capable of functioning in an industrial environment. Where special environmental conditions are essential for correct equipment operation (e.g. computer hardware), such requirements control shall be clearly identified in the submittals identified in this specification. Factors such as dust, air contamination, and heat from local sources, abrasives, moving or falling objects, or vibration shall also be considered. Advise the Owner or their Representative of the necessity for these provisions as well as the specific requirements for each system.

13. Responsibility for Supply and Installation

- a. Supply and install all necessary BHS Computer and PLC Control System hardware that is required for the BHS installation, to provide a fully functioning system on a “turnkey basis”; this includes all related control consoles, monitors, control stations and associated mounting structures, PDPs, MCPs and PLCs, as required, to satisfy the implementation of the BHS.
- b. Coordinate the requirements of the control system elements in the PC-type Computer Terminal Workstations, MCP/PLCs, field control components and related functions with the Owner or their Representative.

14. Responsibility for Programming

- a. Program the BHS Computers and PLCs for all conveying, maintenance diagnostics and reporting functions associated with the project. Program the control system interfaces between the BHS and any other interfacing system (e.g., such as but not limited to the EDS machine, Fire Alarm and Access Control Security Systems).
- b. Program all monitoring system functions, associated with the BHS project. These functions shall include:



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- 1.) The provision of audible and visual system alarms at the workstation(s) (e.g. both on the computer monitor and on the printers).
- 2.) Real time reaction to a failure and the capability of choosing alternate paths from the monitoring system.
- c. Programming techniques, data structures, and documentation shall be acceptable to, and approved by, the Owner or their Representative. Details of the above shall be made available to the Owner or their Representative.
- d. Submit the as-built programming documentation for the BHS computers and PLCs to the Owner as follows:
 - 1.) Two complete (duplicate) CD sets covering all applicable computer and PLC programming documentation.
 - 2.) Two complete (duplicate) sets of hard copy documentation (all programs).
 - 3.) Software for the BHS computer systems as well as the BHS PLC control system including all PLC ladder logic shall be provided in both searchable .pdf format and software versions.
 - 4.) The system software shall be written using as much non-proprietary software as possible.
 - 5.) Delivered software shall include both executable files and fully commented source code for all applications (with the exception of purchased “off the shelf” software). Include all 3rd party software required to view or edit the source code. Establish with a reputable escrow service company a “software escrow account” for all withheld source code as well as documentation required to reconstruct the executables to invoke “prior intellectual property” rights and withhold source code for any system software. This software escrow account shall provide the Owner access to the source code and documentation for a minimum of 15 years. Access to the escrowed information will be authorized in the event of the Contractor’s inability to correct design errors in the software, contract default, insolvency or termination of business activities.

15. System Redundancy

- a. The BHS PC-type Computer Terminal Workstations shall report on any BHS related hardware failure, raise a critical alarm and inform the maintenance personnel through both display/text monitor(s) and an audible alarm. Provide fully programmed ‘Warm Backup’ redundant PLC’s for the outbound system, and fully programmed ‘Cold Backup’ redundant PLC’s for the outbound Oddsize subsystem. Warm backup PLC’s shall be centralized in the PLC cabinet and shall provide manual switchover in case of a fault. Cold-Back-up PLC’s shall provide redundancy based on removal of the failed PLC, via an arrangement that permits quick replacement of the failed controller processor, with a pre-loaded replacement controller processor (cold back up). The cold back-up PLCs shall be part of the original equipment complement and shall not be



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construed as a spare.

- b. Failure of primary redundant equipment shall not degrade the response time of the control system. In the worst-case scenario where every piece of primary equipment has failed there shall be no impact on system performance whatever the combination of the failure.
- c. The BHS shall reconfigure itself automatically after redundant hardware takes control (the secondary system will become the primary, the failed system will become the secondary when it comes back on-line). The switch over handled by the system shall be fully automatic without need for any operator intervention for the reconfiguration. The BHS shall report any hardware failure, power failure, communication loss, and similar faults by raising a critical alarm and to inform the maintenance personnel through both a visual display on the text monitor(s) and by an audible alarm.
 - 1.) When there is system equipment running on the UPS(s) during a power failure, the BHS shall monitor the UPS(s) battery level, raise a critical alarm and inform the maintenance personnel through display on the text monitor(s) and audible alarm when the battery level becomes critical. This will allow the BHS O&M staff sufficient time to do a systematic shutdown of the BHS computer system. The system should monitor the state of all UPS(s) at all times to ensure that the required power backup functionality is always available and raise an alarm on the PC-type Computer Terminal Workstations if the battery level becomes critical.
- d. Backup equipment where provided shall be used as redundant equipment. All hardware, software, networking and system architecture shall comply with the requirements for a redundant system.

B. Computer and PLC Control System Architecture

1. General

- a. The Control System Network Architecture shall be based on a decentralized Baggage Handling Workstation design and a centralized redundant Warm Back-up PLC system design with remote I/O for the Outbound BHS and Mini In-Line CBIS subsystems. The Outbound Oddsize subsystem is the exception to this, and shall be based on a decentralized redundant Cold Back-up PLC. The control system shall be controlled by new PLCs, these PLCs shall interface with three types of equipment:
 - 1.) BHS field devices (such as but not limited to motors, sensors, scanners)
 - 2.) PC-type Computer Terminal Workstation(s)
- b. The BHS conveyor control system shall be based on multiple Programmable Logic Controllers (PLCs), interconnected to each other by the BHS low-level data communication highways.
- c. Local area networks (high level communications) shall be employed to provide data messaging between the BHS computers and PLCs. Provide industrial network(s) to link together distinct remote stations. Ensure that a single connection failure from any



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interface does not impede the Mini In-Line CBIS and BHS operation.

- d. The Owner's high-level network should be used for connection to all applicable systems and all other networks (e.g. Fire Alarm and Access Control Security Systems). The Contractor shall supply data communication highways. Provide all necessary connection(s) from the Owner provided high-level network to the BHS network (for example, 1000 base Ethernet with TCP/IP).
- e. Baggage encoding for the CBIS shall be accomplished by the BHS (at the point of pseudo-ID acquisition), or by utilizing the EDS machine if a bag ID is not received from the BHS. Positive baggage tracking of the CBIS security screening process shall start with an interface at the baggage dimensioning device and at the handoff point from the BHS to the EDS machine, as specified elsewhere in this specification.
- f. The BHS PC-type Computer Terminal Workstations shall provide two (2) ports for each of the interfaces. It shall be the Contractor's responsibility to ensure that a single connection failure from any of the connected airport information systems does not impede the BHS operation.
- g. The Control system architecture presented herein is for reference only and is intended to convey the minimum functional system requirements for the interfacing of the Mini In-Line CBIS and BHS equipment, and other Terminal system(s). The Contractor shall consider the following:
 - 1.) Centralizing the entirety of the outbound BHS and CBIS PLC equipment in a PLC cabinet (with the exception of the Oddsize subsystem, which can be decentralized) and utilizing remote or centralized I/O. The PLC system equipment shall be configured in Warm-Back-up configuration and provide a "bumpless and seamless transfer" of controls and information should the primary processor experience a failure. Display the subsystem status monitoring and report functionality for all the CBIS and BHS equipment (complete outbound BHS within the Ivan Munroe Terminal).
 - 2.) Provision of BHS PC-type Computer Terminal Workstations and outbound BHS PLCs with I/O located within the Motor Control Panels.
 - 3.) Provision of Oddsize Outbound subsystem PLC equipment (primary and cold back-up) located within the Motor Control Panels with system status monitoring on the PC-type Computer Terminal Workstations.
 - 4.) Utilization of multiple PC based computers.
 - 5.) The Contractor shall provide startup warning alarms and sufficient startup delay to comply with OSHA standards on all conveyors.
 - 6.) The Contractor shall be responsible for all necessary field component controls (such as but not limited to photocells, belt tachometers, BDD and control stations) for the installed conveyors.
 - 7.) BHS and Mini In-Line CBIS HSPDs shall have the capability to be put into either



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a divert-all mode, divert every other bag or disabled operation. Additionally, several contingency operation scenarios require the operation of HSPDs in a particular manner, and the selection of those modes shall be available through the PC-type Computer Terminal Workstations. All selections shall be selectable on the workstation computers. This HSPD capability will be reviewed and approved by the Owner and the TSA or their representatives.

2. Baggage Handling Computer (BHC) System Equipment

a. General

- 1.) The computer system equipment shall be off the shelf, currently supported by the vendor. The below listed requirements are minimum requirements; all hardware and software applications to be provided shall be considered to be “state of the art” at the time of the bid award.
- 2.) Provide a BHC system that shall include PC-type Workstation(s) management and statistical reporting functions for the entire Ivan Munroe Terminal outbound BHS reflecting the specified BHS/CBIS installation and all associated equipment, including the EDS machine.

b. BHC System Elements

- 1.) The following elements are considered to be a part of the baggage handling computer system:
 - a.) PC-type Computer Terminal Workstation(s), which shall allow for the following functions:
 - (1.) Concurrent operation of both PC-type Computer Terminal Workstation computers, so that in the event of a failure of one workstation, the other one is not affected and can be used for all tasks associated with the BHS and CBIS.
 - (2.) Collect and store data from the field PLCs to include in reports and status displays at the BHS workstation.
 - (3.) Software program(s) as required to accomplish the functions specified herein.
 - b.) BHS workstations, which shall allow for the following functions:
 - (1.) Software program(s) as required to accomplish the functions specified herein.
 - (2.) Video Display Units (VDU) for data output.
 - (3.) High-speed laser printers.
 - (4.) Communication modems.
 - (5.) Transfer switches/interface modules/selector switches.



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- c.) Communications highways
- d.) Local Area Networks (LANs)
- c. PC-type Computer Terminal Workstation(s) - Management Information System (MIS) and Maintenance Diagnostics System (MDS)
 - 1.) The PC-type Computer Terminal Workstation(s) shall provide MIS/MDS type functionality in addition to the top level BHS control functions and shall be configured as a redundant system for the BHS and CBIS statistical information gathering and report generation capability to permit the display and printing of certain defined Operations and Maintenance Reports; both printed and on-screen. The PC-type Computer Terminal Workstation(s) shall be located at the Ground Level area, as illustrated in the accompanying drawing package. The PC-type Computer Terminal Workstation(s) shall collect data from the BHS and Mini In-Line CBIS PLCs, including the EDS machine, and accurately display the pertinent information on diagnostic screens.
 - 2.) The PC-type Computer Terminal Workstation(s) shall provide the Human Machine Interface (HMI) fault monitoring of the Outbound BHS. Both the primary and redundant Touchscreen Terminal/PC workstations shall be located at the Ground Level area, as illustrated in the BHS drawings. The MIS/MDS shall consist of PC Type computers, which shall be online at all times with the PLCs for data collection. This computer system shall collect data from the PLCs, which shall include all BHS and CBIS equipment / control functions (including the EDS machine) and display them accurately and clearly (i.e., in real-time, dynamic pictorial format). Display all the pertinent information and operational status of the BHS and Mini In-Line CBIS on the graphic and text screens, which shall provide color indications of predefined system areas. The PC-type MIS/MDS Computer Terminal Workstation(s) shall have the capability to monitor the BHS and the Mini In-Line CBIS with zoom capability into any part of the system for more specific details of the fault.
- 3. BHC System Workstations
 - a. The BHC System Workstations shall provide the HMI interface to the BHS and CBIS and shall be composed of multiple computing nodes configured in a redundant, independent arrangement to provide the following minimum basic functions:
 - 1.) Operator interface to the PC-type Computer Terminal Workstations.
 - 2.) Permit operators to produce statistical and custom reports.
 - 3.) Allow operators to monitor the system status, respond to faults and configure equipment control.
 - 4.) Enable and disable certain system control functions.
 - b. The workstations shall be provided with appropriate log-on procedures, based on predefined user names and associated passwords, as specified elsewhere in this



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specification.

4. BHS Interface Requirements

- a. The BHS Computer/Controls System shall interface directly with the Ivan Munroe Terminal Fire Alarm and Security Access Control System for the BHS related Fire/Security Doors. Coordinate the location of all local smoke detectors and fire zones with the shutdown control functionality of the conveyors that are impacted by a fire alarm.
- b. The BHS Computer/Controls System shall also interface directly with the Mini In-Line EDS security screening machine and the bag status displays at the CBRA workstation(s) (using the Bag Auto ID Transfer or BAIT process between the BIT BSD and the RRS) to allow the transfer of the screened bag image(s) and distinct bag tracking ID number to the CBRA workstation(s). Allow for the transmission of data pertaining to individual bag security status (e.g., cleared, alarmed, EDS Unknown, BHS Unknown). The Computer Control System and PLC Control System shall allow for bag routing contingent on CBIS security status.
- c. The BHS Computer/Control System and the associated Baggage Inspection Table Bag Status Displays shall be interfaced with the CBRA workstations to enable the TSA to bring up the bag identification on the CBRA workstations (i.e. Bag Status Displays).

5. BHS PC-type Computer Terminal Workstation Functional Description

- a. The BHS PC-type Computer Terminal Workstations shall accomplish the following MIS tasks:
 - 1.) Online statistical report generation.
 - 2.) Online maintenance report generation.
 - 3.) It shall be possible to both view on screen and print any report.
 - 4.) TSA data, including passenger and maintenance data. Coordinate with the TSA and the Owner or their Representatives for data information/retention management task requirements.
- b. Each PC-type Computer Terminal Workstation shall be identical in that emulation of any subsystem or function can be accomplished from any workstation. In the event of a failure of one of the two identical Workstations, the other shall be able to function alone and provide all MIS/MDS capabilities while the alternate workstation is unavailable.
- c. In addition to the power conditioning function, if the main power supply fails the system must protect the complete database by means of battery powered data storage, such that re-entry of data is not required after power has been re-established. The battery powered storage system shall give a minimum storage period of two (2) hours before data is lost and must be re-entered. When system equipment is running on UPS(s) during a power failure, the PC-type Computer Terminal Workstations shall



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monitor the UPS's battery level, raise a critical alarm and inform the maintenance personnel through display on the text monitor(s) and audible alarm when the battery level becomes critical, this will allow either the BHS computer system to automatically do a controlled shutdown or give the BHS operator sufficient time to do a systematic shutdown and saving of the database. The system is to automatically perform a safe shutdown when the UPS registers a low power situation.

- d. A simple means to test computers for online capability and subsystem control (if a failure is suspected) shall be provided by means of an operator initiated self-testing routine i.e. using pull down menus. In addition, computers shall carry out automatic self-testing routines each time they are switched on for operation.
 - e. Provide a means to monitor Computer and PLC System Performance including PLC Scan-Times on the PC-type Computer Terminal Workstations. Provide a warning on the PC-type Computer Terminal Workstations when the computer system or PLCs may be close to a "Gridlock" situation, i.e. less than 20% memory capacity.
 - f. Processor and data storage capacity shall be sized to permit up to a 33% increase of processing and storage capacity. Further capacity increase shall be possible by addition of expansion modules.
 - g. The process computers shall have the capability of storing, sorting and processing up to a minimum of ten thousand (10,000) current pseudo-ID bag tag number records, or a sufficient quantity as coordinated with the Owner and TSA to ensure that unique ID's for security screening are preserved according to TSA procedures.
 - h. Application codes and configuration data shall preferably be executed directly from RAM reads instead of loading from mechanical devices such as hard disk. These application programs stored in the RAM should allow remote access for modification and the ability to download revised codes. Only voluminous operational field switching and status data shall be copied and archived to hard disk.
 - i. The task of the PC-type Computer Terminal Workstations is the data administration on the entire control system. The PC-type Computer Terminal Workstations handle the storage and retrieval of configuration data, graphics, and field switching records, BHS status and other database information. The computer systems require the use of "off the shelf" Windows-based operating system for the PC Type MIS/MDS Computer Terminal Workstations.
 - j. Failure of either of the PC-type Computer Terminal Workstations shall initiate a critical alarm (consisting of an audible and text/visual alarm annunciated on the alternate PC-type MIS/MDS Computer Terminal Workstation).
6. Workstation System and Equipment
- a. The Operator Workstations shall provide the operator interface to the PC-type Computer Terminal Workstation MIS/MDS functions. Operators shall also be able to produce statistical reports as specified herein. The Workstations shall also serve as the Operator interface to the MDS allowing operators to monitor the status of the system,



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respond to faults, configure equipment control and all other operational modes. Production of custom reports from the databases maintained by the PC-type MDS Computer Terminal Workstations shall be possible with the use of off-the-shelf software supplied as part of the system.

- b. The workstations shall require log-on procedures with predefined user names and associated passwords. The workstations shall enable and disable certain functions depending on user name. Each Operator Workstation shall operate independently of the others, however, it shall be possible to determine the status of and users logged on to any other workstation (with appropriate user name and password).
- c. There shall be two (2) Operator Workstations as illustrated in the BHS drawings, each shall be provided with two monitors and other hardware (such as but not limited to CPUs and keyboards) as described elsewhere in this specification. Each Workstation shall be capable of controlling the BHS. It shall be possible to configure either Workstation independently in any of the modes listed below. Switching between modes shall take a maximum of five (5) seconds.
- d. The graphic and text screens provided shall be scalable to monitors/displays of differing sizes (i.e., allow for future replacement of monitors/displays of similar sizes without cutting off any information displayed on the workstation screens).
- e. Modes:
 - 1.) When accessing the PC-type Computer Terminal Workstation(s) MDS application - both monitors acting in concert to graphically display the entire system with a floating pointer between the two monitors. When zooming in on a section of the system, only the monitor that displays that section of the system in the overview screen shall show the larger scale area of the system requested by the operator while the other screen shall remain showing its half of the overview screen. In this mode, a three-line text bar shall appear at the bottom of one of the monitors to display system faults in text. The textual display shall scroll showing the most recent, unacknowledged or uncorrected, highest priority faults.
 - 2.) When accessing the PC-type Computer Terminal Workstation(s) MDS application - one monitor graphically displaying the entire system and one monitor providing a textual display of alarms. It shall be possible to configure the text display to display alarms based on different sort criteria such as but not limited to highest priority, unacknowledged/uncorrected, and by alarm time stamp. It shall be possible to configure either screen as the text or graphics monitor.
 - 3.) When accessing other applications - one monitor graphically showing the system status with a five line text bar appearing at the bottom of one of the monitors to display system faults in text. The textual display shall scroll showing the most recent, unacknowledged or uncorrected, highest priority faults. The graphical display shall be that display which was left on that monitor when changing from the MDS application to another application. The other monitor shall provide the



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display for the application being accessed at the Operator Workstation and the keyboard and mouse shall provide input for the current application. It shall be possible to configure either screen to display the above information.

- 4.) When accessing other applications - one monitor providing a textual display of alarms. The configuration of the textual display shall be that configuration which was last defined for the textual display in the MDS application. The other monitor shall provide the display for the application being accessed at the Operator Workstation and the keyboard and mouse shall provide input for the current application. It shall be possible to configure either screen to display the above information.
- f. All aspects of the BHS shall be controlled and monitored by the BHS workstations. The BHS workstation computer equipment shall be housed in workstation type cabinet(s) located in the CBIS area as illustrated in the BHS drawings.
7. Workstation Control System
 - a. The design and operation of the Workstation Control System is to be modeled after the design and operation as basically described herein.
 - b. The description of operation and required equipment is provided as a basic guideline and should not be construed as being all-inclusive.
 - c. The Workstation shall be protected with a continuously running computer virus protection program. The Contractor shall submit details of the anti-virus protection program (i.e. manufacturer) to the Owner or his representative for approval.
 - d. To accommodate the normal daily flight schedules, this system shall be capable of running 24 hours a day, 7 days a week, 52 weeks per year. It is understood that there will be periods during the day/night (dependent on the flight schedule) when the BHS will not be processing baggage to allow periodic maintenance of the computer systems.
8. Workstation Basic Functions
 - a. Both workstations shall house the same software and be interchangeable with the other workstation. This process shall be as simple as unplugging one workstation and plugging in the replacement (if a physical relocation of the Workstation is necessary).
 - b. Both workstations (with the correct security level) shall have the ability to program the PLCs.
 - c. The Workstations shall be configured in a redundant, independent arrangement to provide the following basic functions:
 - 1.) Collect data from the PLCs to include in reports and status displays.
 - 2.) Provide Operations and Maintenance Reports, both printed and on-screen, reflecting system status in the areas of the following. It shall be possible to print any viewed message on the screen. Reports shall be capable of selecting and printing hourly, daily, weekly, monthly, quarterly and yearly updates as well as



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manually entered time periods. Specific report requirements are detailed elsewhere in this specification, however, in general, reports for the following shall be required:

- a.) Throughput (number of bags processed for each subsystem). Selectable in 0 to 60 minute intervals.
 - b.) Equipment operating/malfunction performance summary for each subsystem and individual item
 - c.) System communications behavior
 - d.) EDS Report
 - e.) Day end report
 - f.) Computer and PLC status report
 - g.) Individual PLC status report
- 3.) Display system status and fault conditions on graphic screens, text screens, and printers, indicating the following (this listing is not to be construed as being all inclusive):
- a.) Communications Integrity.
 - b.) Tach/Shaft Encoder Status: Tach out of limits.
 - c.) HSPD Status: Overload, Failed Extended, E-Stopped, Motor Disconnect Off/On, Failed at home, Divert All.
 - d.) Conveyor Status: Timed out, Running, Cascade, E-Stopped, Jammed, Overload, Motor Disconnect Off/On.
 - e.) Oddsize Conveyor Status: Timed out, Running, Cascade, E-Stopped, Motor Disconnect Off/On, Jammed, Overload, Full.
 - f.) Make-up Device Status: Timed out, Running, Cascade, E-Stopped, Motor Disconnect Off/On, Jammed, Overload.
 - g.) BDD Array Status: Array failure, statistics per array. Provide audible fault annunciation at the Workstation for any failure that occurs at the BDD array. Failures include but are not limited to photocell failure, tach failure, and head failure.
 - h.) EDS Machine Status: Timed out, Failed, Restart, Motor Disconnect Off/On.
- 4.) Monitor PLC I/O to sense bag movement; issue sort directives to PLCs to direct bag movement.
- 5.) Provide for system re-route/re-configuration.
- 6.) Allow maintenance and supervisory personnel password protected access to PLC programming software. Provide two (2) levels:



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- a.) Monitor mode
- b.) Program mode
- 7.) Provide a visual indication (e.g. hour glass) to indicate that the computer processors are processing and are running. Display status of a process or processor that is predicated on another process or processor.
- d. Main Menu Options
 - 1.) The following list depicts the menu structure available to an operator from either of the Workstations. Menus are displayed as pop-up windows when the operator presses the associated letter or uses the cursor and enter keys to make choices. The escape key allows one to back out of a menu or dialog box. Some menu choices lead to interactive dialog boxes where the operator may be prompted to enter additional data (i.e., Flight Table information).
 - 2.) Additionally, accompanying text identifies and describes each available Main Menu option. This same text shall also displayed when corresponding items are chosen from the Help Menu screen.
 - 3.) Main Menu Options and Help Menu Screen. The following are samples of the types of main menu and help menu screens that should be available, the Contractor shall submit to the Owner or his representative examples of the screens that are to be utilized for review and approval:
 - a.) Using the Keyboard
 - b.) Utilities
 - c.) Operations Report
 - d.) Maintenance Report
 - e.) Problem Resolution Text
 - f.) Others as required to provide specified function
 - 4.) Using the Keyboard/Mouse: The workstation system uses the keyboard or mouse to make menu selections and to accept data from the user.
 - 5.) Utilities
 - a.) The Utilities Menu is a group of commands that are used for general-purpose needs. The options for this menu are noted below:
 - (1.) Clear all Statistics: Clears ALL of the statistics that are kept by the workstation and the programmable logic controllers. These statistics are kept on a daily basis. Once they are cleared, they cannot be recovered without a password entry and second level confirmation.
 - (2.) Change System Date: Used to set the system date on the workstation system.



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- (3.) Change System Time: Used to set the system time on the workstation system.
 - (4.) Coordinate System Times: Used to update the system time on all system computer and programmable logic controllers.
 - (5.) Change Alarm Printout Spacing: Used to change the spacing between alarm messages on the alarms printer.
 - (6.) Exit to PLC Programming Software: Used to exit normal operational mode and enter into a password protected, maintenance function, for PLC programming and diagnostics functions.
 - (7.) Run Diagnostic Tools: Used to automatically run computer and software diagnostic tools to check on functionality of workstation computers and software.
 - (8.) Others as required to provide specified function
- 6.) Operations Reports: The Operations Reports are used to monitor the daily functions of the system. Reports may be printed to the printer or displayed on the screen or can be transferred to a file in CSV format. Specific report requirements are defined elsewhere in this specification.
- 7.) Maintenance Reports: The Maintenance Reports are used to monitor the status of the pieces of equipment in the system and to diagnose any problems that might arise. Reports may be printed to the printer or displayed on the screen. Specific report requirements are defined elsewhere in this specification.
- 8.) Problem Resolution Text
- a.) Problem Resolution Text is a tool to help correct problems that arise with the conveyor system. When a fault occurs, it will have a number next to the description that appears on the system alarm printer.
 - b.) A selection can be made from the Problem Resolution option on the Main Menu for the appropriate text.
 - c.) The text will state the problem, followed with the proper primary action that should be taken. As is appropriate, additional actions for correction of the problem will also be listed in the text.
 - d.) A brief listing of the problems includes the following. However, this listing is not to be construed as being all inclusive:
 - (1.) Jammed Bag
 - (2.) HSPD Jam
 - (3.) Motor Overload
 - (4.) HSPD Failed at Home



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- (5.) Belt Tach/Shaft Encoder Failure (tach out of limits)
 - (6.) Missing Bag Jam
 - (7.) PLC Communications Line Failure
 - (8.) Off-Line Update Failure
 - (9.) EDS Machine Failure
 - (10.) BDD Failure
 - (11.) OG Subsystem Fault/Failure
- e.) Operator shall have the ability to change, edit, and save all problem resolution text.
- 9.) Override Capability: It shall be possible, through appropriate operator input at the PC-type Computer Terminal Workstations to individually override automatic control of a conveyor thereby allowing the conveyor to run despite a sensor or other such failure. An appropriate graphical and text display shall be provided for conveyors in this “override” mode of operation. Override control of security critical components such as diverters to security screening shall require appropriate high level password protection. Any overridden condition of a security critical component shall be prominently annunciated on the PC-type Computer Terminal Workstations. Startup warning and e-stop functionality shall remain intact despite an override condition. Neither public area conveyors nor security doors at the public area shall have override capability. Coordinate the specific override requirements and functionality with the Owner and their representative.

B. System Status

1. Panelview/Touch Screen Terminal

- a. Supply, install and program Touch Screen Terminal such as an “Allen Bradley”, family of “PanelView” terminals (or equivalent as approved by the Owner or their representative).
- b. The Touch Screen Terminal shall be installed in the front face of each of the new MCP's as indicated on the contract drawings. The Touch Screen Terminal shall be constructed as a NEMA 4 rating (outdoor) or NEMA 12 for indoor use as applicable.
- c. The Touch Screen Terminal shall be capable of accurately and clearly depict the BHS. The terminal shall be configured to display system status as described below, in both text and pictorial format. Submit to the Owner or their representative their functional design for approval.
- d. The graphics portion of the terminal shall display, in real time, dynamic pictorial format, the operational status of the conveyors and make up



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devices that are connected to the system PLCs. Framed icons and specific conveyor I.D.s representing conveyor sections shall change color according to the following scheme. This shall immediately highlight problem areas so that the problems that arise may be corrected in the minimum amount of time:

Condition	Color
Normal Operation – Conveyor Drive On/Running	Green
Normal Operation – Conveyor Drive Off/Timed Out	Black
Emergency Stop Actuation	Red
Motor Overload	Blue
VFD Fault	Flashing Blue
Conveyor Jam Condition	Yellow
PLC Communication Loss (Individual Components)	Red
Equipment Out of Service	Brown
Over Temperature	Flashing Red

- e. The textual portion of the terminal shall display, in color coded text format, the operational status of the conveyors and make up device that are connected to the system PLCs. The terminal provides color indications of a predetermined fixed area of the system. The text portion of the terminal shall not interfere with the graphical display area. The textual portion of the terminal shall automatically scroll to show the most current fault. The textual display must also have a scroll back function to display faults that have scrolled off the display. The condition and the specific conveyor I.D representing the conveyor sections and system devices change color according to the following scheme. This shall immediately highlight problem areas so that the problems that arise may be corrected in the minimum amount of time:

Condition	C o l o r	Text Displayed
Normal Operation – Conveyor Drive On	Green	Running
Normal Operation – Conveyor Drive Off	Black	Timed Out
Emergency Stop Actuation	Red	E-Stopped
Motor Overload	Blue	Overload



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VFD Fault	Flashing Blue	VFD Fault
Conveyor Jam Condition	Yellow	Jam
PLC Communication Loss (Individual Components)	Red	Communication Error
Equipment Out of Service	Brown	Out of Service
Over Temperature	Red	Over Temperature

f. The Touch Screen Terminal shall be connected to an audio/visual alarm, which will be activated when a system alarm is triggered (i.e. jam condition or E-stop).

g. Provide the Touch Screen Terminal with EPROM or similar to provide memory backup.

9. Diagnostics Reporting

- The graphics screens for every application contain context sensitive on-line help for every function. Both operation and displays are designed for personnel who lack computer training. HTML type help navigation of related topics shall be provided. The operator can call up detailed information from the database by clicking the mouse on the lighting elements in the graphic image or by entering search codes on the keyboard. The detailed information is displayed in list and mask form.
- The BHS Contractor may be permitted access by the Owner or their representative from a remote location to perform diagnostics on the application software, check on systems configurations and integrity of database.
- Hardware reliability information of all major individual hardware for this project, including the Mean Time Between Failures (MTBF) and its standard deviation for all the equipment are required for all this equipment.

C. EDS Security Screening Devices

- The BHS shall interface directly with the Mini In-Line EDS security screening machines. Allow for the transmission of data pertaining to individual bag security status (e.g. Cleared, Alarmed, EDS Unknown, BHS Unknown and Out of Gauge). The Control System shall allow for bag routing contingent on the security status.
- Allow for the initiation of a security screening reports to be included with the provided new PC-type Computer Terminal Workstation reports. The security screening reports shall include information regarding the number of bags assigned each security status (e.g. Cleared, Alarmed, EDS Unknown, BHS Unknown and Out of Gauge), and the resulting bag routing.

D. Programmable Logic Controller (PLC) Functional Description

- Provide Programmable Logic Controller(s) (PLCs) for direct interface between all input



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and output devices in the BHS. Wire emergency stop circuits through mechanical control relays; which, when interrupted, will remove all power from the output modules of the PLC.

2. Provide each PLC with an EPROM or similar safeguard to provide memory backup.
3. Provide PLCs with Ethernet capability for connection to external devices, such as the PC-type Computer Terminal Workstations.
4. Provide each PLC with a minimum of 35% excess memory or capacity for 25% expansion and each I/O with space for adding 25% more modules.
5. Input/output (I/O) modules shall have a visual indication of the status of each I/O point. The status displayed shall be for both signals input into each I/O module and the output signal from each I/O module.
6. Provide a fully annotated printout as well as a software copy of the up-to-date PLC software and program.
7. All PLCs shall employ a battery back-up system capable of storing data for a minimum period of two hours, should a power outage occur.
8. In the event of an emergency stop or a power outage on a subsystem, the PLC shall retain all baggage tracking information such that upon restart of the conveyors, the subsystem shall route bags to the appropriate location(s).
9. Provide primary and backup PLCs. Each of the Owner's BHS/CBIS PLCs shall be provided with a warm backup redundant fully programmed PLC, containing the same software/control functions of the respective primary PLC. The minimum requirements for primary and back up PLCs are described in the "Programmable Logic Controller Functional Description" section of this specification.
10. The Oddsize subsystem Programmable Logic Controller (PLC) shall be backed up with an arrangement that permits quick replacement of a failed controller processor with a pre-loaded replacement controller processor (cold back up). Quick replacement shall mean quick cable disconnection and removal of mounting bolts.
11. Provide additional "Warm-Back-up" PLC systems (to control e.g., separate subsystems) if the scan times of the primary "Warm-Back-up" PLCs are too excessive that they cannot carry all the operations of the system (e.g., controls, tracking, EDS interfaces, Communications, HMI). The PLC scan-times for periodic tasks and continuous tasks shall be monitored by the system controls and displayed on the PC-type Computer Terminal Workstations with three different LED indications (e.g., normal, above normal and critical). Above normal and critical PLC scan-time conditions shall be reported to the PC-type Computer Terminal Workstations. The PC Type Computer Terminal Workstation(s) reports shall be available at acceptance testing.
12. The primary function of the Programmable Logic Controllers (PLCs) shall be the control of all conveyors including, but not limited to:



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- a. Tracking of baggage on conveyors from shaft encoders and strategically located photoelectric sensors for verification.
 - b. Tracking shall be of shift register methodology; the use of FIFO shall not be implemented.
 - c. Jam detection
 - d. Normal Start/stop routines
 - e. Auto-Stop/Auto-Start timing circuits and start-up routines
 - f. Actuation of diverters and merges.
 - g. Cascade stop control
 - h. Inch-and-Store control, start/stop routines
 - i. Control of associated feed conveyors
 - j. EDS/BHS interfaces
 - k. Baggage Dimensioner Interfaces
 - l. Statistical reporting to the BHS PC-type Computer Terminal Workstations
 - m. Selection of alternate flow paths in the event of a failure
 - n. Self-diagnostics
13. All PLCs interface modules and I/O cards shall be located in cabinets as specified herein.
14. Commonality of PLC manufacturers shall be maintained utilizing the minimum number of individual models.
15. All BHS equipment associated with the BHS/CBIS shall have fully programmed redundant PLCs that are configured in “warm back-up mode”. In the event of a primary component failure the warm back up has to be manually switched to become the primary component. Warm Back-up refers to a control component that is concurrently tied into the I/O structure along with the associated primary component. In the event of a primary component failure, the warm back-up component shall retain the latest current status of the related system and shall assume full operation after manual intervention. Up until primary component failure, no output from the back-up unit is transmitted. In the event of a failure, the warm back-up processor shall take over control of the system after it has been manually switched to become the primary component. The configuration of the PLCs shall ensure that all bag tracking information shall be continuously updated to both the on-line as well as the warm back-up unit. Only the on-line PLC shall be controlling the operating baggage system. It shall be possible to reset the failed processor without affecting baggage processing so that the system is once again in a fully redundant configuration. Failure of a processor shall be annunciated at the PC-type Computer Terminal Workstations both visually and audibly.

E. CBIS Baggage Tracking Verification



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1. The system shall accurately track baggage in the CBIS to its final decision location (i.e., from the BDD location to a point of diversion, to/from the EDS machine, and the merge onto the clear bag subsystem (including through the failsafe photocell at the baggage removal/reinsert conveyor and the clear bag subsystem). Ensure the shaft encoder model that is chosen is applicable to meet the EDS subsystem tracking criteria based on conveyor belt speed/resolution required (i.e. shaft encoders utilized for tracking within an EDS system (slow speed tracking area).
2. If a bag gets out of its respective “tracking window”, that bag shall be tracked as an “unknown bag” to the baggage removal/reinsert conveyor for (for Level 3 screening). If a bag is not successfully dimensioned or gets out of its respective “tracking window” between the BDD and SS2 diversion point shall be tracked as an “unknown bag” and routed to the OG1 removal conveyor. The Baggage System PC-type Computer Terminal Workstations shall generate appropriate fault messages indicating the “unknown bag”.
3. All baggage dimensioned by the BDD arrays shall be verified for proper destination. If a bag has been successfully dimensioned by the BDD or tracked from the EDS machine but fails to appear at the EDS subsystem tracking photocell, that bag shall be identified as a missing bag by the tracking control system. Three missing bags at a tracking photocell shall cause the tracking control system to automatically stop the associated conveyors and declare a “missing bag jam”. Note that all missing bag occurrences shall be reported regardless if they are singular or multiple occurrences.

F. BHS/CBIS Network Requirements

1. General
 - a. The BHS/CBIS low-level data communication network specifications and requirements are written based on the best hardware, software and network concepts/designs that are available in the market today. Install the latest and best hardware, software and network concepts/designs that are available in the market at the point of installation.
 - b. Submit the following information with regards to the network design issues at the point of bidding to the Owner or his representative:
 - 1.) Performance of the network
 - 2.) Security: No single point of failure
 - 3.) All the protocols to be used
 - 4.) Quality of service in terms of bandwidth management
 - 5.) Installation and site management
 - 6.) Evolution of the network devices
 - 7.) Knowledge transfer
 - 8.) Network architecture and design



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2. Low Level Network

- a. For the BHS low-level network use a Data Communications Highway (DCH) (or approved equivalent) as an industrial network to link together distinct, remote stations. Each station may consist of a programmable controller (PLC), a computer, or an intelligent RS-232-C device (interface module). The DCH shall provide high-speed communication and fast data acquisition. It shall be of rugged construction and well suited to a baggage environment.
- b. The central trunkline of the Data Communications Highway shall consist of adequate cabling capable of high-speed inter-communication between up to 200 devices via interface modules. The central trunkline shall have the capability of being up to 15,000' long, with the remote stations being as far as 100' away from the trunkline. The network shall display a high degree of noise immunity and rejection from electromagnetic and radio frequency interference (EMI/RFI).
- c. The DCH shall utilize a time-sharing method of communication control, thus eliminating the possibility of any one-interface module from dominating the network. The DCH shall allow for inter-communication of many types of ASCII devices, including, but not limited to:
 - 1.) PLCs
 - 2.) Maintenance Terminals
 - 3.) Monitors/Displays
 - 4.) Computers
 - 5.) Printers
 - 6.) Modems
 - 7.) BDDs
- d. For the communication use a synchronous data stream from one interface module to another or to the primary baggage system computer, and provide data transfer, message acknowledgments, and error recovery. The data shall refer to ladder rungs; register data, I/O status, and other information.
- e. Provide RS-232 D-shell connectors with captive retaining screws, "D" concentric twist-lock twin-axial connectors, or approved equipment. In any case, ensure that they provide easy connection to control and interfacing devices, and display a high degree of noise immunity and rejection from EMI/RFI.
- f. Ensure that expansion may be accomplished by interface module-to-interface module linking with no limit.
- g. Use standard protocols with error recovery on all DCH transmissions for error checking.
- h. Place source/destination message routes in the command for each device wishing to



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communicate.

- i. Provide repeaters as required along the length of the communications highway to boost signal strength.
- j. Provide data ports at strategic points on the communications highway to allow for system monitoring by personal computers.
- k. At a minimum, configure the DCH as a ring or provide redundant trunkline to ensure a single break in the trunkline does not render the system inoperable.

l. Network Architecture

- 1.) ControlNet (or approved equivalent) may be installed as an industrial network to link together and provide high-speed communications between distinct remote components of the BHS. The network must be capable of a minimum scan time of 5 ms and be capable of receiving, processing, and transmitting information within 50 ms or as required to facilitate baggage tracking. The network must be capable of operating in a hot backup configuration without any degraded functionality. The cables that form the main backbone shall not have the same cable-laying route and shall be routed a minimum distance of 15 feet apart from one another. This shall ensure that in the event of cable mishap involving a single cable the backbone will not be lost.
- 2.) A communications bridge (for example ControlLogix Gateway (or equal)) must be incorporated to provide interfacing between distinct communication interface modules. This bridge must be capable of providing a link between the High Level network (i.e. PC-type Computer Terminal Workstations, and the like), Data Communication Highway, and the BHS control network (PLCs and all other networked components).
- 3.) The network communication speed must not be less than 5 Mbits/sec. The network architecture should be designed to optimize data transfer between network devices to fulfill the required time constraints.
- 4.) At a minimum, shielded cable shall be used as the physical media to connect components of the network. Cable must be capable of normal use in high noise environments. NEMA approved cable taps, connectors, and adapters suitable for use in a bagroom environment must be used. Fiber optic cable should be used wherever possible.
- 5.) Particular attention must be given to voltage across network components. Refer to manufacturer's literature for exact range of voltage potential.
- 6.) Appropriate power supply ratings must be considered and applied for network components.
- 7.) Repeaters must be used as recommended by the manufacturer to maintain network communication speed and reliability.



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- 8.) Network switch must be by the Owner's approved manufacturer.
- 9.) No more than 32 I/O points may be assigned to each I/O module.

G. Security

1. Provide a secure computer control environment for the BHS. To achieve this, the network operating system shall provide multiple levels of password access appropriate for the level and authorization of staff, workmen or operators working on the BHS.
2. Different passwords are used for different access combinations by:
 - a. Personnel group: Handling agents, apron/baggage supervisors, maintenance staff, CBRA operators, maintenance contractors, or TSA Managers.
 - b. Different operating modes: Operations, monitor, training/ simulations or configure.
 - c. Modes of access: From CBRA, backup sites via dial-up modem lines.
3. Global commands that have a large impact on operations will require higher-level password e.g. invocation of fail-safe to BHS equipment.
4. Operator personnel shall have the capability to monitor all security violations through system alarms. All security violations shall be logged by the system. Security violations shall include the following as a minimum:
 - a. Unsuccessful log-ins
 - b. Expired password date
 - c. Failure to log-off
 - d. Attempting to gain access to a higher user level than logged on for
 - e. Operator initiated event
5. Under Fail-safe conditions, BHS shall default to a pre-defined state (Normally ON). The Contractor shall provide details of how forced fail-safe mode is being invoked for the Owner or his representative's approval.
6. Provide a test mode to allow tests to be carried out off-line on any software modifications carried out before saving the modified program into the live systems.
7. All of the system workstations shall have identical functional capabilities. Selective access to the different functional capabilities shall be controlled through the use of log-on IDs and passwords.
8. The password system must have at least six (6) levels of security clearance, e.g.:
 - a. Handling Agent
 - b. Operator
 - c. System Engineer



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- d. System Manager
 - e. System Administrator
 - f. TSA Manager
9. These different levels of security clearance will differ in the access to the various system functions regarding system operation and configuration. Differentiation shall be at least performed for the following functions:
- a. Display modification
 - b. Database modification
 - c. Report modification
 - d. System configuration
 - e. Report display
 - f. Command initiation
 - g. Operator actions
 - h. Access to operating system
 - i. Application programs
10. Security shall be performed at the access level to a menu, configuration dialogue, command window, and the like.
11. A user level will be assigned to every person who is given access to the system. The user shall be required to log-on to the system through the various interfaces. All log-on shall be recorded in the system event log. Unsuccessful log-ins shall raise an alarm. The system shall maintain a security database of the number of allowable unsuccessful log-ins and password expiry dates, which is maintained by the security officer. This feature shall allow identification of the operator responsible for all operations executed from the specific workstation or interface.
12. If, after eight ((8) configurable) hours an operator has not logged off, an alarm message shall be sent to that operator workstation until that operator is logged off. The intent of this action is to prevent log-on from extending across operator shift changes.
13. Any system event that is operator initiated shall be recorded with the ID of the operator and the workstation it was issued from.
14. Access to the security configuration shall only be allowed to the user with the highest level, e.g. system administrator.
15. Level of access by vendor dial-in shall be by the Owner or his representative's approval.
- H. Software Design Requirements
- 1. Incorporate software/hardware consistent with industry standards, and where required



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software/hardware that is compatible with the Owner's equipment. Schedule a series of coordination meetings with the Owner and his representatives (on-site) prior to detailed design to ensure the connectivity/compatibility proposed software/hardware system. Provide all connections between the BHS related computer/PLC systems.

2. Provide all software proprietary information to the Owner upon Final Acceptance, but this shall not release the Contractor of responsibility for any technical defects (bugs) that occur with the software. In addition, submit to the Owner or his representative a staffing schedule (supervisors and software engineers) to accomplish the specified work.
3. For all software unique to the BHS and not "commercially available" the As-Built Deliverables shall include, as a minimum, all of the information necessary to make revisions in the software program applications for the BHS for changes or expansions or extension of the BHS, such as functional, performance and interface requirements; descriptions of the supervisory, control, and operating software; source listings; flow charts; configuration control documentation; and programmer and user manuals incorporating appropriate modification and control procedures, including the name of any sub-contractor used for preparation of this software.
4. For all "commercially available" software used in the BHS, the As-Built Deliverables shall include all of the documentation that is available from the supplier of such software. Copies of all programmer and user manuals and other similar material shall be provided to the Owner along with a complete and fully documented listing of all software programs.
5. All systems and workstations shall be equipped with continuously running virus detection software to prevent virus infection. Submit details of the virus protection program (i.e. manufacturer and model/version) to the Owner or their representative for approval.
6. At a minimum, adhere to the following software architecture and provide all associated hardware required to accomplish intended functions of the BHS:
 - a. Human Machine Interface (HMI)
 - 1.) Shall provide a user-friendly interface.
 - 2.) Shall be of the multi-tasking operating system type that can control multiple programs at once.
 - 3.) Shall incorporate object linking and embedding (OLE) technology, or similar.
 - 4.) Shall have the ability of running a software program that will automatically monitor the "wellness" of all installed software on the BHS workstation computers. Provide the capability of automatically initiating a self-test routine from any/all of the installed computers.
 - b. Networking/Communication
 - 1.) Shall be compatible with the data communication highway(s) (DCH) protocols.
 - 2.) Shall provide fast interfacing between all communication/ control tiers.



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I. Software Confidentiality

1. Do not disclose, or use in future work, any proprietary operation information of the Owner's facility, or any information considered a trade secret by the Owner, which was obtained during the course of the project work.
2. Except as otherwise required by law, the Owner will not publicly disclose trade secrets or proprietary software information obtained from the Contractor in the performance of the Contractor's obligations pursuant to this Contract. To the extent it is necessary to provide the Contractor's trade secrets or proprietary software information in order to operate or maintain the BHS, the Owner will, by contract, prohibit the Owner's operation and maintenance contractor from publicly or privately disclosing the Contractor's trade secrets or proprietary software information.
3. Any information that the Contractor believes is a trade secret or proprietary software information shall be specifically identified and marked as such. Blanket type identification shall not be permitted.
4. In the event the Owner receives a request for Contractor's specifically identified trade secrets or proprietary software information, the Owner will notify the Contractor, and the Contractor will be required to fully defend, in all forums, the Owner's refusal to produce such information. Otherwise, the Owner will make such information available.
5. All software version upgrades and bug fixes for proprietary software shall be provided during the five (5) year warranty period.

J. Source Code

1. All software shall be delivered with well-commented source code in addition to the executable version. Software shall be delivered in both hard copy and machine-readable formats on a media acceptable to the Owner. The Contractor may propose a non-disclosure agreement.
2. The Owner shall have permission to use the software as necessary to support operations at Tallahassee Regional Airport once obtained from the Contractor.
3. A backup copy of the configured system software shall be provided on DVD-ROM or CD-ROM media. All original distribution software shall be delivered with an installable backup. While DVD-ROM or CD-ROM is the preferred media types, tape or diskette is acceptable if required by the specific software.

- END OF PART II -



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PART III - EXECUTION SPECIFICATIONS

3.01 PREPARATION

A. General

1. Verify conditions in the field prior to start of work. If unanticipated mechanical, electrical, or other elements that conflict with intended function or design are encountered, investigate and measure both nature and extent of the conflict. Submit written report to the Owner in accurate detail. Pending receipt of directive from the Owner, rearrange work schedule as necessary to continue overall job progress without undue delay.
2. Cover and protect systems and equipment from damage and soiling during installation, demolition, removal or alteration work, including equipment to be salvaged and stored. Erect and maintain dust-proof partitions and closures to prevent spread of dust or fumes to occupied portions of the building.
3. Obtain and pay for all airport security badges, permits, inspection fees, and certificates relative to all phases of the BHS construction.
4. Provide supports or bracing to prevent movement, settling, or collapse in which an area is to be removed and adjacent system is to remain. If safety of system appears to be endangered, cease operations and notify the Owner immediately. Take precautions to support endangered work until determination is made for continuing operations.
5. Locate, identify, stub off and disconnect electrical system services that are not indicated to remain. Provide bypass connections to maintain continuity of electrical service to remaining system. Obtain permission and provide advance notice to the Owner if shutdown of electrical service is necessary during changeover.

3.02 WORKMANSHIP

A. General

1. Perform installations, demolition, removal and alteration work as shown within the specified BHS right-of-ways, with due care, including support and bracing. Be responsible for damage, which may be caused by such work, to any part of existing system or items designated for reuse.
2. Perform restoration and new work in accordance with applicable technical sections of the specifications. Where cutting and new work involve the exterior building envelope, consult the Owner to ascertain if existing guarantees, warranties or bonds are in force and execute the work so as not to invalidate such agreements.
3. Execute the work in a careful and orderly manner, with the least possible disturbance to the public and to the occupants of the building(s).
4. Materials installed by the BHS Contractor, whether provided by him or not, shall be installed in a neat and workmanlike manner. Particular attention shall be paid to



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manufacturer's instructions as to installation procedures.

5. Protect the employment and places of employment of each of his employees engaged in the construction work by complying with the appropriate standards as prescribed by OSHA.
6. Take necessary precautions to keep noise producing operations (such as impact hammering, Carborundum sawing, compressed air machinery and the like) to a minimum. Select equipment, which is of a quieter nature than others and enclose areas of operation with acoustical screens and partitions or other means necessary to accomplish reduction of noise.
7. Equip motorized equipment with mufflers or other types of sound control and blanket equipment with acoustical materials.
8. Locate installation, demolition and alteration equipment safely so that no part thereof shall endanger normal airport operations, including runways, terminals, terminal buildings, approach ways, and power utility, lighting and communication lines.
9. Promptly remove debris to avoid interference with system operations.
10. Cut out embedded anchorage and attachment items as required to properly provide for patching and repair of the respective finishes.
11. Ensure that the standard of work and materials throughout the Project shall be of first-class quality and workmanship in every respect, the Owner will not accept workmanship, which for any reason, is otherwise.
12. Ensure that all equipment, components and materials are free from defects.

3.03 FABRICATION & INSTALLATION SPECIAL CONSIDERATIONS

A. General

1. Equipment is to be designed to meet the requirements of handling airline baggage. This entails consideration and care to be used particularly in fabrication of all components to ensure that projections, welds, sharp corners and transfer points that may cause possible damage to various types of bundles, handbags, suitcases, and trunks are eliminated. Ensure that bottom glides on cases, strings, tags, straps, bag handles, destination tags and the like are guarded against damage on side guards, transfer points, and all surfaces which baggage may contact on the conveyor system.
2. Coordinate all on-going site work and with concurrent airport/airline operations.
3. Take into effect any long lead procurement items and take the necessary actions required to complete any installation in the ceiling space.

3.04 DELIVERY, STORAGE, HANDLING AND ON-SITE RESPONSIBILITIES

A. Delivery, Storage, Handling

1. Assume responsibility for the receiving, unloading, storage, protection, security and



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distribution of all material delivered to the site associated with this Contract.

2. As necessary for the work, provide flagmen and erect proper barricades and other safeguards, post danger signs and other warnings as warranted by hazards and existing conditions.
3. Assume responsibility for receiving, storing, handling, setting and connecting all equipment required for the BHS installation.
4. Provide and maintain adequate protection against weather so as to preserve his work, materials, equipment, apparatus and fixtures free from injury, pilferage or damage.
5. Furnish to the Owner, on demand, Bills of Lading for all equipment being shipped to the work site. Identify on each Bill of Lading each component and assembly involved, the equipment items to which they belong, the date and time of pick-up and the expected date and time of delivery to site. The shipping of such material shall involve proper identification of items, proper packing and proper means for unloading them at the work site.

B. On-Site responsibilities

1. General

- a. Erect all temporary barriers and barricades to separate work areas from areas of public access, if applicable.
- b. Provide exhaust fans (e.g. hepafilter) to limit fumes/odors from welding, metal cutting and painting if the work being carried out is in an occupied/operational area.
- c. Coordinate with any interfacing, on-going site work.
- d. Provide adequate portable office facilities, communication, equipment and locker room for field force.
- e. The BHS Contractor shall pay all costs of rental, installation, use and removal of accommodation and communication equipment.
- f. Furnish shop drawings for any substitutions of equipment specified in this specification or shown on the drawings. During the progress of the job, revised drawings may be issued. Ensure all work is performed based on the latest drawings issued.
- g. Clean and maintain work spaces, travel routes, and any other areas of work effected by his trade including but not limited to:
 - 1.) Remove on a daily basis of all erection rubbish and discarded materials.
 - 2.) The burning of waste material is prohibited. Remove and dispose of scrap and waste material in accordance with applicable laws, codes, regulation ordinances and permits.
 - 3.) Be responsible for all fines received for failure to maintain or perform cleaning, and all costs due to damages directly caused by this Contractors work.



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- 4.) The BHS Contractor shall use their hoisting material for rubbish removal.
 - h. Be cognizant that the equipment and lay down areas for the work may/will require relocation as directed by the Construction Manager or the Owner.
 - i. Be responsible for any employee parking and any site transportation that may be required to/from the construction site.
 - j. Be responsible for any escort service required for the transportation of materials and employees on the ATO side of the facilities.
 - k. Enforce the Owner's instructions, laws, and regulations regarding signs, advertisements, fires and the presence of liquor and firearms by any person at the job site.
 - l. Provide the services of a competent field superintendent during erection, wiring, testing and correction of any discrepancies occurring during the Final Acceptance period.
 - m. Smoking shall only be allowed in areas as designated by the Owner.
2. Mechanical Work
 - a. Provide and install all supports, anchors and any other special considerations or requirements not provided for in this Specification but necessary to facilitate the complete mechanical installation and safe operation of all equipment and components.
 - b. Provide electrical connections for heavy-duty machinery, such as welding machines, and battery chargers as required for the installation of the BHS.
 - c. As construction proceeds, perform any additional site surveys which may be necessary.
 - d. Document in writing any mechanical, electrical or piping conflicts that may impact conveyor installation and submit to the Owner or their representative immediately following the site inspection and prior to the installation.
3. Electrical Work
 - a. Provide the necessary conduit, wiring and other electrical components to complete the electrical installation from power distribution points (PDPs), to the equipment and be responsible for all electrical interconnections within the equipment and system.
 - b. Provide all labor, materials, equipment and service necessary for and reasonably incidental to proper completion of all electrical work including electronic controls as required for the proper operation of the system as detailed in these specifications. Provide within the design standardization of components, function and maintenance procedures.
 - c. Drawings and specifications are to be considered as supplementing each other. Work specified but not shown, or shown but not specified, shall be performed or furnished as though mentioned in both specifications and drawings.



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- d. Provide and install as required, at no additional cost to the Owner, minor items, accessories or devices reasonably inferable, as necessary, to complete the electrical installation.
- e. Refer all conflicts between the requirements of these specifications and drawings or between either and applicable codes to the Owner or their representative for clarification before proceeding with the affected portion of the installation.
- f. Obtain and pay for all permits, inspection fees, and certificates relative to the electrical work. Deliver all certificates and letters of approval to the Owner upon completion of the work.
- g. Locate all electrical equipment as shown on drawings. However, actual field conditions shall be checked to determine exact locations and avoid interference with other trades. The Owner or their representative must approve all deviations from the Contract Drawings.
- h. At no additional cost do any reasonable location adjustment of electrical equipment requested by the Owner prior to installation.
- i. At no expense to the Owner, correct work improperly installed due to lack of construction verification.
- j. Install materials and components in a neat and proficient manner. Particular attention shall be paid to manufacturer's instructions as to installation procedures.

3.05 INSTALLATION

A. General

1. Installation of the BHS shall be in strict compliance with the Construction Drawings, to be prepared in compliance with this Specification document and Contract Drawing Package. These drawings shall show in detail the location of each conveyor and the relationships between adjoining conveyors, conveyors and slides or chutes and any other transfer, which might affect baggage movement.
2. Assume responsibility for all interfaces between the BHS and the Facility. Check the "As-Built" condition of the Facility as defined in drawings and as confirmed by site inspection prior to fabrication, installation or removal of any BHS equipment. The system arrangement and layout shall ensure equipment alignment and clearance when installed in the Facility.
3. Provide all equipment required to complete the total system. Furnish all tools and necessary equipment for the performance of the installation tasks and exhibit sufficient planning to ensure their availability at the job site as required by the workflow. The Owner will not furnish tools, forklifts or erection equipment.
4. Staff the project to ensure timely completion. The BHS Contractor shall accelerate construction as required if schedule milestones are not met.
5. Provide all supports, anchors and any other items necessary to facilitate the complete



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mechanical installation and safe operation of all equipment and components.

6. Where equipment is to be installed in an operating facility provide a construction schedule to the Owner or their representative for approval that will minimize interference with normal operations.

B. Tolerances

1. Maintain the following tolerances for BHS equipment installation:
 - a. Maintain dimensions to exterior building walls or building columns within 1/4".
 - b. Install all conveyors level from side to side, within 1/8" across the width of the conveyor. In the event that the floor/ceiling is sloped, install the conveyors parallel to the floor in the direction of belt travel.
 - c. In plan and in elevation, install conveyors straight to within 1/4" of a taut line stretched at the belt elevation over the length of each intermediate section of conveyor.
 - d. Plumb supports vertical within 1/8" per 3 feet.
 - e. Maintain side clearances to building elements including walls and columns a minimum of 6" unless otherwise specified.
 - f. Verify all "As-Built" and existing building conditions prior to final fabrication.
 - g. Shimming between adjacent intermediate sections of conveyors is permissible but do not exceed 1/4" of total shim stock at any one location.
 - h. As the building area becomes available, install all header steel (even if header steel is ahead of conveyor fabrication/delivery), to preserve conveyor right-of-ways. Preserve conveyor right-of-ways in all cases as soon as practicable.
 - i. The maximum allowable lateral offset in the conveyor slider bed shall be 1/8" in 40 feet of length.

C. Side Guards

1. Install side guards so that adjoining guards do not project into the flow of baggage. Clean any field cut edges and welds of burrs, and slag and grind smooth. Filler material at joints or seams is not permissible.
2. Notch the formed edge of the side guards around any vertical hanger or leg.
3. All side guard joints are to provide a snag-free surface. Side guards shall provide a continuous, uninterrupted surface the entire length and height of the joints. Lapped or out-of-line joints will not be accepted. Welding of joints is not permitted.
4. Care is to be used in the design and installation of the side guards at the point of intersection with the conveyor fire/security doors. This interface point must not act as a snag/catch point for baggage or baggage tags.
5. Conveyor side guards must be flared on the downstream side of the intersection with the



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conveyor fire/security doors. Additionally, special detail must be provided with the conveyor bed section at this point. Its width must be extended to close the void between the bedside rails and the flared side guards.

6. Adjacent side guard joints are to be of the bolted butt coupled joint type at power turns and conveyor sections. Coupling of adjacent side guards or head/tail pulley supports to power turns shall be in alignment with the effective belt width of the turn to prevent interference with baggage movement.
7. Side guards of power turns must not be welded to adjacent straight conveyor side guards.
8. Mounting of any mechanical or electrical equipment on the outside radius side guard of power turns is not accepted since it restricts maintenance access to the outer perimeter chain or guide bearings of the power turn belt.

D. Belt Splicing/Lacing

1. Belting material and the related lacing hardware must be trimmed in a 1" "V" notch fashion. Additionally, the nylon jacket of the lacing connecting pin (cable) must be enlarged with heat to prevent any lateral movement of the connecting pin (cable).
2. If "dutchmans" are used, the length of the "dutchman" must be at least equal to or greater than the circumference of the conveyor drive pulley.
3. All belt splices, shall be cut square, to ensure proper tracking.
4. Install each lacing with a single lacing pin (cable) extending the full width of the belt.
5. Assemble the lacing so that the centerlines of the matching belts are in line within 1/8".
6. The actual length of belting installed on each unit is to be included on system drawings and in the spare parts list.
7. All rough top belting to be ground smooth within 1" of the cut end to allow proper seating of the belt lacing.
8. In locations that require a noise level of 65 db (A) or less, such as the CBRA, use vulcanized spliced belting. The conveyor shall facilitate the replacement of a clipper lacing for repair/replacement of damaged conveyor belt.

E. Belting

1. Check all pulleys and rollers for squareness to the centerline of the conveyor. Adjust when necessary.
2. Free conveyor beds of all foreign material and broom clean before pulling the belt.
3. Minimize number of belt lacings on each conveyor. Do not make belt segments shorter than 4'. Maximum acceptable number of lacings per conveyor belt segment is two (2).
4. Both sides of the pulley shaft elevations at the bearings shall be set within 1/32" of one another.



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F. Belt Tracking

1. Ensure all belts track within 1 inch of center on any drive, tail pulley or intermediate point.
2. Run each conveyor for a minimum of 4 hours with no load and 4 hours with a baggage load as encountered in actual service before acceptance testing.

G. Floor Supports

1. All conveyors shall be adequately sway braced in order to ensure that there is no lateral or longitudinal displacement.
2. All support structure must be designed and installed so that maintenance access to the conveyor components, gap pans and access to catwalk(s), work areas and drive aisles are not blocked.

H. Anchoring

1. Firmly anchor all equipment and structures to the floor or building structure where permitted, subject to review and approval, by the Owner or their representative. Align, level and finish grout, as required.
2. Anchor floor supports to the floor with a minimum of two (2) stud expansion anchors having a minimum size of 1/2" diameter by 2-3/4" long, unless otherwise noted on the specification drawings.
3. Weld floor supports, which rest on a steel mezzanine or intermediate structure.
4. Anchor impact protection with a minimum of four 3/4" diameter epoxy adhesive anchors, each having a minimum tensile strength of 3000 psi, concrete of 20,000 pounds and a minimum shear strength of 18,000 pounds, and a minimum embedment of 6", unless otherwise noted on the specification drawings.

I. Lubrication

1. Fill all reducers to the proper oil level using oil recommended by the manufacturer.
2. Install breathers at the highest opening.
3. Clean roller chains of dirt or debris and manually lubricate per manufacturer's recommendations.
4. Replace all lubrication fluids if testing or checkout period exceeds manufacturer's suggested start-up change-out interval.
5. Apply grease per manufacturer's specifications to all grease fittings (unless they are sealed for life type bearings) prior to initial start-up of the equipment.

J. Motor Installation

1. Wire each motor on all components to a separate disconnect switch which shall be mounted within sight of the motor but not more than 3 feet from the motor.
2. Provide a means of disconnecting power, including the capability of being locked in the



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“Off” position that meet or exceed the requirements of NEC Article 430 (or applicable local code), to any clutch or brake (if separately or group powered) mounted as part of drive unit so as to minimize the potential of electrical shock during any servicing or maintenance operations.

K. Jacking Bolt Installation

1. Install all jacking bolts in conjunction with pulley and motor bearing housings based on the following criteria:
 - a. When mounted in a threaded bracket, engage the bearing with the cup of the jacking bolt and lock the jacking bolt in position with a jam nut on the inside of the bracket (i.e., between the bearing housing and the bracket) to ensure the proper locking configuration.
 - b. When mounted in a non-threaded bracket, engage the bearing with the cup of the jacking bolt, position a jam nut on the inside of the bracket, and position a single flat washer, lock washer, and finished or semi-finished nut on the outside of the bracket (i.e., between the jacking bolt head and the bracket) to achieve the proper locking configuration.
2. Use of socket male/female adapters in conjunction with the jacking bolt is unacceptable.
3. Allow for minimum adjustability of the jacking bolt on either side of the mounting bracket equal to the maximum amount of adjustability provided for the associated bearing by the mounting slots.

L. Sheave/Sprocket Alignment

1. Align shafts, sprockets and sheaves using a steel straight edge. The use of a string for this purpose is not acceptable. Demonstrate during Acceptance Test that corresponding surfaces of mating sprockets/sheaves are in line within 1/32" in 24". Misalignment shall be determined by placing the straight edge against the face of one sprocket/sheave and measuring the gap it makes with the opposite sprocket/sheave. The operation shall then be reversed so that a total misalignment can be determined.

M. Fasteners

1. Protect all fasteners (such as but not limited to nuts, bolts, screws, and setscrews) against accidental loosening by the use of lock nuts, lock washers, jam nuts, or other suitable means, and against corrosion by plating or the use of corrosion resistant materials such as zinc plating or stainless steel materials.

N. Shaft Mounted Components

1. Mount all shaft mounted components using keys, splines, or equivalent, with positive retention devices.

O. Painting and Finishing

1. Equipment Finish



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a. Stainless Steel

- 1.) Cover all metal components and surfaces of conveyors in public view with Type 304 stainless steel with No. 4 brush finish. Stainless steel shall incorporate smooth flush edge seams. Radius type edges are not acceptable.
- 2.) The BHS Contractor shall also be responsible for the design; fabrication and installation of stainless steel trim frames around conveyor wall penetrations in public areas. The trim frames will be constructed of 12 gauge, 4" x 4" stainless steel angle. The BHS Contractor shall coordinate trim design/details with the Architect, the Owner or their representative.
- 3.) All stainless steel trim elements and related connections are to be smooth and flush without openings or projections on which bag tags or straps may catch.
- 4.) All flat head screws used to attach the stainless steel shrouding, such as the horizontal portions attached to the conveyor bed, are to be completely countersunk so that no portion of the screw head is above the adjacent surfaces. Such flat head screws are to be of the Phillips Head type. Grinding or filing of the screw heads to accomplish the above is not acceptable.
- 5.) Field welding of any stainless steel trim element is not acceptable. Additionally, no blemishes of the stainless steel trim elements shall be accepted. This includes those blemishes that are caused by poor manufacturing practices as well as those caused in the field plus those caused by field attempts to remove any blemish.

b. Protect all metal surfaces from corrosion using one or more of the following methods:

- 1.) Electro-galvanize or use stainless steel for slides and chutes unless otherwise specified on the contract drawings.
- 2.) Electro-galvanize or hot-dip galvanize conveyor side guards if exposed to outdoor environment, and paint on the outside only if used in interior areas.
- 3.) Use cold rolled or hot rolled low carbon steel primed and painted on both surfaces in all interior areas.
- 4.) As an alternative to items .2) and .3) above, the BHS Contractor can offer Powder Coating as an alternative due to superior quality and resistance to the elements.
- 5.) Use as received pre-painted housings from component supplier, such as motors, gearboxes and bearing housings.
- 6.) Paint conveyor slider bed components only on the outside exposed surfaces. Do not paint the surface in contact with the belting.
- 7.) Finish paint electrical enclosures normally purchased primed prior to assembly and delivery to the construction site.
- 8.) Protect all unpainted surfaces (shafts, slider bed, side guards) with a suitable rust inhibitor during shipping and installation.



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- 9.) Prime and finish paint all catwalks, stairways, ladders and support steel.
 - 10.) Provide galvanized threaded rods. Protect the ends of all threaded rods with a suitable galvanizing spray after the threaded rods are cut to length.
 - 11.) Apply an industrial quality primer and enamel to all to-be-painted surfaces in accordance with the manufacturer's directions. All paint shall be of the same make, type and color.
- c. Prepare surface to be painted in accordance with paint manufacturer's requirements and as described below. If there is a discrepancy between the two, the manufacturer's requirements will take precedence. Suitable precaution shall be taken to ensure cleanliness during the period between cleaning and other finishing processes.
- 1.) Preparation of Surface
 - a.) Prior to the application of any finish, clean all surfaces to be free of dirt, grease, oil, flux, flash metal, spatter metal, sand, rust, scale, or oxides, and all other debris that might interfere with the effective application of the finish. Clean surfaces immediately before the finishing operation. Take suitable precaution to ensure cleanliness during the period (which shall be of minimum duration) between cleaning and other finishing processes. For galvanized surfaces, adhere to the following:
 - (1.) Clean: Prepare surfaces so prime coat bonds well and adheres permanently.
 - (2.) Rust-Inhibitive Wash: Use a compatible chemical solution such as phosphoric metal etches. Thoroughly remove solution with water and allow drying.
 - 2.) General Application: Apply primer and enamel to provide a surface of high quality appearance free from runs, sags, cracks, flaking, peeling, blushing, or other defects which may affect drying characteristics, durability, and appearance of the painted surfaces. Apply primer and enamel by brushing, spraying, or dipping.
 - 3.) Basic Application: Finish surfaces with not less than one coat of primer and one coat of enamel. Apply the primer and one coat of enamel at the factory and the touch up of enamel, if required, shall be applied at the installation site, after erection, by brushing. When primer or enamel applied to the equipment prior to erection has been burned, chipped, or otherwise removed during erection, or where new unfinished metal is installed, finish the exposed surfaces with not less than one coat of primer and a finish coat of enamel, of the same color and type as originally painted, after sanding the surface to be painted down to the bare metal. After installation, clean and touch up all scuffed or otherwise marred surfaces, as above.
 - 4.) Masking: Do not obscure equipment nameplates, identification plates, or other identifying markings when painting the equipment. Whenever possible, apply the



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plates and markings after painting. In all cases where they cannot be applied after painting, mask or otherwise protect them to retain their legibility. After painting, thoroughly and effectively remove all masking and protective coatings.

2. Conveyor Identification

- a. Permanently and indelibly mark all conveyor equipment such as but not limited to conveyors (both powered and slave driven), merge conveyors, pushers, diverters, sort devices, make up units, power turn conveyors, and tapered pulleys with its respective (discrete) identification as defined on the contract drawings. All conveyor segments and other equipment such as diverters, and the like shall be identified as specified elsewhere in this document by carefully and neatly painting with black paint the equipment identification characters utilizing a stencil, nominally 4" in height, in a conspicuous location (on both sides of a conveyor adjacent to the conveyor drive in the case of a conveyor). The only acceptable identification markings on any conveyor equipment, is to be of the specified conveyor identification numbers for this project. Any other form of identification or markings (other than the CBIS Conveyor Marking specified below) on the conveyor equipment is not acceptable and must be removed.
- b. Identify conveyors in public areas by means of engraved plaques (riveted or bolted) with 2" high black lettering on a stainless steel background.
- c. Conveyor identification shall be consecutive with no missing numbers in a sequence. In the event of any additions or deletions prior to each system installation, renumber the conveyors to adhere to this requirement.
- d. Completely remove or print over any identification on reused equipment or any temporary markings associated on new conveyors for manufacture, shipping or installation.
- e. Where temporary markings or labels on the conveyors or other equipment are required for installation, use a medium which is readily removable with water or a readily available commercial solvent, such that they may be removed without requiring any refinishing of the surface on which they appear. After installing, remove any temporary markings.

P. Safety Signage

1. Furnish and install safety signage throughout the BHS as described within these Contract Documents and any associated addendums. The safety signage shall be located in all areas and locations where there is exposure to hazards for maintenance/operational personnel and the public. Refer to OSHA, ANSI, NEC, National Safety Council, local, federal and state codes for recommended location, size, shape, design and verbiage required for safety signage, examples of some of the types of signs are included in the contract drawings, these examples are not to be construed as the only signs required. The verbiage of the sign shall be appropriate for the particular location/hazard.
2. The safety signs shall be clearly visible and firmly affixed. The following is a list of locations where safety signage should be placed as a minimum, this list is not to be



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construed as being complete since it is only provided as a guide:

- a. All potential pinch points
 - b. Rotating parts
 - c. Chain and V belt guards
 - d. On all conveyors that are under the control of auto start
 - e. Outside of electrical cabinets and disconnects boxes
 - f. On all catwalks including step up/step down locations
 - g. At load and unload (CBRA and make-up devices) areas
 - h. At EDS devices
 - i. Adjacent to HSPDs
 - j. Adjacent to Vertical Sort conveyors
 - k. Adjacent to tip chutes
 - l. Areas of low overhead clearance
 - m. Fire/Security doors
 - n. Around areas of false ceilings
3. Safety chains and prominently displayed placards/signs shall be placed at the bottom of ladders and stairs to indicate restricted area for “authorized and trained personnel only”.
 4. Placards/signs indicating locations of all E-stop control stations and lanyards shall be clearly visible.

Q. Welding

1. Nationally certified welders shall perform all welding, and all welding shall be in strict compliance with local and national codes. Provide to the Owner or their representative upon request, copies of certificates verifying that the welder(s) are nationally certified.
2. Only compressed natural gas (CNG) and electric welders shall be used.
3. Connecting welding equipment to any MCP power supply shall not be acceptable.
4. Provide a fire watch at all times during welding and in compliance with local codes before approving any cutting or welding operation. A fire safety supervisor or appointee shall inspect the work area and confirm that the following indicated precautions have been taken in order to prevent fires:
 - a. Ten pound ABC Dry Chemical Fire Extinguisher to be kept on site.
 - b. No flammable liquids permitted within 50 feet of work.
 - c. Floors swept clean of combustibles.



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- d. All wall and floor openings covered.
- e. Covers suspended beneath work to collect sparks.
- f. Opaque screens placed between work and spectators.
- g. Fire watch is required to observe all work and shall remain on site for a minimum of 30 minutes after completion of work.
- h. The Owner is to be notified prior to beginning work.

R. Maintenance Access

- 1. Where walls immediately adjacent to conveyor equipment affect maintenance access, advise the Owner or their representative of the location and size of the wall opening that needs to be developed to permit access to drive components, bearings, and other equipment that would normally be inaccessible because of the wall.

3.06 SPECIAL CONTROL REQUIREMENTS

A. Control Stations

- 1. Mount controls, consisting of but not limited to push buttons, selector switches, indicator lights, in Control Stations. All controls shall be grouped to minimize the number of operating points throughout the system. In the application of a single control for a specific function, push-button stations may be employed.
- 2. Locate control stations as specified. Position control stations so as not to impede access to the equipment for servicing.
- 3. Mount all Control Stations located in public areas flush to the equipment and equip with stainless steel cover plates. Control stations located in the view of the public shall not be mounted on the top surface of the conveyor front cladding.
- 4. Locate Control Stations so as to be clear of normal vehicular and personnel traffic lanes. Install guards to prevent inadvertent actuation where this cannot be accomplished.
- 5. Control Stations shall contain the appropriate control elements such as push buttons, selector switches, and those indicator lights, which will augment operations.
- 6. Control Station functions shall be identified in English using elementary concise terms supplemented by graphic symbols. All identification plates shall be mechanically affixed to the console face.
- 7. Control Stations shall conform to the environmental requirements specified herein. Outdoor applications shall employ weather tight, corrosion resistant boxes, switches, push buttons, and lights.
- 8. Emergency Stop push buttons, disrupting electrical control power, shall be employed where an emergency may require immediate shut down. Where more than one emergency stop push-button is used in any circuit or subsystem, only the indicator lamp in the activated E-Stop push-button shall be energized. Actuation of any emergency stop shall be



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announced on the respective status monitoring system.

9. Indicator lights, especially outside the facility, shall not be affected by extraneous light, and shall be clearly visible in all lighting conditions.
10. Control elements such as but not limited to switches, push buttons, and handles, shall be selected for ease of operation in an industrial "bag room" environment.
11. Control elements such as but not limited to switches, push buttons, indicator lights, and bulbs, shall be easily replaceable and reasonably protected from physical damage.
12. Freestanding control stations shall be mounted on extremely rugged and braced pedestals with large firmly anchored base plates. The design shall account for extraneous loading and generally abusive conditions.
13. Provide independently anchored impact protection wherever control panels, control consoles or control stations are exposed to work area traffic.

B. Photocell Functions

1. As a minimum, provide photocells to perform the following functions:
 - a. Cascade Stop
 - b. Jam Detection
 - c. Over-Height Detection
 - d. Over-Length Detection
 - e. Merge And Priority Control
 - f. Auto Start
 - g. Auto Stop
 - h. Indexing Control (Accumulation)
 - i. HSPD Timing
2. Combine photocell functions wherever possible provided proper operation of each circuit is maintained.
3. Cascade Stop
 - a. Locate a head end sensor photocell within 12" of the discharge ends of all straight conveyors and 6" on power turns and queue conveyors (or an appropriate distance from the discharge end to ensure that the piece of stopped baggage does not transition/stop on the downstream conveyor) so that the center of the photocell beam is approximately either 2.5" or 3" above top of the conveyor belt to provide the signal for operation of cascade stop circuits.
 - b. Should a downstream conveyor stop as a result of a jam condition, motor disconnect switch in the OFF position, or mechanical/electrical failure, the conveyor immediately



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upstream of the stopped conveyor shall continue to run until the head end photocell is blocked. At that moment, the conveyor shall stop. The preceding upstream conveyor will run until its head end photocell is blocked. This cascade stop function will continue through the upstream conveyors until the jam/failure is cleared or the first conveyor in the subsystem has stopped.

- c. The cascade stop photocell shall also be utilized for jam detection functions, but no control station shall be installed in conjunction with this photocell. Upon the detection of a jam at this photocell, initiate the following steps:
 - 1.) Stop the conveyor with the cascade stop photocell and the one immediately downstream.
 - 2.) Provide a jam indication signal at the Touch Screen Terminal and a visual warning signal in the field (within the vicinity of the jam location).
 - 3.) Illuminate the jam indicator light in the nearest jam reset/restart control station.
 - d. Cascade controls logic shall include programming to initiate the Ticket Counter (and Curbside) Start Ready Pushbutton "Green light" to flash when the respective ticket counter (or curbside) conveyor subsystem has cascaded back to the load belt. This will notify the ticket counter/curbside agent that a jam/fault has occurred in the subsystem.
4. Jam Detection
- a. Locate a head end sensor photocell to provide the signal for operation of jam detection circuits within approximately 12" of the discharge ends of all straight conveyors and 6" on power turns and queue conveyors (or an appropriate distance from the discharge end to ensure that the piece of stopped baggage does not transition/stop on the downstream conveyor). The center of the photocell beam is to be approximately either 2.5" or 3" above top of the conveyor belt.
 - b. As a minimum, provide jam detection photocells and a jam indicator with a jam/restart/emergency stop control station in areas that have a relatively high frequency of jams. This shall include the discharge ends of all conveyors feeding onto power turns, at the bottom of inclines and decline conveyors, at all merges for both the primary and secondary lines, opposite all pushers and diverters and at any other location where experience indicates a potential jam point.
 - c. As soon as the photocell detects a jam (blocked for longer than an adjustable (0 to 10 seconds in the PLC), predetermined (nominally set to 6 seconds) length of time), initiate the following steps:
 - 1.) Stop the conveyor with the jam detection photocell and the one immediately downstream, unless the photocell is mounted on a conveyor that feeds onto a power turn. In this case the conveyor with the jam detection photocell, the power turn and the conveyor immediately downstream of the power turn are to be stopped.
 - 2.) Provide jam indication signal at the Touch Screen Terminal.



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- 3.) Illuminate the jam indicator light in the control station.
 - d. Whenever a conveyor stops for any reason, reset the jam detection timer and hold until the conveyor restarts.
 - e. The jam detection circuitry is only to function whenever the associated conveyor is running; i.e., if the conveyor is stopped and the jam detector photocell is blocked, the jam detection circuitry will not sense a jam condition and thus report a false jam condition.
 - f. Conveyors that cascade stop as a result of a jam are to be “latched stopped” through PLC logic until the jam reset push button has been activated.
5. Over-Height Detection
- a. Provide over-height detection photocells at the TC1 input to the system to detect bags that are too high to clear the lowest downstream obstruction for all possible routes. This photocell shall be set at 36" above the top of the conveyor belt unless otherwise stated.
 - b. Provide over-height detection immediately upstream of the EDS (at the associated Light Curtain) to detect bags that are too high for the EDS (as per manufacturers guidelines).
 - c. As soon as the photocell is interrupted, stop the conveyor.
 - d. Provide jam indication signal at the Touch Screen Terminal and the PC workstation.
 - e. Provide an oversize indicator lamp in the control station; this lamp may be the same unit as that for over-length detection. Illuminate the oversize indicator lamp in the control station if an over-height bag is detected.
 - f. Program the over-height circuit to require the following sequence to reset:
 - 1.) Actuate associated E-stop
 - 2.) Clear the photocell by removing or re-positioning the over-height bag, the oversize indicator lamp shall extinguish
 - 3.) Press the start push-button.
 - 4.) Clear the fault on the Touch Screen Terminal and PC workstation.
6. Over-Length Detection
- a. Provide over-length detection photocells at the TC1 input in the system and immediately upstream of the EDS (at the associated Light Curtain) to detect bags that are too long.
 - b. Program the over-length measurement circuit to stop the conveyor if a preset bag length (adjustable in the PLC) is exceeded.
 - c. Provide jam indication signal at the Touch Screen Terminal and PC workstation.



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- d. Provide an oversize indicator lamp in the control station. This lamp may be the same unit as that for over-height detection. Illuminate the oversize indicator lamp in the control station if a preset bag length (adjustable) is exceeded.
- e. Program the over-length circuit to require the following sequence to reset:
 - 1.) Actuate associated E-Stop
 - 2.) Clear the photocell by removing the over-length bag, the oversize indicator lamp shall extinguish
 - 3.) Press the start push-button. This push-button may be the same unit as that for over height detection.
 - 4.) Clear the fault on the Touch Screen Terminal and PC workstation.
7. Provide Light Curtain upstream of each EDS to detect overlength. Overheight and out of gauge bags. The Allen-Bradley Safety Light Curtain may be used. Catalog number 440L-P4D0300-N or approved equal.
8. Missing Bag Jam
 - a. For EDS security screening systems a missing bag jam is defined as a jam that occurs when three (3) consecutive bags are sensed at a conveyor head end photocell and not detected at the next downstream photocell within a predetermined period.
 - b. All tracked conveyor subsystems shall incorporate missing bag jam detection logic.
9. Merge and Priority Control
 - a. 90° Merges
 - 1.) Merge windows shall be dynamic in that the control system establishes a window only upon indication that a bag has arrived at either the merge or through line induction photocell (i.e., a fixed window control system will not be acceptable). Merge windows shall be variable and shall be established on the basis of bags per minute (BPM) throughput requirements per subsystem with associated window spacing. Bag length shall be measured by the control photocells to adjust the merge window length as required.
 - 2.) Photocells, timers and appropriate control stations shall be located on the conveyor equipment in 90° merge situations with functionality as follows. For all intents and purposes for this project, the conveyor line onto which bags are to be merged shall be referred to as the primary line, while the conveyor line from which bags are merged from shall be referred to as the secondary line:
 - a.) A photocell shall be located at the discharge end of the secondary line merge conveyor. This photocell shall have the functions of jam detection, head end sensing and priority control. The jam detection function of this photocell shall detect a jam at the merge point resulting from bags being transferred from the secondary line onto the primary line. When this occurs, both belts involved



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shall be stopped until the jam is cleared (along with other appropriate conveyors upstream that will cascade stop as necessary).

- b.) The 90-degree merge conveyor is to be programmed in a run on demand mode and use energy management timers to stop. As a bag is transported towards the merge conveyor an auto- start photocell, located on the upstream conveyor, once blocked will actuate the start-up of the merge conveyor. If after 20 seconds (adjustable in the PLC) the auto-start photocell doesn't detect any baggage then the merge conveyor shall stop.
- c.) Merge window logic in the PLC is used to monitor and track the flow of bags on the primary conveyor line upstream of the merge. The merge window logic shall use a photocell and timer to measure bag length in order to determine the required merge window for proper transfer onto the primary line. The merge window logic is used to track the position of bags and the space between the bags on the primary line. The head end photocell on the conveyor immediately upstream of the merge conveyor on the secondary line shall be used to measure the length of bags as they move onto the 90- degree merge. The PLC utilizes this length to calculate the bag window size required on the primary line to merge a bag into. If the required bag window is determined to be available on the primary line then the bag is not stopped and is merged onto the primary line. If the bag window is determined to be unavailable then the bag is stopped and held on the merge conveyor until the appropriate size window is detected on the primary line.
- d.) The merging function shall be provided in two modes. Primary priority and reverse priority. In primary priority mode (to be considered normal mode of operation) bags on the primary conveyor line shall have priority over bags on the secondary conveyor line. The secondary line will have to wait for openings between bags on the primary line to be able to merge into. Priority control shall monitor the time in which the photocell on the primary line is being blocked, indicating that the appropriate merge window is being searched for.
- e.) Reverse priority mode shall be actuated in two different cases. First, if the 90-degree merge conveyor is stopped with bags in queue upstream (to a point which will be determined in design review meetings based upon criteria such as but not limited to subsystem length and BPM requirements) then the secondary line is considered to be full and the reverse priority function shall be actuated for the period of time it takes to empty the secondary line of bags from the point in which the reverse priority was actuated. Second, if a bag is on the 90-degree merge waiting for a window and an opening is not detected for 60 seconds (adjustable in the PLC) then reverse priority shall also be enabled. The primary line conveyor onto which bags are being merged shall be stopped, and all merge control functionality of the secondary line shall be disengaged to allow for continuous and uninterrupted baggage flow from the secondary onto the primary line for 60 seconds (adjustable in the PLC), thus



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purging the secondary line of bags. Upon completion the merging function will revert back to primary priority mode.

10. Auto Start

- a. Provide Auto Start photocells upstream of sections of transport conveyors not specifically controlled by START/STOP switches. The same photocell may control both Auto Start and Auto Stop circuits.
- b. Program Auto Start circuits to start a string of conveyors whenever an Auto Start photocell is interrupted.
- c. Before any conveyors may be started, audible start-up warning alarms shall be actuated, audible throughout the area to be affected by the starting of the conveyors. Activation of the alarms shall be through the PLCs. The horn shall sound and after a period of between 5 and 25 seconds (adjustable in the PLC) the conveyor subsystem shall start.
- d. Each conveyor in the subsystem shall be sequentially started from output to input point with an appropriate delay between each motor starter actuation as to ensure electrical power surges are minimized. The next sequence of conveyors controlled by Auto Start functionality shall start in a similar manner, triggered by baggage at a predetermined location within the line.

11. Auto Stop (Time-Out)

- a. Provide Auto Stop photocells upstream of sections of transport conveyors not specifically controlled by START/STOP switches. The same photocell may control both Auto Start and Auto Stop circuits.
- b. Program Auto Stop circuits to stop a string of conveyors if an Auto Stop photocell does not sense a bag for an adjustable time period (adjustable in the PLC).
- c. If a conveyor stops for any reason, reset the auto stop timer and hold until the conveyor restarts.

12. Indexing Control (Accumulation)

- a. Provide a photocell at the discharge end of each conveyor feeding an indexing conveyor.
- b. Program the indexing conveyor to run when the photocell is blocked and to stop when it is clear.
- c. Include a time delay so that the conveyor can be programmed to continue for a preset interval after a bag clears the photocell and is completely on the indexing conveyor.

13. HSPD Timing

- a. Provide a photocell at an appropriate distance upstream of each HSPD with the center of the photocell beam at a height of 2.5" above the top of the conveyor belt for HSPD timing/arming.



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- b. Program the photocell function to ensure accurate HSPD-bag contact; given bag size, belt speed, and HSPD cycling speed.

C. Motor Overloads

1. Size the motor overload heaters not to exceed 115% of the full load amps as indicated on motor nameplate.
2. In the event of any subsystem motor drawing excess current, appropriate protection shall be provided to isolate supply to all subsystem elements. Either the single "motor overload" indicator on the affected MCP panels shall illuminate, or if individual "motor overload" indicators are specified for each drive then the effected drive indicator will illuminate.
3. Following rectification of the cause of the overload and resetting of the overload protection device in the motor control panel or motor control center as applicable, the system may be restarted by actuation of the "start" button, at which stage, the "motor overload" indicator shall be extinguished and normal control shall resume.
4. "Motor overload" fault conditions shall be reported both visually and audibly on the Touch Screen Terminal.
5. In the event of individual conveyor motor overloads, all upstream conveyors shall revert to cascade stop mode, while all downstream conveyors shall continue to run in normal mode of operations.

D. Jam Indication/Restart

1. Provide an Illuminated Amber Jam Light (in a common enclosure with an Emergency Stop push-button and green re-start pushbutton) adjacent to all jam detection photocells as follows: As a minimum, provide jam detection photocells and a jam indicator with a jam/restart/emergency stop control station in areas that have a relatively high frequency of jams. This shall include the discharge ends of all conveyors feeding onto power turns, at the bottom of incline and decline conveyors, at all merges for both the primary and secondary lines, opposite all pushers and diverters, and at any other location where experience indicates a potential jam point.
2. Illuminate the Jam Lamp when the jam detection photocell senses a jam condition.
3. Restart the conveyor and extinguish the lamp only after the following sequence:
 - a. Actuate (push in) Emergency Stop push-button (E-Stop indicator lamp goes on)
 - b. Clear the jam
 - c. The jam light shall "flash" (indicating the jam photocell has been cleared and the conveyor is ready for restart).
 - d. Reset (pull out) emergency stop push-button (E-Stop indicator lamp extinguishes)
 - e. Depress green "re-start" push-button (conveyors restart after warning alarm sequence)
4. Paint the control station enclosure with "Safety" yellow paint and label with the conveyor



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Item Designations of the conveyors being controlled in 1/2" high block letters. Jam detection reset control stations shall be placarded with the conveyor designations, which are being controlled.

5. In most cases the control stations shall be located adjacent to the conveyors under control and shall be accessible only to the personnel clearing the jam to avoid a subsystem being re-started in an unsafe condition (e.g. personnel on conveyor). Note that all such control stations shall be located on the catwalk side of conveyors so equipped with catwalks.

E. Start-Up Warning

1. Provide amber rotating beacons and audible horn alarms as start-up warnings in areas as specified.
2. Activate the beacon and the horn for an adjustable period of time prior to the start-up of the conveyor system.
3. Appropriate audible start-up warning alarms shall be provided at public areas such as ticket counter, curbside check in, and rechecked baggage input points.

F. Alarm Silence

1. Provide an ALARM SILENCE momentary contact push-button on the door of the MCP which, when depressed, shall silence the audible alarm. The design of the control circuitry shall be such that multiple faults shall always sound the associated fault warning alarm; i.e., if a jam condition has caused the alarm to have been sounded and the alarm has been silenced by the act fault but has not yet been corrected, a second fault occurring after the alarm has been silenced shall again cause the fault warning alarm to sound.
2. Do not extinguish the illuminated fault indicator until the fault has been corrected.

G. Emergency Stop Push-Buttons

1. Locate Push buttons as required to ensure that operating and maintenance personnel can easily and quickly reach an Emergency Stop Push-Button from anywhere in the system. In addition, ensure that Emergency Stop Push-buttons are installed at the following locations:
 - a. Around the perimeter of all Flat Plate make-up.
 - b. At each end of load/unload conveyors.
 - c. Along lengths of conveyors, whether running at floor level or overhead mounted on conveyor support legs or building columns a maximum of 50' apart.
 - d. In each jam indication enclosure.
2. Wire all Emergency Stop push buttons for a single subsystem in series with the coils of one or more emergency stop relays. Size the normally open contacts of the relays in series with the power source of the PLC output module(s) controlling the conveyors in the subsystem. The PLC shall not be required to remove power from the associated conveyors for an emergency stop condition.



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3. Upon actuation of an Emergency Stop push-button, stop the associated conveyors in the subsystem, illuminate the lamp in the head of the push-button in a steady burning mode, and illuminate the red emergency stop fault light at the MCP.
4. Restart the conveyors and extinguish the indicator lamp and MCP fault light only after the following sequence:
 - a. Reset (pull out) emergency stop push-button (indicator lamp and MCP fault light extinguish)
 - b. Depress the green "Re-Start" push-button (conveyors restart)
5. When a jam has been detected and an Emergency Stop push-button in the jam indication enclosure is activated, follow the same sequence of stopping the conveyors and illuminating the light in the head of the push-button, but do not activate the fault warning circuits at the MCP.
6. When the normal re-start switch for the conveyor is actuated, extinguish all emergency stop push-button lamps within the subsystem associated with that particular emergency stop actuation, actuate the start-up warning alarms and, after a delay, start all conveyors in the subsystem.
7. Note that the activation of an Emergency Stop push-button switch must not close any powered fire/security door within the area of control of the Emergency Stop switch.
8. "E-Stop" conditions shall be reported both visually and audibly on the Touch Screen Terminal.

H. Control Stop/Start Crossover Control Stations

1. Provide Control Stop/Start control stations at all maintenance catwalk crossovers and makeup device crossovers to ensure that TSA operating and BHS maintenance personnel can easily and safely reach the EDS machines and BHS equipment for scheduled maintenance (such as IQ Bag Testing) as well as in case of jams or faults at the EDS devices, or along the conveyor lines / make-up device for scheduled maintenance on the conveyor equipment, including make-up devices.
2. Each Control Stop/Start control station shall have a two device control station installed adjacent to the crossover on both sides of the conveyor / make up device (a total of two control stations per crossover):
 - a. One device of the control station shall be a red momentary contact Stop push-button switch to stop the associated subsystem conveyor immediately underneath the crossover to allow personnel to crossover the conveyor / make up device while the conveyor / make-up device is stopped. Upstream conveyors with baggage arriving at their head end photocell shall cascade stop while the crossover conveyor / make-up device is under a Control Stop condition.
 - b. One device of the control station shall be a green momentary contact Start push-button switch to start the associated subsystem conveyor immediately underneath the



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crossover after the personnel have crossed over the conveyor while the conveyor is stopped. Note that the conveyor / make-up device under the crossover shall not start if the conveyor is stopped for another fault condition (such as cascade stopped, jammed, or emergency stopped).

3. Upon actuation of a Control Stop push-button, there shall be an indication on the Touchscreen Terminal and PC workstation that the conveyor / make-up device has been stopped for greater than thirty (30) seconds if the associated Control Start push-button has not been pressed to start the conveyor / make-up device after the personnel have crossed over. This shall notify operators that the subsystem has a stopped conveyor / make-up device that requires activation of one of the Control Start push-buttons located at the crossover.

I. Security Door

1. Provide a photocell to detect bags under the security door.
2. The door is to be equipped with either a limit, photocell or proximity switch mounted in such a manner so that the "fully open" position of the door is sensed. If the door is sensed by the limit or proximity switch not be in the fully open position, the associated conveyor shall be stopped if running or shall not be permitted to start if the conveyor is not already running. Note that this limit or proximity switch is in addition to those limit or proximity switches provided with the door operator if the door is powered.
3. The door is also to be equipped with a limit, photocell or proximity switch mounted in such a manner so that the "fully closed" position of the door is sensed. If the door is sensed by the limit or proximity switch not be in the fully closed position, annunciation shall be sent to the system fault monitoring system for rectification of the problem. Note that this limit switch is in addition to those limit or proximity switches provided with the door operator if the door is powered.
4. Interface and test the door interface with the building security system for door open/closed status.
5. Program the security door to operate as follows:
 - a. Normal Start/Stop
 - 1.) Start: Open the security door immediately. Ticket counter inputs require card swipe permissive start. PLC to provide Building Security System with "Running status".
 - 2.) Stop:
 - a.) Run the feeding conveyor for one minute, stop the conveyor and lower the security door. PLC to provide Building Security System with "Door Closed" status.
 - b.) If a bag is detected under the door via the door clear photocell or the door pressure switch, continue to run the conveyors until the photocell is clear and



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reattempt to close the door. The door should continue attempting to close, however an alarm should be displayed on the fault monitoring system that the door has failed to close after the third attempt.

- b. A security door control station (Type 2) shall be installed adjacent to each door for maintenance personnel use only (not accessible from the public side) which shall contain the following:
 - 1.) Maintenance/Auto Switch
 - 2.) Emergency Stop
 - 3.) Start Pushbutton
 - 4.) Door Open Pushbutton
 - 5.) Door Closed Pushbutton
- c. When the Maintenance/Auto is in the Maintenance position, the door open and door-closed switches are active. Related conveyor systems are not active when in the maintenance mode. Activation of the ticket counter or curbside security card swipe is not required when in the maintenance mode.
- d. All powered security doors must be equipped with a manual release mechanism to permit the disengagement of the door drive unit so that the door can be either raised or lowered.

J. Fault Warning Alarm

- 1. Provide an audible/visual alarm on the MCP controlling the system and Touchscreen Terminal/PC workstation.
- 2. Activate the alarm and one of the following indicator lights whenever any fault has caused a section of conveyor to stop or prevent it from starting:

<u>Condition</u>	<u>Color</u>
Jam	Amber
Motor Overload	Blue
Emergency Stop	Red

K. High Speed Paddle Diverter

- 1. Provide photocells at strategic upstream locations to synchronize HSPD operation with bag position.
- 2. Provide a sensor at the "home" position of the HSPD to stop the sort conveyor if the HSPD does not return to the home position within a preset time after it has started its cycle. Report the fault condition to the Touch Screen Terminal. The sensor is to be of the shaft encoder type with proximity detector controlled by a Warner Electronic Controller (or approved equivalent) so that the "at home" paddle position shall always be the same.



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3. Provide each HSPD with one disconnect switch to control both the clutch/brake and motor.
4. Provide a photocell on the receiving conveyor spur to which the HSPD discharges to report to the control system that a bag has successfully transferred and that no jam has occurred. If a jam is detected, inhibit further pusher operation and report the fault condition to the Touch Screen Terminal.
5. Each HSPD feeding a conveyor spur shall have a four device control station installed adjacent to the photocell or on the housing of the HSPD for maintenance personnel operation of the HSPD:
 - a. One device of the control station shall be a green momentary contact Reset/Start push-button switch to allow for reset of the associated subsystem conveyors and energizing of the HSPD motor following a jam condition and subsequent clearing of the photocell at the charge end of the associated receiving chute, opposite the HSPD.
 - b. One device of the control station shall be an Illuminated Amber Jam Indicator Lamp to signal a jam condition of the photocell at the charge end of the associated receiving chute, opposite the pusher/HSPD.
 - c. One device of the control station shall be Maintained Contact Illuminated Red Mushroom Head Emergency Stop type switch to stop the associated subsystem conveyors and energizing of the HSPD motor.
 - d. One device of the control station shall be Auto/Cycle momentary switch. This will allow for the manual cycling of the HSPD for testing purposes

L. Motor Safety Disconnect (MSD)

1. Provide Motor Safety Disconnect Switches as described in part 2 of this specification.
2. Rotation of the MSD to the off position shall cause the conveyor or other component to stop and appropriate alarm/statuses to be displayed on the Touchscreen Terminal/PC workstation as described in part 2 of this specification.
3. Rotation of the MSD to the On position shall allow the conveyor or other component to restart (with appropriate startup alarm) only if:
 - a. The conveyor does not pass through a wall or floor penetration.
 - b. The conveyor is not a public area conveyor.

M. Interlocks

1. Provide Failsafe interlocks and limits in the system to ensure safe operation. Assume responsibility for the integration of all interlocks and limits that may be necessitated by the characteristics of the elements selected for combination into a total system. Interlocks and limits shall be included for the protection of personnel, equipment and baggage, and in the performance of the operational functions specified for the subsystem and elements comprising the system.
2. Provide electrical interlocks between the various conveyors in a subsystem to inhibit a



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conveyor from discharging baggage onto a stopped conveyor. Interlocks shall be cascaded from the last conveyor in a train to the first. This provision shall apply to all subsystems even if two different suppliers provide the equipment under separate contract.

3. Provide warning signals, which are activated automatically upon start-up, where appropriate. Flashing lights shall be visible from all points in the vicinity of the equipment concerned. Alarms shall be audible within the equipment vicinity and each alarm in the system must be distinctive from any sound within the hearing range, and shall not be unduly annoying to working personnel and shall comply with all applicable codes and regulations. Although not specifically mentioned in the control subsystem descriptions all automatic start-up functions shall be preceded with appropriate audible and visual indicators unless otherwise specified.
4. Inhibit further equipment action upon sensor failure should personnel safety be in doubt. Inform the involved equipment operator or maintenance personnel of such failure through the MCP and Touch Screen Terminal. Sensors shall be selected and positioned such that false signals from debris, ambient light, and personnel movement do not cause activation.

3.07 ELECTRICAL & CONTROLS SPECIAL CONSIDERATIONS

A. Power Source

1. The electrical equipment and PLC control systems supplied by the BHS Contractor shall be compatible with, and operate reliably and effectively with, the normal electrical supply typically available at airport locations. The equipment shall not be unduly sensitive to fluctuations in supply voltage which may typically vary by plus or minus ten percent (10%) of nominal values.
2. The BHS Contractor shall provide necessary electrical supply filters, conditioners, and regulators for all equipment, which cannot meet the specifications stipulated.

B. Outbound System input conveyor "Manual Start" Sequence

1. The ticket counter subsystem shall be initiated to start via a Security Card Swipe Device. Activation of the security card swipe shall supply power to the respective control station, located at the associated conveyor segment area. Actuation of the Subsystem's Illuminated Start push-button will energize the respective Visual/Audible warning alarms along the conveyor line, both in the public space and air side, for 10 seconds (adjustable) - e.g., ticket counter input conveyor respective sub-system right-of-way catwalks and the work aisle(s) of the make-up devices. The security door shall open while the "Run" 10 second alarm sounds and flashes. After the 10 (ten) second "Run" alarm period and when the Security door is fully opened, the check-in collection conveyor(s) shall start. The downstream transport conveyors, CBIS conveyors, mainline conveyors and the flat plate make-up device shall start via an auto-start function. The downstream transport conveyors shall all start sequentially from the output to the input with an appropriate delay between each motor starter actuation to ensure electrical power surges are minimized. The start-up warning signal at the flat plate make-up device shall sound only if the device is not already running.
2. The subsystem security doors shall open and close consistent with the respective subsystem



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start-up and shut-down sequence.

C. System Ready Indication

1. A green indicator light, labeled SYSTEM READY and located on the door of each MCP shall serve to indicate that the devices under its control are ready to operate upon receipt of a START signal, from the BHS control system and local card swipe device. To accomplish this, the light shall illuminate under the following conditions, per the respective subsystem:
 - a. Power is applied to the MCP.
 - b. The local conveyor motor and Security door disconnect switches are in the "ON" position.
 - c. All Emergency Stop pushbuttons are reset.
 - d. No Motor overloads are tripped.
 - e. No Jam conditions are indicated
 - f. No oversize conditions are indicated.
 - g. All HSPDs are in the HOME position.
 - h. No faults are indicated on the MCP, Touch Screen Terminal or PC workstation.

D. Flat Plate/Make-up Device Control Stations

1. Flat Plate/Make Up Device
 - a. Provide Four "Reset/Re-Start/E-Stop" Pushbutton control stations (one each side of the flat plate make-up device) for Manual Start-up operation of the make-up device; In case the flat plate/slope pallet make-up device times-out before all baggage has been sorted, activation of any "Reset/Re-start" button on the flat plate make-up device shall cause the device to run for an additional twenty (20) minutes (adjustable) without the feed conveyors operating.

3.08 BHS DETAILED CONTROL DESCRIPTIONS/REQUIREMENTS

A. General Design Requirements

1. The following subsystem control descriptions apply the referenced components and circuits to the operational aspect of the system and specify the actual elements under their control.
2. By means of suitable computer dialogue at the PC workstation (or by "Mouse" manipulation and using pull-down menus) it shall be possible to make changes to baggage flow in response to a variety of conditions such as:
 - a. Jams
 - b. Equipment Failure



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- c. Conveyor full condition
 - 3. In each case an operator, having access to the proper passwords, as an example, will be able to:
 - a. Activate a HSPD and set it to operate either continuously or in an alternating sequence.
 - b. Shut down a HSPD or conveyor.
 - c. Set up alternative flow paths, for instance, to bypass a defective section of conveyor, or similar.
 - 4. Reference the Contract Drawings for conveyor equipment power distribution and subsystem indication. Location for each of the new MCPs is referenced on the BHS Partial Plan and Control Plan Drawings. Power distribution point (PDP) locations for the new MCPs are at the immediate area of the respective MCP as shown on the BHS Partial Plans.
 - 5. The Control Functions associated with the outbound system subsystems are described in the following paragraphs. Apply the generic subsystem/conveyor line functional description to the detail design of each electrical subsystem of similar type.
 - 6. Provide software for the control system reflecting the sequence of operation for each subsystem as described in the following paragraphs. The paragraphs describe the particular subsystem specific controls that will be required in addition to those standard controls (i.e., Jam Detection, Jam Reset, Cascade Stop, Oversize Detection, Merge Control, Auto Start, Auto-Stop, Emergency Stop, and all other controls functionality described elsewhere in this document) that will be required for each subsystem (described elsewhere in this document).
- B. Ticket Counter Subsystems
- 1. General
 - a. There is one outbound ticket counter subsystem – TC1.
 - b. Motor Control Panel MCP-1 shall power and control the following TC1 conveyor segments and associated equipment:
 - 1.) TC1-01 through TC1-03 conveyor segments
 - 2.) Security Door SD/TC1-03
 - c. All fault annunciation and status reporting for the outbound ticket counter conveyor subsystem shall be displayed both graphically and in text on the PC workstation and Touch Screen Terminal.
 - 2. Control Equipment Components
 - a. A minimum of two control stations shall be provided for Start/Stop control of the ticket counter conveyor line. One station shall be located on the wall, adjacent to the charge end of the TC1-01 conveyor, the second on the wall, adjacent to the discharge end of TC1-02. The final location of these control stations shall be coordinated with the



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Owner or their representative prior to installation.

1.) The control station located at the charge end of TC1-01 and discharge end TC1-02 shall include the following operators/control devices (Type 3):

- a.) Lighted "Reset/Start" Pushbutton
- b.) System "Stop" Pushbutton
- c.) Sonalert Warning Device
- d.) Oversize Pilot Light
- e.) "Lighted Push-Pull (Lockable) E-Stop

b. Ticket Counter Conveyor Start Sequence:

a.) The conveyor line's local "Subsystem Start" shall be enabled via the security card swipe to supply power to the respective TC1 line Start/Stop control stations. The Ticket Counter conveyors shall be activated by the security card swipe. This action shall supply power to the pushbutton control stations located at the Ticket Counter area. Pressing a "Start" pushbutton on any ticket counter control station shall energize the TC1 Start-up alarm(s) in the check-in area, along the outbound transport line and the bagroom for 10 seconds (adjustable). The start-up alarms in the bagroom area shall sound only if the make-up device is not already running. The Fire/Security door shall open while the "Run" 10-second start-up alarm sounds and flashes. After the 10 second "Run" alarm period and when the Fire/Security door is fully opened, the ticket counter check-in conveyors TC1-01 through TC1-03 shall start.

b.) Automatic System Cascade Start:

(1.) The conveyor segments downstream of TC1 load conveyors shall start via an "Auto Start" sequence. Provide auto start photocells upstream of sections of outbound transport conveyors, not specifically controlled by the "Start/Stop" control station. Program the auto start circuit to start conveyor segments TC1-01 through TC1-03 and the SS1 subsystem conveyors (if not already running) whenever the auto start photocell is interrupted. The downstream TC1 / SS1/OSR1/CL1 transport conveyors shall all start sequentially from the output to the input with an appropriate delay between each motor starter actuation to ensure electrical power surges are minimized.

c.) Automatic System Cascade Stop:

(1.) The conveyor segments downstream of TC1-01 shall stop via an "Auto Stop" sequence. Provide auto stop photocells upstream of sections of outbound transport conveyors, not specifically controlled by the "Start/Stop" control station. Program the auto stop circuit to stop conveyor segments TC1-01 through TC1-03 whenever the auto stop photocell does



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not sense a bag for 5 to 30 minutes (adjustable). The same photocell may control both "Auto Start" and "Auto Stop" functions.

d.) Manual Stop:

- (1.) Depressing the "Stop" pushbutton on either of the Ticket Counter Control Stations shall stop conveyors TC1-01 through TC1-03 and close the security door (if the Door Clear Photocells are not blocked); conveyor segments TC1-02 through TC1-03 shall run for a predetermined period to clear all bags on the conveyor segments, prior to the stoppage of the conveyor segments and closure of the door.

e.) Over-Height / Over-Length Detection

- (1.) An over-height and an over-length photocell shall be provided at the discharge end of TC1-03 on the non-public side of the security door; their respective indicator lights shall be located on the public side, on the Type 3 control stations.
 - (2.) Over-Height: Interruption of the over-height photocell shall immediately stop conveyor TC1-03 and illuminate the respective indicator light on the control station; the associated indicator light shall signify, by a steady burning indication, the Oddsize bag condition which shall change to a flashing signal once the fault condition has been cleared. The conveyors shall be restarted by resetting the E-stop and pressing the start pushbutton. Upstream conveyors shall cascade stop appropriately if baggage arrives and blocks the associated conveyor(s).
 - (3.) Over-Length: When the over-length photocell has been blocked for a duration greater than the amount of time for an item of maximum length to pass by that photocell shall immediately stop conveyor TC1-03 and illuminate the respective indicator light on the control station; the associated indicator light shall signify, by a steady burning indication, the Oddsize bag condition which shall change to a flashing signal once the fault condition has been cleared. The conveyor shall be restarted by resetting the E-stop and pressing the reset/restart pushbutton.
 - (4.) Over-Height and Over-Length Baggage shall be manually transported into the Oddsize screening area.
- f.) Start-up alarms and fault alarms shall be located as required, along the outbound line and mainline/make-up device area. Start-up and Fault Warning Alarm(s) location and function shall be consistent with the specified requirements indicated elsewhere in this document.
- g.) Jam Reset and Emergency stop control station(s) location and function shall be consistent with the specified requirements indicated elsewhere in this document.



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- h.) CS/SD TC1-03 control station located at TC1-03 (Type 2 – Security Door Control Station) provides manual control for the door when in “Maintenance” mode. CS/FD TC1-03 door control station shall be installed adjacent to each fire door for maintenance personnel use only (not accessible from the public side) which shall contain the following:
 - 2.) Maintenance/Auto Switch
 - 3.) Door Open Black Pushbutton
 - 4.) Door Closed Black Pushbutton
 - 5.) Reset/Restart Green Pushbutton
 - 6.) Lighted Push-Pull (Lockable) “E-Stop” Red Maintained Contact Pushbutton
- c. One (1) Type 10 control station on the motor control panel (MCP) door shall also be provided. Consistent with the contract requirements this control station shall be labeled as CS/MCP TC1, and include the following controls/features:
 - 1.) “Reset/Restart” Green Pushbutton
 - 2.) “System Ready” Green Illuminated Indicator Light
 - 3.) Lighted Push-Pull (Lockable) “E-Stop” Red Maintained Contact Pushbutton
 - 4.) “Alarm Silence” Yellow Pushbutton
 - 5.) “Lamp Test” Gray Pushbutton
 - 6.) “System Fault” Amber Indicator Light
 - 7.) “Motor Overload” Blue Indicator Light
- 3. Other Control Functions:
 - a. Control Functions associated with the conveyor line's Security Door operation, Cascade Stop, Jam Detection/Restart, Oversize Detection/restart, Emergency Stop/Reset, Motor Control Panels, Motor Overload conditions and respective Alarm Silence function(s) shall be compliant with the specified requirements described elsewhere in this document.
 - b. Flash the Ticket Counter Start Pushbutton “Green light” when the respective ticket counter conveyor subsystem has cascaded back to the load belt. This will notify the ticket counter agent that a jam/fault has occurred in the subsystem
- C. EDS Security Screening Systems (SS1 and SS2)
 - 1. General
 - a. The SS1 and SS2 subsystems shall be powered by new MCP-1 and associated PLC's configured in a warm back-up mode.
 - b. The type of EDS device to be provided and integrated into the Baggage Handling



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System for this project is the CT-80DR manufactured by Reveal Imaging Technologies, Inc.

- c. The BHS Contractor shall be responsible for obtaining the latest CT-80DR Integration Guide, CT-80DR Site Planning and Design Guide and CT-80DR Interface from Reveal.
 - d. The control sequence of operation and functionality of the EDS system shall abide by the TSA protocols contained in the Version 6.0 of the Planning Guidelines and Design Standards document. Obtain the TSA protocols / Planning Guidelines and Design Standards as indicated elsewhere in this specification from the TSA's website as required.
 - e. Assist the TSA's OST and IV&V representatives in performing the mandated Test Readiness Review (TRR) and Integrated System Acceptance Tests (ISAT) for both the originating Outbound EDS systems. Obtain the latest copy of the TSA's SSTP and ISAT test procedure (from the TSA via the Owner) to ensure the completed CBIS meets all the protocols and requirements contained within, prior to the specified Pre-Test readiness review (Pre-TRR) and the TSA's TRR and ISAT(s). Prior to performing the Pre-TRR, TRR and ISAT(s), carry out a "dry test run" to confirm the system is ready for these tests and coordinate the scheduling of these tests with the Owner and the TSA.
 - f. It should be noted that all documentation that is associated with the operation/functionality of the CBIS, including the Detection SAT, Pre-TRR, TRR and ISAT are Security Sensitive Information (SSI) and will have to be managed/controlled as such, in accordance with 49 CFR Parts 15 and 1520.
 - g. Provide and coordinate with the EDS equipment manufacturer as required to coordinate the details of the necessary interface(s) between the BHS and EDS systems in order to accomplish the intended operation described herein. The BHS contractor shall, in all cases, be responsible for any conduit, wiring and communication bridges between the BHS and EDS equipment systems that are required for these interfaces (hardware and software).
 - h. Provide bag-centering functionality prior to each EDS device (i.e. as a minimum, fixed diverters attached to the conveyor side guards to force the bag to the center of the conveyor). Refer to Part II of this specification for the minimum requirements for a Directional Input Device (DID). The BHS Contractor shall provide to the Owner and Engineer the type of centering to be proposed for review and approval in a shop drawing submittal one month prior to the scheduled mock-up/prototype.
 - i. Refer to Section 1.02, F. CBIS Requirements for detailed Sequence of Operation Description.
2. Control Equipment Components
 - a. Provide all the necessary control stations with their respective control devices and functions along the SS1 and SS2 conveyor subsystems to accommodate the



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requirements relating to Jam Reset Control Function (i.e., Type 1), Emergency Stop Control/Reset (i.e., Type 8), Security Door Operation (i.e., Type 2), High-Speed Paddle Diverter operation (i.e., Type 9) and MCP control station (i.e., Type 10).

- b. Jam Reset and Emergency stop control station(s) location and function shall be consistent with the specified requirements indicated elsewhere in this document. All Jam Reset and Emergency stop stations associated with the SS1 and SS2 outbound transport conveyors shall be located adjacent to each conveyor drive on the maintenance catwalk/walkway side, so that they are accessible by maintenance personnel.
3. Control Functions
- a. With the exception of the public area startup control stations with associated security card swipe functions (that are part of TC1 upstream), there will be no manual start/stop controls for the SS1 or SS2 conveyors. All conveyors downstream of the ticket counter load conveyors in the ticket counter area shall operate by means of auto-start/stop circuits.
 - b. Automatic System Cascade Start
 - 1.) The normal start-up operations of the SS1 and SS2 subsystems shall be governed by an auto-start circuit and shall be controlled by separate photocells; located on each input subsystem. The photocells shall be located far enough upstream of each input subsystem to allow the SS1 and SS2 subsystem conveyors to come up to speed before baggage arrives. When a bag is detected at the input subsystem's photocell(s), the outbound transport conveyors associated with that input shall start (if not already running) sequentially from the output to the input with an appropriate delay between each motor starter actuation to ensure electrical power surges are minimized.
 - 2.) Startup alarms and fault alarms shall be located as required, along the conveyor subsystem(s), as specified elsewhere in this specification section. Start up and Fault Warning Alarm(s) location, type and function shall be consistent with the specified requirements indicated elsewhere in this specification section and as coordinated with the Owner or their representative.
 - c. Automatic System Cascade Stop:
 - 1.) All conveyor segments shall have the capability to shutdown via an "Auto-Stop" sequence. The conveyors of the SS1 and SS2 subsystems shall shut down through an auto-stop circuit, which shall time-out and immediately stop all conveyors if, after a 15 minute period (adjustable), no bags have been detected by the auto-start circuits and all baggage have cleared the train of conveyors.
 - d. Other Control Functions:
 - 1.) Control Functions associated with the conveyor subsystem's Cascade Stop, Jam Detection/Restart, Emergency Stop/Reset, Motor Control Panels, Motor Overload



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conditions and respective Alarm Silence function(s) shall be compliant with the specified requirements described elsewhere in this specification section.

- 2.) Jam Reset and Emergency stop control station(s) location and function shall be consistent with the specified requirements indicated elsewhere in this specification section. All Jam Reset and Emergency stop stations shall be located adjacent to each conveyor drive on the maintenance catwalk/walkway side, so that they are accessible by maintenance personnel.
- e. CBIS Tracking of Bags shall start at the SS1-01 and SS2-04 conveyors up to and including the entrance to the EDS or the handoff point to the EDS where the EDS will take over for processing. Tracking starts again at the handoff point from the EDS exit point to the BHS. All bags shall be tracked in dynamic PLC RAM via a memory model of the bag ID number. The memory model will be updated in real-time to reflect the position of the bag on every conveyor segment through the entire CBIS
- f. Upon bag arrival, at the conveyor directly interfacing the EDS devices, the BHS shall, through the BHS-EDS interface(s), “hand over” the bag to the EDS equipment device by sending a bag ID number. The BHS system shall provide the EDS system with an ID for each bag and track that baggage item with the unique ID.
- g. A pseudo id will be generated by the BHS PLC. The bag ID shall be easily recognizable as an EDS bag ID (e.g. start with 1 for EDS device #1, 2 for EDS #2). A pseudo id may not be repeated within a 24 hour time frame. Coordinate with the EDS supplier for all BHS/EDS handshake protocol.
- h. Upon receipt of a signal from the EDS equipment, the BHS shall then advance the bag into the EDS equipment device. The bag shall be scanned and, depending on mode of operation, the bag shall be passed back to the BHS. The EDS equipment shall pass the bag back to the BHS by sending an appropriate message that includes status (e.g., cleared, alarmed, EDS unknown) and also echoes the bag ID number upon arrival at the exit conveyor, Upon receipt of the corresponding bag status/hand-over message the BHS shall send a message back to the EDS equipment acknowledging receipt of that status.
- i. Level 1 (EDS Machine screening in the “Hold-on Decision” mode)
 - 1.) Level 1 refers to an EDS device, the Reveal CT-80DR which will be provided for this project on the SS1 and SS2 subsystems by the TSA’s supplier and installed to operate in a fully automated, Hold-Outside mode (i.e., system automatically pass/fails the bag). All originating “in-gauge” checked bags shall be conveyed to the CT-80DR EDS machine for security screening. As a bag enters the EDS machine a discrete (pseudo) identification number shall be handed off from the BHS to the EDS machine. The EDS machine will then use this identifier to associate the individual bag with its screening status. The EDS machine’s software will automatically scan each bag and provide a bag screening status of “Cleared”, “Alarmed”, or “Errored/EDS Unknown”, based on the assessment of the bag images, and will notify the BHS via the EDS/BHS security interface network.



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- 2.) “Cleared” Level 1 bags will be tracked with an interface at the Level-1 EDS machine, which shall be accomplished with the above referenced respective discrete identification number, and continue onto the CL conveyor lines for transport to baggage make-up (MU1-01).
- 3.) A stacked light module shall be provided for the SS1 and SS2 subsystems, installed on a post directly above the BRPs. These stacked light modules shall consist of four different colored lenses, using LED bulbs, for visual indication of the bag’s status (i.e., BLUE (for Failsafe condition); WHITE (for Unknown Bags and Pending Decision); RED (for Alarmed Bags) and GREEN (for Cleared Bags). The status of all “Cleared” Bags will be displayed on the respective stacked light module as they transition onto the Clear (CL) Bag line; the Green indicator light on the stacked light module shall stay illuminated until the bag(s) has fully transitioned past the BRP and onto the downstream CL1 clear bag line.
- 4.) Conveyors CL1-01 and CL2-01 shall be designated as a “Failsafe” position to stop any non-cleared bags that are detected at the discharge end photocell and illuminate the “Blue” indicator light on the stacked light module.
- 5.) If an “Alarmed” or “Errored/EDS Unknown” bag status is received from the Level 1 EDS machine, the BHS shall advance the bag onto the OSR-01 and OSR2-01 conveyors immediately downstream of the EDS machine; “Alarmed” bags, which are automatically alarmed by the Level 1 EDS machine, will be reviewed by the EDS Level 2 TSO performing On-Screen Resolution via the Threat Resolution Interface (TRI) at the BVS computer terminal.
- 6.) All “Errored/EDS Unknown” and “BHS Unknown” (typically mis-tracked) baggage shall be stopped on the OSR1-01 and OSR2-01 conveyors immediately downstream of the EDS machine and be identified by its security status for removal and processing via ETD screening.
- j. Level 2 (EDS On-Screen Resolution):
 - 1.) As noted above, Level 2 refers to the BVS computer terminal that will allow the viewing of the EDS alarmed images by local TSOs via the Threat Resolution Interface (TRI) between the EDS machine and the BVS computer terminal; the BVS computer terminal will be provided with the EDS machine by the TSA’s supplier and will be combined in the same area as the ETD operation.
 - 2.) Baggage that receive an “Alarmed” status from the Level 1 EDS machine will exit the machine and remain on the Level 2 Pending Decision Conveyors OSR1-01 or OSR2-01, while their image is simultaneously transmitted via the EDS/BHS security interface network to the BVS computer terminal for further screening. The images shall be received and displayed on the BVS computer terminal that will be dedicated to the CT-80DR EDS machine. A TSO will view the image on the display for a configurable time duration utilizing Threat Resolution Tools (TRT) to determine if the bag is “Cleared” or “Alarmed”.



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- 3.) Baggage that does not receive a “Cleared” or an “Alarmed” status from the EDS machine will have 25 seconds of OSR time at the Level 2 pending decision conveyors (OSR1-01 and OSR2-01), while the “White” indicator light on the stacked light module is illuminated (e.g., for Unknown Bags and Pending Decisions).
 - 4.) If the TSO at the BVS computer terminal assigns a Level 2 “Alarmed” status or fails to give a decision prior to the expiration of the 25 second OSR time period or in case nobody is logged onto the BVS, the “Red” indicator light on the stacked light module shall illuminate to alert TSO’s of the situation that the bag status can only be resolved via a Level 3 screening process. The “Alarmed” baggage removal/reinsert conveyors (OSR1-01 and OSR2-01) and it’s security status and discrete (pseudo) identification number will be sent to the BHS via the BHS/EDS security interface network to reflect the change in screening to a Level 2 “Alarmed” status, so as to allow the removal of the bag from the baggage removal/reinsert conveyor for processing via ETD screening.
 - 5.) If the Level 2 screening process (i.e., TSO at BVS computer terminal) has “Cleared” the bag, the bag’s security status and respective (pseudo) discrete identification number will be sent to the BHS via the BHS/EDS security interface network to reflect the change in the screening status to a Level 2 “Cleared”, in which case the “Green” indicator light on the stacked light module will illuminate and the bag shall be released from the Level 2 OSR1-01 and OSR2-01 conveyors to transition onto the Clear (CL1 and CL2) Bag subsystems for transport to baggage make-up (i.e., MU1). The Green indicator light on the stacked light module shall stay illuminated until the bag has fully transitioned past the OSR/BRP and onto the downstream CL clear bag line.
- k. Level 3 (Explosive Trace Detection screening)
- 1.) Level 3 refers to a trace operator screening area (i.e., CBRA), which is located at the discharge end of each Security Shunt (SS) conveyor line, downstream of the EDS machine location(s). Screening is basically handled by way of directed manual search, in accordance with TSA protocols, utilizing a Remote Resolution Station (RRS) at the BIT (i.e., trace operators screening Level 2 Alarms).
 - 2.) Alarmed bags shall be removed from the baggage removal/reinsert conveyor (OSR1-01 and OSR2-01) to release the conveyor for the advancement of the next bag. “Alarmed” bags shall be screened per local TSA protocols at the dedicated Level 3 BITs that will be located adjacent to the SS conveyor line. The SS conveyor subsystems will be provided with one (1) ETD workstation each, that will consist of 5’-0” wide baggage inspection tables (BITs), an ETD machine (per BIT), Remote Resolution Station (RRS).
4. EDS Efficiency Requirements
- a. Less than one percent of all bags processed shall jam throughout the system (i.e., from the normal daily point[s] of induction through the EDS, through Resolution [if Non-



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Cleared], and to the point[s] where bags are returned to the outbound system). This is measured by counting the total number of jammed bags and not by counting jam events. This count includes existing BHS systems feeding new EDS screening systems.

- b. For this system which does not have conveyors to reintroduce bags from the Resolution area for screening through an EDS, the error rate as defined below may be no more than one percent of the total bag volume processed.
- c. The error rate formula is:
 - 1.) Error Rate = [(Total Bags at Resolution) minus (Valid Non-Cleared Bags with Tracking IDs)] divided by Total Bags Inducted.
 - a.) Valid Non-Cleared Bags include Alarmed and EDS Unknown bags.

5. EDS Start Sequence

- a. The following start sequence describes security screening for the SS1 EDS subsystem and is typical for all EDS subsystems:
 - 1.) The level 1 EDS unit(s) shall be activated from the local EDS control station at the beginning of the day to allow for sufficient warm-up time. As a minimum, the associated EDS conveyor lines must be running for the EDS device to start up or as required by the EDS machine. Also refer to the EDS “TEST” mode of operation outlined in the following paragraphs.

6. EDS Stop Sequence

- a. The level 1 EDS device(s) shall be shut down from the local EDS control station independently of the baggage system, at the close of the day.
- b. The EDS conveyor lines shall have an auto-stop function. Photocells located at the discharge end of conveyor SS1-01 and SS2-01 shall be on a 20-minute timer (adjustable). If both photocells remain unblocked for 20 minutes while the conveyors are running, individual conveyor lines shall shut down. If an Emergency Stop push button is activated or a jam occurs at any point during operation, the timers shall reset to zero.

7. E-Stop Functionality

- a. Activation of any CT-80DR E-stop will stop the associated EDS subsystem conveyors and CT-80DR device.
- b. Activation of an EDS subsystem conveyor E-stop will not E-stop the CT-80DR.

8. EDS IQ Test Mode Control Stations (Type 21)

- a. A control station shall be installed at the discharge end of each EDS machine's exit conveyor. The location of these control stations shall be coordinated with the Owner and TSA. The control station shall contain the following operators/control devices:



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Description	Label
“Green” flush-head Pushbutton	Reset/Restart
Lighted Push-Pull (Lockable)	Emergency Stop
Normal/Test Keyswitch	Normal/Test

- 1.) In the NORMAL mode the BHS shall operate as already outlined in this document. The key shall be removable only in the NORMAL mode.
 - 2.) In the TEST mode (primarily used by the TSA or EDS Contractor for testing/calibration of the EDS device), all bags input for testing shall stop upon reaching the head end photocell of the EDS device exit interface conveyor and shall require removal and subsequent actuation of the start pushbutton on the control station to re-start the exit conveyor.
 - 3.) While in the TEST mode, bags shall not be diverted to the respective EDS device that is being tested.
- b. An INSERT BAG (Type 17) control station shall be included at the last BHS conveyor prior to the EDS device’s entrance conveyor and shall operate as follows:
- 1.) Operations staff shall wait for an available window and place the INSERT BAG key-switch to manual mode (left hand position).
 - 2.) This shall stop the last BHS conveyor prior to the EDS device’s entrance conveyor.
 - 3.) Operations staff shall place the bag on the conveyor and press the re-start pushbutton; the bag shall then be automatically transported into the EDS device. Upon completion of the Insert Mode operation, the INSERT BAG key switch shall be positioned to the right hand (normal) to place the system back to the normal mode of operation (automated)
- c. Coordinate with the EDS Contractor the necessary EDS/BHS interface, and provide the required BHS controls and exit interface conveyor BHS control station requirements for the EDS TEST mode of operation.

D. Reinsertion Conveyor Control Station

- a. A BAG INSERTION (Type 22) control station shall be included at the Re-Insertion conveyor on the OSR1 and OSR2 subsystem and shall operate as follows:
- 1.) Operations staff shall wait for an available window and shall actuate the BAG INSERTION push button.
 - 2.) This shall stop the last BHS conveyor prior to the re-insertion conveyor.
 - 3.) Operations staff shall place the bag on the conveyor and press the re-start pushbutton; The BHS will assign a pseudo ID prior to entering the CT-80 machine. The pseudo id’s for all bags inducted at the reinsertion conveyor will be given a unique series that will identify them as such. The luggage then would be



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transported utilizing the new ID.

4.) An E-stop shall be provided within the BAG INSERTION control station.

2. Decision Point Stacked Light Modules

- a. Provide at each CT-80DR exit conveyor a stacked light module with amber (Unknown); red (Alarmed) and green (Cleared) lenses using LED bulbs. The light will activate in parallel with the lights on the control station described above. The stacked module shall be mounted on a post at least 30 inches above the side guard so as to provide an additional visual indication of a bags status. (Type 25)

3. Other Controls Functions

- a. If one – (1) EDS machine is not active while the baggage subsystem is running, the bags shall be diverted to the available EDS device.
- b. Submit as part of the functional specification submission a detailed matrix clearly identifying all the possible security screening failure scenarios and the fallback action to be initiated (manually by the control room operator or automatic by the BHS Computer system).

4. EDS Reporting

- a. The BHS reporting system shall provide for report generation of the security subsystem activities. In addition to the reports identified elsewhere in these specifications which will need to reflect EDS activity, it shall be the BHS contractors responsibility to provide a daily log of all bags processed at the EDS devices with appropriate filtering provisions to allow for sort by bag ID specifics, EDS device, decision rendered and lost tracking.
- b. As a fault finding diagnostics tool, the BHS operator shall have (via a pull down screen at the Touchscreen Terminal/PC workstation) the ability to monitor the status of all EDS/BHS handshake/interface signals (per device) in real time. The BHS Contractor shall provide to BNP and the Owner a sample of the diagnostic status screen.
- c. The BHS Contractor shall monitor the following EDS/BHS operations and generate fault messages both graphically and in text at the Touchscreen Terminal/PC workstation and stop directing bags to the faulted EDS line until the issue has been resolved:
 - 1.) Three consecutive baggage IDs lost at the EDS
 - 2.) Loss of communications between the EDS and BHS
 - 3.) Three bags in a row with an “unknown” or “no” status (these are unknown/no bags not generated as a result of an EDS fault reset)
 - 4.) Loss of bag tracking through the EDS line.

E. Clear Bag Subsystems CL1 and CL2



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1. General

- a. These subsystems consists of conveyor segments CL1-01 through CL1-02 and CL2-01 through CL2-08 and associated subsystem tip chute, for transport of “Cleared” baggage from the CBIS to the Makeup Unit MU1-01.
- b. The CL1 and CL2 subsystems shall be powered from the MCP-2, and controlled by the associated subsystem PLCs with warm backup capability.

2. Control Equipment Components

- a. The following description for the CL1 clear bag subsystem and related sequence of operation is provided as an example (CL2 subsystem shall be configured in a similar fashion); detailed control functionality shall be coordinated with the Owner and the TSA through the shop drawing submittal process.
 - 1.) Provide the necessary control stations with their respective control devices and functions for the CL1 conveyor subsystem to accommodate the requirements relating to Jam Reset (Type 1) Control Station, Emergency Stop Control/Reset (i.e. Type 8), MCP control station (i.e., Type 10), and Security Door (Type 2), along with the subsystem specific control stations described below.
 - 2.) Start-up alarms and fault alarms shall be located as required, at the input point, along the transport conveyors, and at the make-up device. Start-up and Fault Warning Alarm(s) location, type and function shall be consistent with the specified requirements indicated elsewhere in this specification section. The location of the alarms shall be coordinated with the Owner and local TSA.
- b. CL1 Conveyor Start Sequence:
 - 1.) The CL1 shall include two modes of startup – automatic and manual. For automatic startup, the CL1 subsystem shall start upon receiving a signal via the EDS/BHS security interface network that a cleared bag is destined for the CL1-01 conveyor. To manually start the subsystem, the start-up functionality first must be enabled via the "System Start" function from the PC-type Computer Terminal Workstation. This function shall allow the local "Reset/Restart" pushbuttons within the CBIS to start the subsystem.
 - a.) Subsystem Initial Start-up (“Manual Start”):
 - (1.) Actuation of the clear bag subsystem's “Reset/Restart” push buttons shall energize the conveyor subsystem’s Visual/Audible warning alarms along the conveyor



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subsystem right-of-way for 10 seconds (adjustable). The subsystem's respective Security door, as illustrated in the BHS contract drawings, shall open while the start-up alarm sounds and flashes. After start-up warning alarm period and when the security door is fully opened, the applicable SS1 or SS2 Removal Reinput conveyor plus the CL1-01 conveyor shall start. The make-up device and CL conveyor segments shall all start sequentially from the output to the input. The start-up warning signal at the make-up device shall sound only if the device is not already running.

a.) Automatic System Cascade Start:

- (1.) When the BHS detects the appropriate signal via the EDS/BHS security interface network that a cleared bag is destined for the CL1 subsystem conveyor segments, the subsystem conveyor segments shall start via an "Auto Start" sequence. Program the auto start circuit to start the CL1 and CL2 conveyor segments and the make-up device, if they are not already running, whenever the auto start signal is received. The CL1 transport conveyors (in addition to the make-up device) shall all start sequentially from the output to the input with an appropriate delay between each motor starter actuation to ensure electrical power surges are minimized.

b.) Manual Stop:

- (1.) Depressing the "Stop" pushbutton on any of the SS1 and SS2 Control Stations shall stop the CL1 and CL2 conveyors and close the Security door (if the Door Clear Photocells are not blocked); CL1 and CL2 conveyor segments shall run for a predetermined period to clear all bags on the conveyor segments, prior to the stoppage of the conveyor segments and closure of the door.

c.) Automatic System Cascade Stop:

- (1.) The CL1 conveyor segments shall stop and the security door shall close via the conveyor line's "Auto Stop" sequence whenever the EDS/BHS security interface does not sense a bag for 5 to 30 minutes (adjustable); CL1 and CL2 conveyor segments shall stop whenever the auto stop circuit (i.e., upstream photoeyes) do not sense a bag for 5 to 30 minutes (adjustable).



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3. Other Control Functions

- a. Jam Reset and Emergency stop control station(s) location and function shall be consistent with the specified requirements indicated elsewhere in this document. The Jam Reset and Emergency stop station(s) that will be associated with the CL1 conveyors shall be located adjacent to the conveyor drive and positioned so that they are accessible by maintenance personnel.
- b. Control Functions associated with the CL1 and CL2 subsystems' Cascade Stop, Jam Detection/Restart, Emergency Stop/Reset, Motor Overload conditions and respective Alarm Silence function(s) shall be compliant with the specified requirements described elsewhere in this document.

F. Ancillary Subsystems (Make-up Unit)

1. Make-Up Unit (MU1-01), General

- a. The Makeup Unit shall be powered from the MCP-2, and controlled by the associated subsystem PLCs with warm backup capability.

2. Control Equipment Components

- a. Provide two (2) Type 15 Make-Up Maintenance Mode Control Stations as located on the BHS Drawings. Consistent with the contract requirements the Type 15 control stations shall be labeled as required and described below with controls/features:
 - 1.) "Jog" Black Pushbutton
 - 2.) "Reset/Restart" Green Pushbutton
 - 3.) "Auto-Maintenance" Two Position Selector Switch
 - 4.) Lighted Push-Pull (Lockable) "E-Stop" Red Maintained Contact Pushbutton
- b. Provide a minimum of one (1) Type 1 Jam Control Station at the CL2 discharge to the MU1 Make-Up Device. This control station shall be mounted on a stanchion and be located so that it is accessible from the outer radius (working area) of the carousel. Consistent with the contract requirements, this control station shall be labeled as required and as described below with controls/features:
 - 1.) "Reset/Restart" Pushbutton
 - 2.) "Jam" Amber Illuminated Indicator Light
 - 3.) Lighted Push-Pull (Lockable) "E-Stop" Red Maintained Contact Pushbutton
- c. Provide a minimum of four (4) Type 8 Make-Up Device Reset/Restart



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Control Stations, located around the perimeter of the Make-Up Device. Consistent with the contract requirements, the control stations shall be labeled as required and as described below with controls/features:

- 1.) Lighted Push-Pull (Lockable) "E-Stop" Red Maintained Contact Pushbutton
 - 2.) "Reset/Restart" Pushbutton
 - d. Additionally, provide one (1) Type 19 "Control Stop / Start" Pushbutton control station for the make-up device crossover (one control station on each side of the crossover), as specified elsewhere in the document.
3. Control Functions
- a. Initial Settings – the system ready indication for the initial conditions of the subsystem(s) shall be as described above in this specification Section (14520, Paragraph **Error! Reference source not found.**).
 - b. The make-up device shall operate by means of auto-start/stop circuits. Additionally, the manual start function described below shall provide the ability to operate the device after the feed conveyor subsystem (CL1) is timed out.
 - c. The baggage system control circuitry shall be designed to assure that the make-up device is running at full speed prior the startup of any feed conveyors.
 - d. In case the make-up device times out before all baggage has been sorted, activation of any restart button on the make-up device shall cause the device to run for an additional twenty (20) minutes (adjustable) without the feed conveyors operating.

3.09 CONSTRUCTION PHASING SEQUENCE

A. General

1. The BHS scope of work will be in accordance with an overall project phasing sequence. Reference the Owners installation schedule. The BHS contractor shall be required to coordinate all work with the Program Manager, other disciplines working in the immediate area of construction, airline flight schedules and hours of operation, so as not to impact the Terminal's normal functions and concurrent airline operations.
2. Schedule and coordinate the BHS Scope of Work (installation, removal, refurbishment, and interim connections), in accordance with the phasing sequence indicated by the project's overall phasing plan and the phasing sequence described herein. Coordinate all work with the Owner/Program Manager, other disciplines working in the immediate area of construction, airline flight schedules and hours of operation, so as not to impact the Airport's normal functions and concurrent airline operations.

3.10 DEMOLITION/EQUIPMENT REMOVAL



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A. Maintain Operations

1. Remove existing equipment indicated on the Contract Drawings as "To Be Removed". Maintain operation of unaffected baggage handling equipment through the implementation of temporary electrical connections or the addition of supports to replace connections or supports removed in the demolition process.
2. If the removal of equipment creates unsecured access to a secured area, provide a guard on a 24-hour per day basis until installation of equipment returns the area to secured status.

B. Conduit Removal

1. Remove conduit including junction boxes and control/wiring devices rendered unused by the demolition process in its entirety to the motor control panel. Exception: abandon in place the imbedded portion only of any imbedded conduit after removing all conductors. Where a conduit passes through a floor or wall, cut the unused conduit flush with both surfaces of such floor or wall and abandon the section within the floor or wall if it cannot be removed without breaking masonry. Ensure that any area where material has been cut away is left in a clean and flush condition with no holes or protrusions showing. Where removal creates an indentation in concrete, chip away the surrounding concrete, cut the material (e.g., anchor bolts, conduit) below floor level and fill flush with cement.

C. Support Steel Removal

1. Remove support steel including header beams and attachments rendered unused by the demolition process in their entirety. Remove anchor bolts flush with floor, wall, or ceiling by burning or cutting.

3.11 DEMOLISHED MATERIALS TO BE DISPOSED

A. General

1. Remove and dispose of any materials or items demolished and not designated to become the property of the Owner or to be reinstalled.

B. Equipment Disposal

1. Remove from Airport site all debris, rubbish and other materials resulting from demolition and alternation operations on a daily basis. Transport and legally dispose equipment off-site in legal landfills or scrap yards. Obtain written permission from the property Owner on whose property the removed materials shall be placed, and submit a copy of the agreement to the Owner.
2. Burning of removed materials is not permitted on the project site.
3. Store materials, which cannot be removed daily in areas specified by the Owner.
4. Do not store or sell removed items on-site.

3.12 OPERATION AND MAINTENANCE TRAINING

A. General



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1. Instruct and train the Owner operating and maintenance personnel at the work site. Conduct this training prior to Conditional Acceptance of each phase of the work and ensure competence in the operation and maintenance of the new equipment and the system/subsystems.
2. Training is to be provided by a professionally qualified instructor. Use of site supervisors, equipment or system designers as an instructor for the formal training will not be accepted unless approved by the Owner or their representative.
3. Furnish all tools, equipment, materials and supplies, and perform all functions and services required to complete the training as specified. With the exception of safety and overview training, training shall be divided into separate categories for operations training and maintenance training further broken down to specific trades.
4. No actual operations training of a piece of equipment will be permitted until the equipment is properly installed and is operational.
5. A detailed outline of the proposed training to be conducted shall be submitted to the Owner or their representative for review and approval in accordance with the schedule of submissions prior to the testing of the system. The training program submittal shall include, at a minimum, the following information for review:
 - a. Types and durations of training/classes.
 - b. Name and professional credentials for each instructor/trainer.
 - c. Max/min number of persons allowed per class.
 - d. Any specialty type of requirements such as classroom/conference room space, VCR, TV, or white board (to be coordinated with the Owner however the Owner is not responsible to supply the above mentioned space or materials)
 - e. Copies of all training materials, to be used during training. All training binders/materials shall be submitted for review in the format in which they will be used during the on-site training. It should be noted that the O&M manuals will not be allowed to be used for training purposes; however consolidated sections of the O&M manuals which have been tailored for classroom training are permitted.
6. Times and duration of the classes may involve irregular hours in order to provide training of the operational and maintenance personnel on different shifts.
7. All training sessions will be monitored and approved by the Engineer. Any session or portion thereof deemed unsatisfactory, based on evaluation of the training, shall be repeated by the BHS Contractor or the BHS Contractors representative at no additional cost to the Owner.
8. Develop and maintain a training attendance record for all operation and maintenance training sessions presented. The record is to note the following information in duplicate form. The original copy of the record is to be forwarded to the Owner with the second copy being retained by the BHS Contractor for his files. The recorded training information must



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include for each session:

- a. Date of training session
 - b. Name of project
 - c. Name of Instructor
 - d. Subject of training
 - e. Time of training session
 - f. Signature and department of each attendee
9. Provide the Owner with two (2) copies and the Local TSA with one (1) copy of the video recording of one (1) complete operational and maintenance training class for this project. The video recording shall be provided to the Owner/Local TSA in a media acceptable to the Owner (DVD or VHS).

B. Operational Training

1. Provide formal instruction of the Owner's operational personnel at the site who will be charged with operation of the BHS. Include a description and on-site demonstration of the electrical controls and their operation, modes of operation, the operating limitations of the equipment and the safety devices and their functions.
2. Minimum requirements for Operational Training shall include, but not be limited to, the following:
 - a. Operating procedures for all BHS/CBIS conveyance equipment.
 - b. BHS equipment within the CBRA.
 - c. BHS Control Interface with CBIS.
 - d. System Safety procedures, including lock-out and Tag-out requirements.
 - e. Bag Jam Clearing procedures, as coordinated with the Airport's O&M group and local TSA.
 - f. Sensitive Security Information (SSI) Training for any BHS/CBIS related reports that are classified as SSI; this training shall comply with government SSI guidelines as per the TSA's PGDS, Appendix G.
3. All operations or individuals with access to either viewing or printing reports shall also be trained in SSI procedures (as coordinated with the TSA) prior to operation. These training sessions shall be conducted prior to the operational start-up of the respective BHS/CBIS.
4. Provide a minimum of 4 hours of operational training per shift for this project, for a minimum of three (3) shifts.

C. Maintenance Training

1. Provide formal training of the Owner's BHS maintenance personnel with the objective of



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preparing the employees to perform the required preventive maintenance to minimize breakdown and to perform necessary repairs when work stoppages or breakdowns of the equipment occur. The training shall include, but not limited to the following:

- a. Preventive and corrective maintenance procedures, including replacement of parts; lubrication quantities, types, frequencies and application points; and an estimate of the time to perform such procedures.
 - b. Special tools, techniques, or procedures required for either preventative or corrective maintenance of the equipment, or it's auxiliary or support components.
 - c. Procedures to perform adjustments required for alignment, wear and calibration for all preventative and corrective maintenance, and an estimate of time required to perform such procedures.
 - d. Assembly and disassembly procedures, including parts lists required for appropriate and corrective maintenance. Models, "exploded" views, and audiovisual materials shall be used for training. These materials shall be handed to the Engineer upon completion of training. Hands on field training shall be provided, subject to the approval of the Owner.
2. The formal training shall consist of classroom and on the equipment training, as required to properly train personnel for each shift, prior to the start of operation. The training must cover all aspects of the electrical and mechanical equipment provided in this project. The electrical aspects shall include but not be limited to, electrical controls and control systems and PLC control systems.
 3. On-site training shall be scheduled to commence immediately following classroom training and shall stress hands-on performance based application of the classroom training. Equipment shall be started and relevant systems and components shall be demonstrated.
 4. Off-site training, primarily for the technical trades e.g. electricians, controls technicians; mechanics shall focus on specialized, technical training and shall be provided by the manufacturer at their factory or training facility. In the event the Owner requests specialized factory training on a particular piece of equipment, the BHS Contractor shall make arrangements with the applicable manufacturer to provide such training.
 5. Provide maintenance training for any specialized equipment used in the related system that is not of the BHS Contractor's design or manufacture. The qualified representatives will present such training, from the manufacturer of the specialized equipment.
 6. Provide a minimum of 4 hours of maintenance training per shift for this project, for a minimum of three (3) shifts.
 7. Examples of specialized equipment and other BHS maintenance related training include, but are not limited to those items listed below:
 - a. Safety Procedures including Lock out/Tag-out
 - b. Operation and Maintenance Manual use



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- c. Warranty Procedures
 - d. System Preventative Maintenance
 - e. EDS/BHS System Interface and Troubleshooting
 - f. Power Turns
 - g. Flat Plate devices
 - h. 45 Degree Merge conveyor
 - i. HSPDs
 - j. Fire/Security Doors
 - k. Programmable Logic Controller Systems including basic ladder programming techniques
 - l. Computer Systems Equipment
 - m. Interfaces to the Owner Networks
 - n. Problem Resolution Screens
 - o. System Reports
- D. Supplemental Training
- 1. Should the Owner require supplemental training beyond that specified above, provide at a time and at rates as mutually agreed upon between the Owner and the BHS Contractor.

- END OF PART III -



PART IV - QUALITY CONTROL SPECIFICATIONS

4.01 FIELD QUALITY CONTROL

A. Quality Control Manual

1. Provide a Quality Control Manual acceptable to the Owner or their representative.
2. Indicate inspection lists and methods that will be utilized for quality control inspection and testing to confirm compliance with the specified requirements.
3. The Quality Control Manual shall assure that there is a system for final inspection and testing of completed products, construction and installation. Such testing shall provide a measure of the overall quality of the completed product and shall be performed so that it simulates product end use and function. Final inspection and testing shall provide for reporting to the Owner or their representative any difficulties, deficiencies, or questionable conditions. When modifications, repairs, or replacements are required after final inspection or testing, there shall be re-inspection and re-testing of any characteristics affected.
4. The Quality Control Manual shall provide instructions for handling, storage, preservation, packaging, and shipping to protect the quality of products and prevent damage, loss, deterioration, degradation, or substitution of products. It shall also require and monitor the use of procedures to prevent handling damage to articles. Products in storage shall be protected against deterioration and damage.

B. Quality Assurance

1. The BHS Contractor shall be responsible for all quality control of its Work, including work performed by any of its subcontractors. It shall be the BHS Contractor's responsibility to include in its own direct subcontracts those provisions which are necessary to assure that the quality of subcontracted work will be as good as that required of the BHS Contractor by the requirements herein.
2. The Owner or their representative shall have the right to audit and inspect the BHS Contractor's and its direct subcontractors' quality systems. Such audits may be conducted on a random or routine basis and may include an audit of the BHS Contractor's inspection and test records. The Owner or their representative shall have the right to witness any tests or inspections and shall have access to all test data including test procedures, test specifications, and test results. The Owner or their representative shall have the right to conduct independent tests or inspections at its own expense on any material or equipment to be used on the project. Should such the Owner or their representative directed independent test result in failure, the BHS Contractor shall reimburse the Owner's expense for the test. The objective of all audits, inspections, or tests conducted by the Owner or their representative is to ensure that all BHS Contractor-performed work is accomplished in compliance with the Contract Documents.
3. The Owner or their representative shall have the right to reject, and the BHS Contractor shall replace at the BHS Contractor's cost, any construction, production or installation, or



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portion thereof, which has not been accomplished or documented as accomplished in accordance with the accepted Quality Control Plan.

C. Quality Assurance Representative

1. Appoint a Quality Assurance Representative acceptable to the Owner or their representative who shall be responsible for the overall quality assurance implementation and monitoring of the general requirements.
2. The quality assurance representative shall be available on-site during the construction period at all times and be qualified to advise the Owner or their representative on the overall BHS scope of work (i.e., installation/removal procedures, refurbishing, provisioning, start-up and maintenance of the equipment).

D. Configuration Management Plan

1. Maintain strict configuration control of all aspects of the design, construction, fabrication and installation of the BHS Systems. Submit a Configuration Management Plan for the Owner or their representative review and approval. The BHS Contractor shall be responsible for carrying out all aspects of this Plan.
2. Establish a system, to identify, organize and track all documents developed as part of the BHS Contract Work throughout the duration of the project. Serialize all correspondence and transmittals, and establish a logging system for incoming/outgoing correspondence showing action requirements and action taken. Drawings, specifications, subcontract documents, reports, estimates, studies, reviews, and computer files, shall be tracked by a logging system.
3. Tracking logs for correspondence and documents shall be provided when requested by the Owner or their representative. Establish a single source for transmitting and receiving documents and correspondence. Material from the BHS Contractors subcontractor's shall be consolidated and submitted to the Owner or their representative by the BHS Contractor.
4. Logs for correspondence and document control shall be provided to the Owner or their representative on electronic media and in reproducible hard copy for use in the Owner's document control system.
5. Once configuration for an element of the BHS System is established (for example, at Design Reviews), the configuration of all such elements shall not be changed by the BHS Contractor without proper approval as provided for in the Configuration Management Plan. Once configuration changes are approved, formal Change Order Documentation shall be circulated in accordance with a distribution list (which shall include the Owner or their representative) developed for that purpose.
6. At conditional acceptance of the system (or completion of a phase), provide a software solution that automatically manages configuration and change management for all operating software applications to carry out the following functions as a minimum:
 - a. Monitor critical computer services



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- b. Log system events across concurrent processes
 - c. Audit and log changes made to the running processes
 - d. Verify, backup and recovery programs and system files
 - e. Secure access to editing and monitoring functions
 - f. Provide file management for all system components
 - g. Manage and secure product access
7. The audit function shall track every change made to the BHS system and its operating programs, including detecting who, where and when changes were made. The archive file management function shall manage all revisions carried out to the system, as files are modified, revisions shall also be stored and be accessible for future use.

E. Safety Program Manual

1. Prepare a site-specific safety program manual acceptable to the Owner or their representative.
2. Designate a Safety Manager/Coordinator acceptable to the Owner or their representative.
3. The Safety Program shall be implemented by the BHS Contractor to identify and resolve hazards. The Safety Program shall emphasize the prevention of accidents by resolving hazards in a systematic manner. The Safety Program Plan, as described below, will identify the responsibilities of all parties for implementing the Safety Program.
4. The Safety Program shall demonstrate compliance with all applicable safety rules and regulations. The levels of compliance shall meet the OSHA Standards, ANSI Standards, NFPA Standards, NEC Standards, and trade association standards and recommendations as applicable.
5. The safety program manual shall contain as a minimum the following:
 - a. Have as its objective to provide for the safety of the passengers, employees, general public and equipment.
 - b. Encompass all elements within the BHS Contractor-provided BHS Systems.
 - c. Include all interfaces with Facilities provided by others and identify all hazards within the Facilities that may result from the unique characteristics of the BHS System.
 - d. Identify the safety roles and responsibilities of all the BHS Contractors' organizational elements and require accountability of each.
 - e. Contain a hazard resolution process that includes the procedures necessary to identify and resolve hazards.
 - f. Indicate safety inspection lists and methods that shall be utilized by all personnel employed on this project.
 - g. A plan for furnishing and enforcing the use of individual protective equipment



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including hard hats, rain gear, protective footwear, protective clothing and gloves, eye protection, ear protection, respirators, safety belts, safety harnesses, safety lifelines and lanyards, and high visibility reflective safety vests.

- h. A plan for providing first aid facilities, supplies, and trained personnel.
- i. A plan for employee safety training to include employee safety orientation during the first week of work, weekly work crew safety meetings, periodic safety meetings for supervisory personnel, and special training prior to working with especially hazardous materials or operations.
- j. Emergency plans for items such as, but not limited to, fire emergencies, severe weather, earthquakes and other geologic hazards, or flooding emergencies, seriously injured personnel, traffic accidents along the project site, and injuries of members of the public.
- k. Pre-construction planning relative to safety and control of hazards including special tools, equipment, facilities, and individual protective gear.
- l. A plan for periodic safety inspections, investigations of all accidents and injuries and submission of timely reports.
- m. Submission of injury/accident/incident data for statistical analysis.

F. Project Management Team

- 1. Submit to the Owner or their representative for review and approval, the following listing of key personnel with resumes and qualifications that will be working on the project:
 - a. Senior Project Manager
 - b. On-Site Field Supervisor(s)
 - c. Professional Engineer(s)
 - d. Safety Manager
 - e. Configuration Control/Schedule Manager(s)
 - f. Quality Control/Assurance Manager(s)
 - g. Project Manager(s) - Electrical and Control Systems Engineering
 - h. Project Manager(s) - Mechanical Engineering
 - i. Project Manager(s) - Computer Systems Engineering
 - j. Instructors/training personnel (in addition, provide instructors professional qualifications)
- 2. Include on-site and off-site participating personnel and the percent of anticipated participation on this project. The Owner or their representative reserves the right to approve or reject key personnel from the list.



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3. The Project Manager and on-site Superintendent(s) shall not be changed without the Owner's or his representative's written approval.
4. The BHS Contractor, individuals or entities constituting the BHS Contractor and the officers or directors of the BHS Contractor or entities or key members of the Project Management Team shall have records of past performance sufficient to assure the Owner or their representative that they have the experience, competence and integrity to successfully complete a project of this magnitude.

G. Workmanship

1. Ensure that all equipment is manufactured and installed in accordance with the best commercial practices consistent with the intended design and usage and is acceptable to the Owner or their representative.
2. Ensure that all materials and components are new and free from defects. Do not supply used equipment, whether refurbished or reconditioned, unless indicated in the specifications and drawings or without the express approval of the Owner or their representative.
3. The Owner or their representative shall reserve the right to inspect any conveyor component at the BHS Contractor's factory prior to shipment of said components. The BHS Contractor shall co-ordinate with the Owner or their representative, fabrication of any components that the Owner or their representative requests to inspect such that said components are fully assembled and available for inspection by the Owner or their representative at the previously arranged time of the factory visit.

H. Pre-Installation Meeting

1. Prior to the start of the installation; attend meetings on-site as required or requested by the Owner or their representative. The Owner or their representative will schedule the Pre-Installation meetings, for the purpose of coordinating the on-site installation with ongoing airport operations.
2. Provide at the initial pre-installation meeting to the Owner or the Construction Manager the following:
 - a. Safety Program Manual
 - b. Drug Policy Manual
 - c. Submittal Schedule
 - d. Project Organization Chart to include all Sub Contractors
 - e. Principle suppliers to include long lead items and planned procurement dates
 - f. Insurance enrollment forms
 - g. Quality Control Manual
 - h. Configuration Management Plan



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- i. Diversity Program
 - j. Updated Master Schedule
 - k. Plans for coordination and notification for utility work
 - l. Plans for coordination with the work of other contractors and procedures for sharing access to the work site.
 - m. Schedule of deliveries of major equipment
- I. Pre-Demolition Meeting
 - 1. Prior to the start of any demolition; attend meetings on-site as required or requested by the Owner or their representative. The Owner or their representative shall schedule the Pre-Demolition meetings for the purpose of coordinating the on-site removal of the BHS equipment with ongoing airport operations.
- J. Work Activities Bulletin
 - 1. Submit a detailed work plan for ISAT (both BHS Contractor and TSA conducted) and individual subsystem testing. A BHS specific “Work Activities Bulletin” must be submitted by the BHS Contractor to the Owner or their representative for distribution to the impacted airlines, other impacted contractors (e.g. EDS manufacturer) and the Owner a minimum of 7 days prior to the testing, demolition or cutover activity-taking place.
 - 2. No work should be commenced unless the BHS Contractor has a signed “Work Activities Bulletin” in hand, and has distributed copies the User Airlines, the Owner or their representative.
 - 3. The “Work Activities Bulletin” shall contain the following as a minimum:
 - a. Contractor’s internal deadlines for completion of pertinent facility interfaces by other disciplines (e.g. permanent system power, support structure, or other facility interface requirements).
 - b. Date and time planned activity to take place from start to finish
 - c. User Airlines that are impacted
 - d. Details of all conveyors to be removed with duration
 - e. Details of all conveyors to be installed with duration
 - f. Electrical installation duration
 - g. Contractors internal testing with duration
 - h. Ticket counter/make up device requirements for loading/unloading of test bags. Coordination with the Owner or their representative and user airlines will/may be required
 - i. Generation of airline 10-digit bag tags/BSMs required for testing. Coordination with the Owner or their representative and user airlines will/may be required



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- j. Witnessed system testing with duration
 - k. Full details of contingency plans
 - l. Details of person(s) (with qualifications) overseeing the activity
 - m. Details and number of personnel to be present who are qualified to troubleshoot all aspects of their respective equipment during the planned activity, for example:
 - 1.) Mechanics
 - 2.) Electricians
 - 3.) Controls Engineers
 - 4.) Computer programmers
 - n. Other affected equipment manufacturers (e.g. EDS manufacturer). Confirmation that these manufacturers have been notified and will be in attendance if required.
- 4. Detailed description of activities required when completing overnight changeovers to ensure that disruption to baggage handling system is kept to a minimum. Include all preparatory work by other trades. Provide backup plan for recovery of operations if changeover work will not be completed in time.
 - 5. Coordination and operational interface to ensure on-going airline and airport operation is not disrupted.
 - 6. Submit as part of the submittal process a sample of their proposed “Work Activities Bulletin” format for review and approval by the Owner or their representative.

K. Field Quality Control Services

- 1. Establish and maintain quality control for operations under this Section to ensure compliance with Contract Document requirements and maintain records of quality control for alteration and removal operations.
- 2. Submit quality control procedures for operations in conjunction with work under this Section for approval. Do not start work prior to receiving approval.
- 3. The procedures shall include a checklist of points to be observed.
- 4. The actual quality control observations and inspections shall be documented and a copy of the documentation maintained on file.
- 5. Any work found not to be in compliance with the Contract Documents, shall be promptly corrected in an approved manner, at no additional cost to the Owner.
- 6. If the facility is under construction or modification, cooperate with other contractors who may be working in the immediate area for coordination of right-of-way clearances and verify as-built conditions.
- 7. Where walls immediately adjacent to conveyor equipment affect maintenance access, advise the Owner or their representative of the location and size of the wall opening that



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needs to be developed to permit access to drive components, bearings, and other equipment that would normally be inaccessible because of the wall.

8. Ensure that the design and installation of all conveyor equipment provides maximum access for operational and maintenance personnel.

L. Approval to Proceed

1. Before starting any work affecting existing baggage handling equipment that shall temporarily discontinue or disrupt service to the existing system/operations, notify the Owner or their representative 72 hours in advance and obtain the Owner or their representative approval in writing before proceeding with this phase of the work.

M. Preparatory Inspection

1. To be conducted prior to commencing work:
 - a. Check schedules, project conditions, protection, traffic arrangements, utilities services maintenance, and related preparatory work for conformance to submittals.
 - b. Check to assure adequate protection against damage.
 - c. Ensure that all workers are qualified.
 - d. Review installation; demolition, alteration, removal and disposal procedures to assure coordination of Contract Documents requirements with each person involved in performing the work.
 - e. Verify as-built conditions and notify the Owner or their representative of conflicts.

N. Initial Inspection

1. To be conducted after a representative sample of the work is complete:
 - a. Review the representative sample of the work against the specification and code requirements previously discussed at preparatory inspection.
 - b. Check for workmanship.
 - c. Check installation, removal and disposal of each item for conformance.
 - d. Check for damage and ensure that damaged work is corrected, at no additional cost to the Owner.
 - e. Submit documentation for review to the Owner or their representative detailing compliance of the above.

O. Follow-Up Inspection

1. Check completed work against results of initial inspection of representative sample of work against items mentioned in the preparatory inspection.
2. Verify that damaged work is corrected properly and approved by the Owner or their representative, at no additional cost to the Owner.



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3. Submit documentation for review to the Owner or their representative detailing compliance of the above.

P. Inspection Results

1. Certify inspection results: This certification shall state that the observations were performed by or under the direct supervision of the BHS Contractors Quality Assurance Representative and that the results are representative of the conditions being certified.
2. Work accomplished shall be considered satisfactory only when the records and inspections show that all variances have been corrected and that the work is in conformance with the Contract Documents.
3. Submit documentation for review to the Owner or their representative detailing compliance of the above.

4.02 TESTING AND ACCEPTANCE

A. Inspection and Testing Procedures

1. General

- a. After installation of the BHS, the BHS Contractor shall demonstrate its operating capability. Accomplish prior to the start of the Systems Acceptance Testing all “debugging” and internal testing. In addition, carry out a “dry test run” of Acceptance Tests prior to conducting such tests with the Owner or their representative to ensure that tests conducted with the Owner or their representative are successful. Make available to the Owner on a daily basis any and all records of internal testing and debugging (with corrective action carried out) performed prior to Acceptance Testing.
- b. The System shall be capable of handling the maximum and minimum specified sizes and weights without jamming, damage or toppling of the baggage.
- c. Provide all actual baggage and simulated weighted baggage required for testing. Actual baggage provided shall be representative of the many different types of baggage pieces encountered during live operations, including the maximum sizes and weights as defined in this specification. Simulated weighted baggage used shall be either weighted tubs or boxes. All baggage used for testing purposes shall be approved by the Owner or their representative prior to testing. The ratio of actual to simulated test baggage for this project shall be 50% of each. If necessary during the testing period, replace any simulated or actual test baggage that becomes damaged to the extent that it is no longer useable in order to maintain a minimum of test pieces at all times.
- d. All tests shall be conducted with the above ratio of actual and simulated baggage except for load tests, which shall be acceptable to be performed with simulated baggage only. No sand, dirt, or other abrasive material shall be used for weight while performing load tests.
- e. Provide appropriate service personnel "on-site" during the testing period to service or adjust, as required, the System equipment as well as to open all control boxes, control



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station covers, drive assembly chain/V-belt guards, and covers for the Owner inspection of the system equipment.

- f. Provide all necessary test, measuring, and recording devices required to demonstrate the operational characteristics and performance of the equipment to the satisfaction of the Owner (clamp-on type ammeter, direct read FPM digital readout tachometer, and all other required devices).
 - g. Provide written notice (minimum 14 days) to the Owner prior to acceptance testing that they have completed all “dry test runs” of the acceptance tests and are ready for the witnessed testing. Ensure that the Owner or their representative witness all Acceptance Tests and shall indicate Acceptance by signing and dating the test data sheet. The Owner reserves the rights to back charge the BHS Contractor for the time and expenses of all who attended the Acceptance Testing on the Owner’s behalf should the requested acceptance test(s) be unsuccessful and require re-testing at a later date.
2. System Inspection and Test Plan Submittal
- a. Prepare an Inspection and Test Plan for this Project based on the information provided below and submitted per the submittal schedule detailed Part 1 of this specification for review and approval by the Owner or their representative.
 - b. The BHS Contractor is to be aware that various subsystems may require testing independent of one another. Therefore, a number of tests will have to be conducted at the various stages of installation.
 - c. The test plan shall be provided in both hard copies for field use during the testing process and a completed (based upon acceptance testing) electronic format agreed upon by the Owner or their representative.
 - d. The test plan shall include as a minimum the following:
 - 1.) Description of each Test
 - 2.) Pass/Fail Criteria
 - 3.) Expected duration of the test
 - 4.) Number of test bags required and where they are to be positioned for the start of the test
 - 5.) List all test equipment required
 - 6.) Number of personnel required for the test to include:
 - a.) Test Supervisor
 - b.) Mechanical
 - c.) Electrical
 - d.) Controls/computer engineer(s)



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- e.) Personnel required to load and remove bags
- 7.) List other affected equipment manufacturers (e.g. EDS manufacturer) that may be required for the test. Confirmation that these manufacturers have been notified and will be in attendance.
- 8.) Details of all reports to be printed after the test
- 9.) Pass/Fail and Notes/Comments sections.
- 10.) Section for witnessed sign off, to include as a minimum BHS Contractor, the Owner or their representative
- e. The following is intended to be a guideline, and is not to be construed as all-inclusive:
 - 1.) Mechanical Static Inspection: Submit a comprehensive, easy to read mechanical equipment inspection plan for every piece of mechanical equipment installed as part of the BHS. This inspection plan shall verify adherence to the Specification for the following items:
 - a.) Belt Conveyors: Gaps between adjacent head and tail pulleys, - Vertical clearance, - Angle of incline/decline, 4" conveyor I.D. - Gaps between adjacent bed sections, - Gaps between adjacent side guard sections, - Baggage snag points, - Sharp edges or shear burrs, - Condition of painted surfaces, - Tightness of all hardware, - Alignment of stainless steel trim and bed section filler plate, - Spacing of vertical braces for side guards/back guards, - Spacing of conveyor supports, - Sway bracing, - Trim securement screw type and countersinking, - Safety guarding/belly pans, - Anchoring/mounting of access ladders, - Installation of right angle transfer transition plate, - Belting material and splicing, - Belt lacing size and cable, - 1" V-notch in belting splice, - Belt path routing, - Belt wrap, - Belt tension, - Pulley diameter, - Pulley shaft diameter, - Vertical alignment of head and tail pulleys, - Lateral position of pulleys, - Return roller diameter, - Return roller spacing, - Bearing mounting lock washers, - Bearing jacking bolts, - Bearing grease zerk removal, - Bearing caps, - Motor and speed reducer mounting lock washers, - Speed reducer drip pan, - Motor/speed reducer related sprocket/sheave and shaft alignment, - Motor/speed reducer related sprocket or sheave key tightness, - Motor/speed reducer related chain/V-belt tension, - Chain/V-belt safety guard, - Speed reducer leakage, - Speed reducer lubrication level, - Mounting of speed reducer torque arm, - Safety finger guards on end pulleys at staffed conveyors (ticket counter conveyors, sort piers, manual encoding) -- 25% take-up pulley position, - Installation of strip door type draft curtain, - Installation of fire/security doors, - Removal of construction related debris, - Maintenance access, - Protective guard railing installation, - Vertical clearance for traffic aisles.
 - b.) High Speed Paddle Diverter: Gaps between adjacent bed sections, - 4" pusher I.D., - Gaps between adjacent side guard sections, - Baggage snag points, -



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Sharp edges or shear burrs, - Condition of painted surfaces, - Mounting and anchoring of pusher assembly, - Tightness of all hardware, - Bearing mounting lock washers, - Bearing grease zerk removal, - Motor and speed reducer mounting lock washers, - Speed reducer drip pan, - Motor/speed reducer related sheave/shaft alignment, - Motor/speed reducer related sheave key tightness, - Motor/speed reducer related chain/V-belts tension, - HSPD safety guard, - Speed reducer oil leaks, - Speed reducer lubrication level, - Mounting of speed reducer torque arm, - Removal of construction debris, - Maintenance access, - Alignment and secureness of HSPD paddle(s)

- c.) Flat Plate Devices: Tray vertical clearance -- gaps between adjacent back guard sections -- gap between perimeter finger guard and top of pallet not in excess of 1/8" -- skirting above and below conveying surface -- sharp edges or shear burrs -- condition of painted surfaces -- tightness of all hardware trim -- securement screw type and countersinking -- baggage snag points -- drive assembly safety guarding -- speed reducer drip pan -- motor/speed reducer type and alignment -- motor-driven sprockets/sheaves alignment -- motor-driven chain/V-belt tension -- speed reducer leakage -- removal of construction debris -- maintenance access -- protective guard railing gap between adjacent plates not in excess of 1/16" -- plate-driving sprocket alignment -- plate-driving chain tightness
- 2.) Electrical Static Inspection: Provide a comprehensive, easy to read electrical equipment inspection plan. For the determination of terminal tightness, all terminals in motor control panels or field mounted devices shall be tightened to the manufacturer's recommended torque specifications utilizing a certified calibrated torque wrench or appropriate tool. The BHS Contractor shall be required to demonstrate to the Owner or their representative that the screws are set at the proper torque value and the BHS Contractor shall include this information in the below referenced electrical static inspection reports. This inspection plan shall verify adherence to the Specification for the following items:
 - a.) Belt Conveyors: Control station I.D./function tags -- control station and disconnect switch accessibility/location -- illuminated push button switch protective guard ring -- tightness of all hardware -- photocell mounting -- tach mounting and coupling -- control circuit wiring size, type, color, and number tag -- power circuit wiring size, type, color, and number tag -- wire "whiskers" at terminal points -- wiring terminal point screw tightness -- splice point wire nuts within junction boxes -- conduit routing and mounting -- tightness of conduit/sealtite fittings -- junction box covers -- unused openings in junction boxes or control device boxes -- safety disconnect switch lockout capability - - lanyard cable supports and limit switch -- maintenance access -- record motor name plate data, size of motor overload heaters, and size of all fuses.
 - b.) Flat Plate Devices: Control station I.D./function tags -- control station and disconnect switch accessibility/location -- illuminated push button switch



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protective guard ring -- tightness of all hardware -- photocell mounting -- control circuit wiring size, type, color, and number tag -- power circuit wiring size, type, color, and number tag -- wire "whiskers" at terminal points -- wiring terminal point screw tightness -- splice point wire nuts within junction boxes -- conduit routing and mounting -- tightness of conduit/sealtite fittings -- junction box covers -- unused openings in junction boxes or control device boxes -- safety disconnect switch lockout capability -- maintenance access -- record motor name plate data, size of motor overload heaters, and size of all fuses.

- c.) High Speed Paddle Diverter: Control station I.D./function tags -- control station and disconnect switch accessibility/location -- illuminated push button switch protective guard ring -- tightness of all hardware -- photocell mounting -- tach mounting and coupling -- control circuit wiring size, type, color, and number tag -- power circuit wiring size, type, color, and number tag -- wire "whiskers" at terminal points -- wiring terminal point screw tightness -- splice point wire nuts within junction boxes -- conduit routing and mounting -- tightness of conduit/sealtite fittings -- junction box covers -- unused openings in junction boxes or control device boxes -- safety disconnect switch lockout capability -- limit switch -- maintenance access -- record motor name plate data, size of motor overload heaters, and size of all fuses.
 - d.) Motor Control Panels: I.D. information for MCP and all devices contained within -- control station I.D./function tags -- illuminated push button switch protective guard ring -- location of control devices -- tightness of all hardware -- control circuit wiring size, type, color, and number tag -- power circuit wiring size, type, color, and number tag -- wire "whiskers" at terminal points -- wiring terminal point screw tightness -- panduit wire raceway -- splices in panduit wire raceway -- panduit wire raceway covers -- conduit routing and mounting -- tightness of conduit fittings -- conduit bushings and chase nipples -- "air-space" around programmable logic controllers -- MCP door(s) mechanical safety interlock -- safety shield over line and load terminals of MCP main breaker -- orientation of status panel -- restraint clips for plug-in type power supply -- installation of hour meter -- hour meter I.D. tag.
- 3.) Mechanical Testing: Provide a comprehensive, easy to read mechanical test plan. This test plan, at a minimum, shall verify the specified functionality of the following:
- a.) Belt Conveyors: Conveyor speed -- belt tracking -- shaft run-out on pulleys -- excessive vibration -- operation of clutch/brake units -- lateral movement of speed reducer on shaft during start/stops -- abnormal noises -- torsion flexing of drive assembly during start/stop operation -- operation of controls
 - b.) Flat Plate Device: Operation of "soft-start" device -- engagement of plate cam followers with drive assembly -- vertical or horizontal displacement of plates through drive assembly section -- excessive vibration -- abnormal noises --



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binding of perimeter finger guards with top surfaces of plates -- operation of controls.

- c.) High Speed Paddle Diverters: Operation of clutch units -- abnormal noises -- cycling speed -- paddle height above belt during cycle -- paddle extension across full width of conveyor belt -- operation of controls--capability of processing all types of baggage, including but not limited to, golf bags.
- 4.) Electrical Testing: Provide a comprehensive, easy to read electrical test plan that clearly identifies all installed control devices, the control device locations in the BHS, the function of the control device, all conveyors affected by the control device, and the expected field result with applicable system monitor message/display. The test plan shall be provided in both hard copy for field use during the testing process and a completed (based upon acceptance testing) electronic format agreed upon by the Owner or their representative.
 - a.) All Control Devices: Photocells -- limit switches -- status lights -- hour meter -- start-up alarms -- fault warning alarms -- fault warning alarms with multiple faults -- fault warning alarm silence buttons -- timer settings -- auto shut-down -- motor overloads -- motor disconnects -- auto start -- cascade operation -- inch and feed operation -- e stop function -- overheight/over length function -- jam function.
 - b.) Workstations: Graphical system status display -- graphic fault warning and associated text display -- report generation (daily, weekly, monthly, annual and on demand) -- accuracy of all reports -- redundancy operation between primary and back up workstations -- problem resolution text -- modification to flight and tag tables -- change sort pier assignments -- system re-route/re-configuration -- monitor redundancy functions -- communication/interfaces with -- access to all security levels -- BSM retention control -- ability to render individual equipment unavailable/available -- statistics and counter reset capability --demonstrate statistical data backup functionality
 - c.) Cable Testing: Test all cables, including all fiber optic, Cat-5e and Cat-6 telecommunication cables, and all cables to be connected as part of an interface to another system (e.g. fire system, host computers, ACAMS, CT-80DR devices, PanelView Terminals).
 - d.) Interface Testing: Test all interfaces with other systems (e.g. fire system, SITA, ACAMS, CT-80DR devices). Coordinate with other trades in support of this testing.
- 5.) Empirical Readings
 - a.) The Empirical Readings which are to be taken at the time of Conditional Acceptance Testing are to include the following:
 - (1.) Main Feeds: Fuse size per phase, actual amperage per phase.



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- (2.) Transformers: Fuse size per phase, actual amperage per phase.
- (3.) Conveyor/Device Speeds: Actual “center-line” speed of conveyor/device.
- (4.) Motors: Nameplate data, horsepower, listed motor current; fuse size per phase, actual amperage per phase, overload heater size or designation.
- (5.) VFDs: record all VFD settings
- 6.) Load Testing: Provide a comprehensive, easy to read test plan listing the expected load rating for each device, at a minimum, provide the following:
 - a.) Individual device identifications with the expected load rating for each device (including tilt tray sorter).
 - b.) Amperage readings per phase under No Load conditions.
 - c.) Fuse Sizes (if applicable) and motor heater settings.
 - d.) Motor nameplate FLA for each device drive and HP.
 - e.) Amperage readings per phase under Full Load conditions.
 - f.) Pass/Fail and Notes/Comments sections.
 - g.) All FLA readings taken during load testing shall be recorded and included in the Final O&M Manual for record.
- 7.) EDS Matrix Testing: The BHS Contractor shall provide a comprehensive, easy to read test plan, which will demonstrate the EDS Matrix system.
 - a.) The BHS Contractor shall provide a comprehensive, easy to read test plan, which will demonstrate the EDS subsystem
 - b.) At a minimum, the test shall verify the ability of the EDS Matrix System to perform the following:
 - (1.) Transfer of bag ID information and screening status between the BHS and EDS device
 - (2.) Sortation through security screening Level 1 EDS matrix(s)
 - (3.) Sortation through security screening Level 2
 - (4.) Sortation through security screening Level 3 ETD matrix(s)
 - (5.) Bag Flow/Sortation through screening level 1 as individual EDS devices are made inoperable/operable
 - (6.) Redundancy Operation through all levels of EDS security screening system.
 - (7.) Level 2 decision timeout verification test
 - (8.) Tracking accuracy as specified within this specification



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- (9.) Functionality of the EDS Test and Insert modes
 - (10.) Operation of the decision point failsafe system. Correct functionality of control station (cleared, alarmed and EDS unknown bag status indicator lights) located at the decision point.
 - (11.) Accuracy of EDS reports
 - (12.) EDS device Hold and Auto Modes of Operation with respect to the BHS system
 - (13.) Test bag insert after an EDS functionality (i.e. the unknown bag should be routed back into the level 1 device)
 - (14.) Test E-stop state between the EDS and BHS (all conveyor belts are stopped, no signal is sent to the EDS device gantry)
 - c.) Assist the TSA in performing the mandated Site Acceptance Testing (SAT) and Integrated System Acceptance Test (ISAT). Obtain the latest copy of the TSA ISAT test procedure (i.e. Battelle Checked Baggage Inspection Systems Performance & Commissioning Plan) to ensure their completed EDS system meets all the protocols and requirements contained within, prior to the TSA ISAT. Carry out a “dry test run” of the ISAT prior to the TSA testing.
- 8.) Test Failure
- a.) A failure during any test period shall be defined as any design characteristic or malfunction of the furnished equipment or materials that damages product or reduces any operating rate below those “specified”.
 - b.) Conditions resulting from improper loading of product or loading product of sizes not included in specification requirements will not be considered as failures.

B. Conditional Acceptance

- 1. Conditional Acceptance for each phase will only be considered after the following are completed:
 - a. The Conditional Acceptance Inspection and Testing procedures presented below are successfully completed as specified.
 - b. Final Operation and maintenance manuals have been delivered.
 - c. Operation and maintenance training has been completed.
 - d. Spare parts as purchased by the Owner for that phase have been delivered.
 - e. All special tools and equipment required for maintenance purchased by the Owner have been delivered.
 - f. The name, address and a 24-hour phone number of a representative who has the Owner and experience to make immediate replacements and repairs for the full life of all



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warranties has been provided.

2. Conditional Acceptance Inspection and Testing

- a. The System, including all upper and lower level controls, shall demonstrate compliance with the approved Test Plan. The individual inspections and tests shall be performed in the order presented above. System deficiencies (punch list items) shall be corrected before performing the subsequent inspections or tests. The Owner at his discretion may request for reimbursement of costs from the BHS Contractor for multiple reinspections of system deficiencies/punch list items.
 - 1.) Mechanical Static Inspection
 - 2.) Electrical Static Inspection
 - 3.) Electrical Testing
 - 4.) Mechanical Testing
 - 5.) Empirical Readings
 - 6.) Load Testing
 - 7.) EDS Matrix Testing
3. Upon successful completion of the specified Inspections and Testing, the Owner will issue a written notice of Conditional Acceptance.
4. A Conditional Acceptance status will indicate that the Owner or their representative have approved the equipment as worthy for operational use.
5. The Conditional Acceptance shall not relieve the responsibility for maintenance, security and insurance on the system.
6. In no case will Conditional Acceptance relieve the responsibility for performing all the work set forth in the Contract Documents.
7. At the time of Conditional Acceptance, the amount of retention held until issuance of a Certificate of Final Acceptance shall be a summation of 10% of the total value of the project and the assessed value of open punch list items (to be determined by the Owner).
8. Conditional Acceptance is applicable to each construction phase and must be issued in writing, by the Owner, prior to commencement of subsequent construction phases. Final Acceptance of individual construction phases or subsystems shall not apply.
9. Conditional Acceptance Operational Period
 - a. Upon issue of a Certificate of Conditional Acceptance, a one (1) month Operational Period will commence in which the Owner will put all systems into on-line operations processing the daily flow of baggage.
 - b. During this one (1) month Operational Period, provide full-time technical site representation during the actual hours of operation 7 days per week. Ensure that the



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representatives shall be capable and duly qualified to provide service for any problems, which occur during this period. At a minimum, the BHS contractor will have one qualified person per shift to trouble shoot and immediately resolve any problems which may arise. The BHS contractors on site personnel shall be capable of trouble shooting and resolving all electrical and controls related issues.

- c. During the one (1) month Operational Period, the BHS Contractor shall be responsible for all maintenance required on the BHS. During this time period the BHS Contractor will be responsible for ensuring that the BHS is fully operational during Airport Operational hours. Should any downtime occur during these hours due to major faults in the BHS (i.e., PLC fault, motor overloads, motor faults, Sort Controller Fault or any other faults deemed major by the Owner) the BHS Contractor will be responsible for immediate rectification and assisting the Owner in any way so that Operations is not impacted in any way.
- d. If, at the Owner's discretion, site representation is deemed unnecessary, it shall be discontinued and the Owner shall receive a prorated credit.
- e. If a problem occurs within the BHS system, and the Owner has elected to not require full-time technical site representation during the one (1) month Operational Period, supply the name(s), address(s) and a 24-hour phone number of representative(s) that can be contacted who have the experience to make immediate recommendations and assist the Owner or the Owner's Maintenance Contractor to return the system to a fully on-line state in the shortest possible time frame.

C. Conditional Acceptance With Defects

- 1. If the System is found to be unacceptable at the time of Conditional Acceptance Inspection and Testing, the Owner will issue a written "Defects List" report containing information about the particular defects that must be remedied before Final Acceptance will be granted. At this time, if the defects do not affect the functionality of the System, the Owner may elect to advise in writing that "Conditional Acceptance with Defects" has been granted. All terms presented in the "Conditional Acceptance" portion of this Specification shall apply.
- 2. A "Conditional Acceptance with Defects" status, if issued, will indicate that the Owner has approved the equipment as worthy for operational use. Subsequent to "Conditional Acceptance with Defects" issuance, the one (1) month Operational Period will commence in which the Owner will put the System into on-line operations processing the daily flow of baggage. The Owner will maintain the right to judge whether any hazard may exist to personnel or equipment due to unacceptable inspection results and revoke this approval. In the event the approval is revoked, the one (1) month Operational Period will be suspended until the hazard is remedied.
- 3. The Owner will be entitled to retain from the project payments an amount commensurate with the value of work remaining to be accomplished. Further, all outstanding work must be performed at times during periods convenient to the Owner and to the requirements of a fully operating system.



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Owner: City of Fayetteville
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4. The Contractor must notify the Owner within the one (1) month Operational Period that all outstanding items on the “Defects List” have been corrected and that Inspection and Testing may continue. When all items have been approved in accordance with the Specifications, this shall conclude Inspection and Testing of the BHS. Only the remaining time of the one (1) month Operational Period will be required prior to application of the Final Acceptance conditions.

D. Delayed Conditional Acceptance With Defects List

1. If the System is found to be functionally unacceptable at the time of Conditional Acceptance Inspection and Testing, the Owner will issue a written “Defects List” report containing information about the particular defects that must be remedied before the one (1) month Operational Period will begin.
2. Items appearing on the “Defects List” will be considered incomplete, defective or not in conformance with the Specifications. The failure to include certain items does not alter the responsibility to complete the System in accordance with the Contract Documents.
3. A maximum period of 15 days will be allowed to correct the outstanding items on the “Defects List”.
4. After all the items on the “Defects List” have been corrected, notify the Owner or their representative that the System is ready for continuing Conditional Acceptance Inspection and Testing.
5. Upon completion of “Conditional Acceptance Inspection and Testing”, the terms presented in the “Conditional Acceptance” or “Conditional Acceptance With Defects List” portions of this Specification will apply, as appropriate.

E. Final Acceptance

1. Final Acceptance will only be considered after all phases have conformed to the Conditional Acceptance terms, all phases have successfully completed the one (1) month Operational Period, and the following criteria is met:
 - a. The System has not experienced repeated repairs and adjustments and is achieving the specified rate, accuracy and availability standards as required by this Specification.
 - b. The System has successfully completed the specified Inspections and Testing, with no outstanding punch list items.
 - c. Record copies of all punch lists and test reports have been submitted.
 - d. The System is in full compliance with the Contract Documents.
 - e. The Owner and all other governing agencies have made their inspections and given their approvals.
 - f. Certificates of Installation Compliance have been issued to the Owner
 - g. Warranties for all materials and equipment received from Subcontractors and Suppliers have been assigned to the Owner.



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- h. A spare parts and tools audit has been conducted and all tools have been turned over to the Owner. All spare parts purchased by the Owner have been delivered.
- i. The PLC and source codes for all programs in the BHS Computer System have been provided to the Owner
- j. Accurate "As-built" drawings and all manuals as specified in this Specification have been delivered.
- k. Operation and maintenance training have been completed.
- l. Responses to all required TSA QLR/TSR report comments have been provided and closed out by TSA.

- END OF PART IV -

Fayetteville Regional Airport – Airline Terminal Improvements – Part 2

Owner: City of Fayetteville

Fayetteville, North Carolina

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NOTICE TO BIDDERS

Pursuant to N.C.G.S. 143-128 sealed proposals will be received from prequalified general contractors by the Fayetteville Regional Airport, on behalf of the City of Fayetteville, North Carolina, until 4:00 p.m., Thursday, August 15, 2019, in the Airport Conference Room, 1st floor, Main Terminal Building, 400 Airport Road, Fayetteville, North Carolina, for the project entitled **“Fayetteville Regional Airport – Airline Terminal Improvements – Part 2”**. A mandatory pre-bid conference will be held at 4:00 p.m., Monday, July 22, 2019, in the ground floor Conference Room of the Terminal Building, 400 Airport Road, Fayetteville, North Carolina 28306. A site visit will take place immediately following the pre-bid conference for those interested in seeing the project areas.

Plans, specifications and bid documents dated July 15, 2019 will be available online for downloading at www.gordonjohnsonarchitecture.com (look for the “Bid Sets and Addenda” tab on the upper right-hand corner of our home page) on Monday July 22, 2019 or may be viewed in the Purchasing Office of the City of Fayetteville, City Hall Building, 433 Hay Street, Fayetteville, North Carolina 28301, between the hours of 8:00 a.m. and 5:00 p.m., Monday through Friday. Plans and specifications will also be on file at www.iSqFt.com.

Each Proposal shall be accompanied by cash, cashier’s check, or certified check drawn on a bank insured by the Federal Deposit Insurance Corporation or Savings Association Insurance Fund. Checks shall be made payable to the City of Fayetteville, North Carolina, in an amount not less than five percent (5%) of the total bid as a guarantee that a Contract, if awarded, will be entered into. In lieu thereof, a Bid Bond which conforms to the provisions of G.S. 143-129 as amended by Chapter 1104 of the Public Laws of 1951 may be submitted by the Bidder.

Performance and Payment Bonds will be required in the amount of 100% of the contract award amount and shall be furnished by the Contractor prior to start of work. All contractors are notified that North Carolina Statutory Provisions (Chapter 87, Article 1) pertinent to licensing of Contractors will be observed in receiving, reading, and awarding of contracts. Bids may not be withdrawn after the scheduled closing time for the receipt of proposals for a period of one hundred twenty (120) days. The Owner may make such investigations as deemed necessary to determine the ability of the bidder to perform the work, and the bidder shall furnish to the Owner all such information and data for this purpose as the Owner may request.

The Contractor shall complete all work within five hundred fifty (550) calendar days. Failure to complete the work within this time frame will cause considerable damage to the City; therefore a liquidated damage charge of \$1,500.00 per day (or actual damages whichever is greater) for each day of overrun will be assessed to the Contractor.

This project will be funded in part with federal grant funds under the Federal Aviation Administration’s Airport Improvement Program. Certain federal contract requirements are included in Appendix D of the contract documents and are incorporated herein by reference, including but not limited to Buy American Preference, Foreign Trade Restriction, Davis Bacon, Affirmative Action, Government-wide Debarment and Suspension and Government-wide Requirements for Drug-free Workplace.

Fayetteville Regional Airport – Airline Terminal Improvements – Part 2

Owner: City of Fayetteville

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The City of Fayetteville, in accordance with the provisions of Title VI of the Civil Rights Act of 1964 (78 Stat. 252, 42 U.S.C. §§ 2000d to 2000d-4) and the Regulations, hereby notifies all bidders that it will affirmatively ensure that any contract entered into pursuant to this advertisement, disadvantaged business enterprises will be afforded full and fair opportunity to submit bids in response to this invitation and will not be discriminated against on the grounds of race, color, or national origin in consideration for an award.

The City of Fayetteville hereby notifies all bidders that in regard to any contract entered into pursuant to this advertisement, that the bidder shall make good faith efforts, as defined in Appendix A of 49 CFR Part 26, Regulations of the Office of the Secretary of Transportation, to subcontract 8.4% of the dollar value of the prime contract to Disadvantaged Business Enterprises (DBE's). Only firms certified as DBE's by the NCDOT Unified Certification Program may be applied to the goal. The apparent successful competitor will be required to submit with the bid information concerning the DBE firms that will participate in this contract. The information shall include the name and address of each DBE, a description of the work to be performed by each named firm, and the dollar value of the sub-contract. If the bidder fails to achieve the contract goal stated herein, they will be required to provide documentation demonstrating that it made good faith efforts in attempting to do so. A bid that fails to meet these requirements will be considered nonresponsive.

The successful bidder must provide written confirmation from each of the DBE firms the bidder lists in their commitment included in the bid. The written confirmation shall be made using the Letter of Intent form and shall be submitted within the time frame established in Appendix C of the contract documents.

The right is reserved to reject any or all bids and to waive all informalities concerning bid, or award bid to the lowest responsible bidder or bidders, taking into consideration quality, performance and the time specified in the proposals for the performance of the contract.

It is the policy of the City of Fayetteville to provide locals and minorities equal opportunity for participating in all aspects of the City's contracting and procurement programs, including but not limited to, construction projects, supplies and material purchase, and professional and personal service contracts.

The City of Fayetteville encourages and invites local, small, and/or minority owned businesses to participate in the City's procurement process.

CITY OF FAYETTEVILLE

Douglas J. Hewett, ICMA-CM
City Manager

Fayetteville Regional Airport – Airline Terminal Improvements – Part 2

Owner: City of Fayetteville
Fayetteville, North Carolina

Bid Proposal: For General Construction of the Fayetteville Regional Airport – Airline Terminal Improvements – Part 2; FAA AIP 3-37-0021-046-2019.

From: _____ License No. _____

To: City of Fayetteville
433 Hay Street
Fayetteville, NC 28301

Re: Fayetteville Regional Airport – Airline Terminal Improvements – Part 2

The undersigned, as bidder, hereby declares that the only person or persons interested in this proposal as principal or principals is or are named herein and that no person other than those herein mentioned, has any interest in the proposal or in the contract to be entered into; that this proposal is made without connection with any other person, company, or parties making a bid or proposal; and that it is in all respects fair and in good faith without collusion or fraud.

A bidder shall be considered disqualified for any of the following reasons, among others;

(a) Submitting more than one proposal from the same partnership, firm, or corporation under the same or different name.

(b) Evidence of collusion among bidders. Bidders participating in such collusion shall be disqualified as bidders for any future work of the City until any such participating bidder has been reinstated by the City as a qualified bidder.

The bidder further declares that he has examined the site of the work and informed himself fully in regard to all conditions pertaining to the place where the work is to be done, that he has examined the specifications for the work and the contract documents relative thereto, and has read the special provisions furnished prior to the opening of the bids; that he has satisfied himself relative to the work to be performed. In the case of conflict between words and figures, the words will govern.

The bidder proposes and agrees that if this proposal is accepted, to contract with the City of Fayetteville in the form of contract specified, to furnish all necessary materials, equipment, machinery, tools, apparatus, means of transportation, and labor necessary to perform all construction in full and complete agreement with the plans and specifications and contract documents entitled FAYETTEVILLE REGIONAL AIRPORT – AIRLINE TERMINAL IMPROVEMNETS – PART 2; F

Fayetteville Regional Airport – Airline Terminal Improvements – Part 2

Owner: City of Fayetteville
Fayetteville, North Carolina

FAA PROJECT 3-37-0021-046-2019 to the full and entire satisfaction of the Fayetteville Regional Airport and City of Fayetteville for the stipulated sum indicated.

The bidder further proposes and agrees that if this proposal is accepted, to commence work on the commencement date specified in the Notice to Proceed and to complete fully all work hereunder within the following consecutive calendar days:

Commencement date to Completion: 550 calendar days

Liquidated damages for failure to complete all work by the specified number of days are fixed at the sum of \$1,500.00 per calendar day.

Lump Sum Base Bid: _____
_____ Dollars (\$ _____)

MAJOR SUB CONTRACTS FOR SINGLE PRIME CONTRACTOR

For projects bid in the Single Prime Alternative list the names, bid, and license number of the major sub contractors here:

Mechanical	_____	\$ _____	License #: _____
Plumbing:	_____	\$ _____	License #: _____
Electrical:	_____	\$ _____	License #: _____
Fire Protection:	_____	\$ _____	License #: _____
Site Work:	_____	\$ _____	License #: _____

ALTERNATES

Should any of the alternates as described in the contract documents be accepted, the amount written below shall be the amount to be “added to” the Base Bid. Award of the contract will be the lowest responsive and qualified bidder based on any combination of Base Bid and Bid Alternates selected by the City at the time of initial contract. The City reserves the right to select the bid alternatives at a later date during the contract or not at all.

1. Alt. G-1: Provide new elevator addition at Concourse B as specified and shown on plans.

ADD _____ Dollars (\$ _____)

Fayetteville Regional Airport – Airline Terminal Improvements – Part 2

Owner: City of Fayetteville
Fayetteville, North Carolina

2. Alt. G-2: Provide two new baggage belt systems in Baggage Claim.

ADD _____ Dollars (\$_____)

3. Alt. G-3: Provide Automated Exit Lane Security Corridor at TSA Checkpoint.

ADD _____ Dollars (\$_____)

4. Alt. G-4: Provide property insurance (builder's risk) as specified.

ADD _____ Dollars (\$_____)

5. Alt. G-5: Provide Water Vapor Emission Control as specified to new concrete slabs.

ADD _____ Dollars (\$_____)

UNIT PRICES

These unit prices are applicable to lump sum work and are for changes in the work, or for unforeseen conditions encountered per Specification Section 01270.

- A. Unit Price A-1 – Replace unsuitable soil per CY:

_____ Dollars (\$_____)

- B. Unit Price A-2 – Undercut and replace with Stone per CY:

_____ Dollars (\$_____)

BOND:

The Undersigned agrees, if awarded the contract to furnish and deliver to the General Consultant within 10 days following receipt of notice of the award, a signed Contract, satisfactory Performance and Labor and Material Payment Bonds, each in an amount equal to 100% of the Contract Price, and all required certificates of insurance.

CERTIFIED CHECK OR BID BOND:

The bidder further agrees that in the case of failure on his part to execute said contract and provide required bonds within 10 consecutive calendar days after written notice is given of the award of the contract, that a check, cash, or bid bond in the amount of 5% shall accompany this bid and shall be paid into the hands of the City, as liquidated damages for such failure; otherwise, the check, cash, or bid bond accompanying this proposal shall be returned to the undersigned.

Fayetteville Regional Airport – Airline Terminal Improvements – Part 2

Owner: City of Fayetteville
Fayetteville, North Carolina

CONTRACTOR’S LICENSE:

The undersigned further states that he is a duly licensed Contractor in the State of North Carolina, and that all fees, licenses, permits, etc., pertinent to the submission of this bid have been paid for in full.

ADDENDUM RECEIPT:

The receipt of the following addenda to the Contract Documents is acknowledged:

ADDENDUM No. _____ DATE _____

ADDENDUM No. _____ DATE _____

ADDENDUM No. _____ DATE _____

ADDENDUM No. _____ DATE _____

OWNER’S RIGHT OF REJECTION:

The City reserves the right to reject any or all bid(s), or sections thereof, as it appears in its judgment to be in the best interest of the City. The undersigned bidder understands that all bids may be rejected if the lowest responsive bid received exceeds the engineer’s estimate and it is determined by the City that an award of contract would not be in the best interest of the City.

PARTIAL SCHEDULE OF VALUES:

All General Contractor Bidders shall submit with their bid the attached Partial Schedule of Values with specific AIP eligible items’ costs filled in.

Fayetteville Regional Airport – Airline Terminal Improvements – Part 2

Owner: City of Fayetteville
Fayetteville, North Carolina

Respectfully submitted this _____ day of _____, 2019.

Bid Proposal from: _____ (Company Name)

(Name of Bidder)

(Address of Bidder)

(Corporation)

by _____
President

Attest: _____
Secretary

Corporate Seal

(Partnership)

by _____

Title _____

Witness: _____

(Proprietorship)

_____ (Seal)

Witness: _____

Bid Proposal

BP-5 of 5

PROHIBITION OF SEGREGATED FACILITIES

- (a) The Contractor agrees that it does not and will not maintain or provide for its employees any segregated facilities at any of its establishments, and that it does not and will not permit its employees to perform their services at any location under its control where segregated facilities are maintained. The Contractor agrees that a breach of this clause is a violation of the Equal Opportunity clause in this contract.
- (b) "Segregated facilities," as used in this clause, means any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees, that are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, sex, or national origin because of written or oral policies or employee custom. The term does not include separate or single-user rest rooms or necessary dressing or sleeping areas provided to assure privacy between the sexes.
- (c) The Contractor shall include this clause in every subcontract and purchase order that is subject to the Equal Opportunity clause of this contract.

Signature of Contractor

Date

Title

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S. C. 1001.

(Reference: 41 CFR § 60)

TRADE RESTRICTION CERTIFICATION

By submission of an offer, the Offeror certifies that with respect to this solicitation and any resultant contract, the Offeror:

- a. is not owned or controlled by one or more citizens of a foreign country included in the list of countries that discriminate against U.S. firms as published by the Office of the United States Trade Representative (U.S.T.R.);
- b. has not knowingly entered into any contract or subcontract for this project with a person that is a citizen or national of a foreign country included on the list of countries that discriminate against U.S. firms as published by the U.S.T.R.; and
- c. has not entered into any subcontract for any product to be used on the Federal on the project that is produced in a foreign country included on the list of countries that discriminate against U.S. firms published by the U.S.T.R.

This certification concerns a matter within the jurisdiction of an agency of the United States of America and the making of a false, fictitious, or fraudulent certification may render the maker subject to prosecution under Title 18, United States Code, Section 1001.

The Offeror/Contractor must provide immediate written notice to the Owner if the Offeror/Contractor learns that its certification or that of a subcontractor was erroneous when submitted or has become erroneous by reason of changed circumstances. The Contractor must require subcontractors provide immediate written notice to the Contractor if at any time it learns that its certification was erroneous by reason of changed circumstances.

Unless the restrictions of this clause are waived by the Secretary of Transportation in accordance with 49 CFR 30.17, no contract shall be awarded to an Offeror or subcontractor:

- (1) who is owned or controlled by one or more citizens or nationals of a foreign country included on the list of countries that discriminate against U.S. firms published by the U.S.T.R. or
- (2) whose subcontractors are owned or controlled by one or more citizens or nationals of a foreign country on such U.S.T.R. list or
- (3) who incorporates in the public works project any product of a foreign country on such U.S.T.R. list;

Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render, in good faith, the certification required by this provision. The knowledge and information of a contractor is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

The Offeror agrees that, if awarded a contract resulting from this solicitation, it will

incorporate this provision for certification without modification in in all lower tier subcontracts. The contractor may rely on the certification of a prospective subcontractor that it is not a firm from a foreign country included on the list of countries that discriminate against U.S. firms as published by U.S.T.R, unless the Offeror has knowledge that the certification is erroneous.

This certification is a material representation of fact upon which reliance was placed when making an award. If it is later determined that the Contractor or subcontractor knowingly rendered an erroneous certification, the Federal Aviation Administration may direct through the Owner cancellation of the contract or subcontract for default at no cost to the Owner or the FAA.

This certification concerns a matter within the jurisdiction of an agency of the United States of America and the making of a false, fictitious, or fraudulent certification may render the maker subject to prosecution under Title 18, United States Code, Section 1001.

Signature of Contractor

Date

Title

(Reference: 49 U.S.C. § 50104; 49 CFR part 30)

CERTIFICATION OF OFFERER/BIDDER REGARDING DEBARMENT
(Bidder or Offeror Certification)

By submitting a bid/proposal under this solicitation, the bidder or offeror certifies that neither it nor its principals are presently debarred or suspended by any Federal department or agency from participation in this transaction.

CERTIFICATION OF LOWER TIER CONTRACTORS REGARDING DEBARMENT
(Lower Tier Contract Certification)

The successful bidder, by administering each lower tier subcontract that exceeds \$25,000 as a “covered transaction”, must verify each lower tier participant of a “covered transaction” under the project is not presently debarred or otherwise disqualified from participation in this federally assisted project. The successful bidder will accomplish this by:

1. Checking the System for Award Management at website: <http://www.sam.gov>
2. Collecting a certification statement similar to the Certificate Regarding Debarment and Suspension (Bidder or Offeror), above.
3. Inserting a clause or condition in the covered transaction with the lower tier contract

If the FAA later determines that a lower tier participant failed to disclose to a higher tier participant that it was excluded or disqualified at the time it entered the covered transaction, the FAA may pursue any available remedies, including suspension and debarment of the non-compliant participant.

Signature of Contractor

Date

Title

(Reference: 2 CFR part 180 (Subpart C), 2 CFR part 1200, DOT Order 4200.5)

LOBBYING AND INFLUENCING FEDERAL EMPLOYEES

The bidder or offeror certifies by signing and submitting this bid or proposal, to the best of his or her knowledge and belief, that:

1. No Federal appropriated funds have been paid or will be paid, by or on behalf of the Bidder or Offeror, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
2. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.
3. The undersigned shall require that the language of this certification be included in the award documents for all sub-awards at all tiers (including subcontracts, sub-grants, and contracts under grants, loans, and cooperative agreements) and that all sub-recipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

Signature of Contractor

Date

Title

(Reference: 31 U.S.C. § 1352 – Byrd Anti-Lobbying Amendment; 2 CFR part 200, Appendix II(J); 49 CFR part 20, Appendix A)

CERTIFICATE OF BUY AMERICAN COMPLIANCE FOR TOTAL FACILITY

Certificate for Project Base Bid

As a matter of bid responsiveness, the bidder or offeror must complete, sign, date, and submit this certification statement with their proposal. The bidder or offeror must indicate how they intend to comply with 49 USC § 50101 by selecting one of the following certification statements. These statements are mutually exclusive. Bidder must select one or the other (i.e. not both) by inserting a checkmark (✓) or the letter "X".

- ☐ (A) Bidder or offeror hereby certifies that it will comply with 49 USC. 50101 by:
- a) Only installing steel and manufactured products produced in the United States; or
 - b) Installing manufactured products for which the FAA has issued a waiver as indicated by inclusion on the current FAA Nationwide Buy American Waivers Issued listing; or
 - c) Installing products listed as an Excepted Article, Material or Supply in Federal Acquisition Regulation Subpart 25.108.

By selecting this certification statement, the bidder or offeror agrees:

- 1. To provide to the Owner evidence that documents the source and origin of the steel and manufactured product.
 - 2. To faithfully comply with providing US domestic products.
 - 3. To refrain from seeking a waiver request after establishment of the contract, unless extenuating circumstances emerge that the FAA determines justified.
- ☐ (B) The bidder or offeror hereby certifies it cannot comply with the 100% Buy American Preferences of 49 USC § 50101(a) but may qualify for either a Type 3 or Type 4 waiver under 49 USC § 50101(b). By selecting this certification statement, the apparent bidder or offeror with the apparent low bid agrees:
- 1. To submit to the Owner within 15 calendar days of the bid opening, a formal waiver request and required documentation that support the type of waiver being requested.
 - 2. That failure to submit the required documentation within the specified timeframe is cause for a non-responsive determination that may result in rejection of the proposal.
 - 3. To faithfully comply with providing US domestic products at or above the approved US domestic content percentage as approved by the FAA.
 - 4. To furnish US domestic product for any waiver request that the FAA rejects.
 - 5. To refrain from seeking a waiver request after establishment of the contract, unless extenuating circumstances emerge that the FAA determines justified.

REQUIRED DOCUMENTATION

Type 3 Waiver - The cost of components and subcomponents produced in the United States is more than 60% of the cost of all components and subcomponents of the "facility". The required documentation for a type 3 waiver is:

- a) Listing of all manufactured products that are not comprised of 100% US domestic content (Excludes products listed on the FAA Nationwide Buy American Waivers Issued listing and products excluded by Federal Acquisition Regulation Subpart 25.108; products of unknown origin must be considered as non-domestic products in their entirety).
- b) Cost of non-domestic components and subcomponents, excluding labor costs associated with final assembly and installation at project location.
- c) Percentage of non-domestic component and subcomponent cost as compared to total "facility" component and subcomponent costs, excluding labor costs associated with final assembly and installation at project location.

Type 4 Waiver - Total cost of project using US domestic source product exceeds the total project cost using non-domestic product by 25%. The required documentation for a type 4 waiver is:

- a) Detailed cost information for total project using US domestic product
- b) Detailed cost information for total project using non-domestic product

False Statements: Per 49 USC § 47126, this certification concerns a matter within the jurisdiction of the Federal Aviation Administration and the making of a false, fictitious or fraudulent certification may render the maker subject to prosecution under Title 18, United States Code.

Certificate for Project Base Bid

Date

Signature

Company Name

Title

CERTIFICATE OF BUY AMERICAN COMPLIANCE FOR TOTAL FACILITY

Certificate for Add Alternate Bid – Passenger Boarding Bridges, Pre-Conditioned Air Units and Ground Power Units

As a matter of bid responsiveness, the bidder or offeror must complete, sign, date, and submit this certification statement with their proposal. The bidder or offeror must indicate how they intend to comply with 49 USC § 50101 by selecting one of the following certification statements. These statements are mutually exclusive. Bidder must select one or the other (i.e. not both) by inserting a checkmark (✓) or the letter "X".

- ☐ (A) Bidder or offeror hereby certifies that it will comply with 49 USC. 50101 by:
- d) Only installing steel and manufactured products produced in the United States; or
 - e) Installing manufactured products for which the FAA has issued a waiver as indicated by inclusion on the current FAA Nationwide Buy American Waivers Issued listing; or
 - f) Installing products listed as an Excepted Article, Material or Supply in Federal Acquisition Regulation Subpart 25.108.

By selecting this certification statement, the bidder or offeror agrees:

- 4. To provide to the Owner evidence that documents the source and origin of the steel and manufactured product.
 - 5. To faithfully comply with providing US domestic products.
 - 6. To refrain from seeking a waiver request after establishment of the contract, unless extenuating circumstances emerge that the FAA determines justified.
- ☐ (B) The bidder or offeror hereby certifies it cannot comply with the 100% Buy American Preferences of 49 USC § 50101(a) but may qualify for either a Type 3 or Type 4 waiver under 49 USC § 50101(b). By selecting this certification statement, the apparent bidder or offeror with the apparent low bid agrees:
- 6. To submit to the Owner within 15 calendar days of the bid opening, a formal waiver request and required documentation that support the type of waiver being requested.
 - 7. That failure to submit the required documentation within the specified timeframe is cause for a non-responsive determination that may result in rejection of the proposal.
 - 8. To faithfully comply with providing US domestic products at or above the approved US domestic content percentage as approved by the FAA.
 - 9. To furnish US domestic product for any waiver request that the FAA rejects.
 - 10. To refrain from seeking a waiver request after establishment of the contract, unless extenuating circumstances emerge that the FAA determines justified.

REQUIRED DOCUMENTATION

Type 3 Waiver - The cost of components and subcomponents produced in the United States is more than 60% of the cost of all components and subcomponents of the "facility". The required documentation for a type 3 waiver is:

- d) Listing of all manufactured products that are not comprised of 100% US domestic content (Excludes products listed on the FAA Nationwide Buy American Waivers Issued listing and products excluded by Federal Acquisition Regulation Subpart 25.108; products of unknown origin must be considered as non-domestic products in their entirety).
- e) Cost of non-domestic components and subcomponents, excluding labor costs associated with final assembly and installation at project location.
- f) Percentage of non-domestic component and subcomponent cost as compared to total "facility" component and subcomponent costs, excluding labor costs associated with final assembly and installation at project location.

Type 4 Waiver - Total cost of project using US domestic source product exceeds the total project cost using non-domestic product by 25%. The required documentation for a type 4 waiver is:

- c) Detailed cost information for total project using US domestic product
- d) Detailed cost information for total project using non-domestic product

False Statements: Per 49 USC § 47126, this certification concerns a matter within the jurisdiction of the Federal Aviation Administration and the making of a false, fictitious or fraudulent certification may render the maker subject to prosecution under Title 18, United States Code.

Certificate for Add Alternate Bid – Passenger Boarding Bridges, Pre-Conditioned Air Units and Ground Power Units

Date

Signature

Company Name

Title

FORM OF NON-COLLUSION AFFIDAVIT

(This Affidavit is Part of the Proposal)

STATE OF _____

COUNTY OF _____

_____ being first duly sworn, deposes and says that he/she is

_____ *(Sole owner, a partner, president, secretary, etc.)*

of _____
the party making the foregoing Proposal that such Proposal is genuine and not collusive or sham; that said Offeror has not colluded, conspired, connived, or agreed directly or indirectly, with any Offeror or person, to put in a sham Proposal, or that such other person shall refrain from submitting a proposal and has not in any manner, directly or indirectly sought by agreement or collusion, or communication or conference, with any person, to fix the proposal price of affiant or any other Offeror, or to fix any overhead, profit or cost element of said proposal price, or of that of any other Offeror or to secure any advantage against OWNER any person interested in the proposed Contract; and that all statements in said Proposal are true; and further, that such Offeror has not, directly or indirectly submitted this proposal, or the contents thereof, or divulged information or data relative to any association or to any member or agent thereof.

Signature of Offeror

Sworn to and subscribed before me this _____ day of _____, 2019.

(Official Seal)

Official Signature of Notary

_____, Notary Public
Notary's Printed or Typed Name

My Commission expires _____, 20____

**Listing of DBE Subcontractors & Suppliers
To Be Submitted With The Bid**

***Fayetteville Regional Airport
Airline Terminal Improvements – Part 2***

The Bidder hereby proposes the following DBE participation in accordance with Appendix C:

DBE Subcontractor or Supplier Name and Address	NCDOT Reporting Number	Cert. Type (DBE)	Work To Be Performed	Subcontract Amount	Amount Applicable to Goal
Total Applicable DBE Participation					
Base Bid Amount					
DBE Participation Proposed (%)					
DBE Participation Goal (%)					8.4%

Bidder (Firm Name)	Signature	Date

Bidder must complete above "Listing of DBE Subcontractors" form and submit with bid. Letters of Intent must be submitted by the apparent low bidder for all DBE subcontractors no later than 2:00 pm of the fifth calendar day following opening of bids, unless the fifth day falls on Saturday, Sunday or an official state holiday. In that situation, it is due in the office of the Airport Director no later than 10:00 am on the next official state business day.

Fayetteville Regional Airport – Airline Terminal Improvements – Part 2

Owner: City of Fayetteville
Fayetteville, North Carolina

BIDDER INFORMATION

Name of Company _____

Address _____

Phone No. _____ Fax No. _____

E-Mail Address _____

Federal I.D. No. _____

DBE / Disadvantaged Business Enterprise _____ Yes _____ No

N. C. General Contractor License Number _____

Bid Submitted by: _____
(Name Printed Out)

(Signature)

Title: _____

Date: _____

**Listing of DBE Subcontractors & Suppliers
To Be Submitted With The Bid**

**Fayetteville Regional Airport
Airline Terminal Improvements – Part 1**

The Bidder hereby proposes the following DBE participation in accordance with Appendix C:

DBE Subcontractor or Supplier Name and Address	NCDOT Reporting Number	Cert. Type (DBE)	Work To Be Performed	Subcontract Amount	Amount Applicable to Goal
Total Applicable DBE Participation					
Base Bid Amount					
DBE Participation Proposed (%)					
DBE Participation Goal (%)					8.4%

Bidder (Firm Name)	Signature	Date

Bidder must complete above "Listing of DBE Subcontractors" form and submit with bid. Letters of Intent must be submitted by the apparent low bidder for all DBE subcontractors no later than 12:00 noon of the sixth calendar day following opening of bids, unless the sixth day falls on Saturday, Sunday or an official state holiday. In that situation, it is due in the office of the Airport Director no later than 12:00 noon on the next official state business day.

APPENDIX 'C'

DISADVANTAGED BUSINESS ENTERPRISE PROVISIONS (Local Government Agencies)

Description

The purpose of this Special Provision is to carry out the U.S. Department of Transportation's policy of ensuring nondiscrimination in the award and administration of contracts financed in whole or in part with Federal funds. This provision is guided by 49 CFR Part 26.

General

This appendix has been developed from NCDOT Special Provision SP1 G63, revised February 16, 2016. Certain additional provisions have been added, to facilitate the management of project data.

Definitions

Additional DBE Subcontractors - Any DBE submitted at the time of bid that will not be used to meet the DBE goal. No submittal of a Letter of Intent is required.

Committed DBE Subcontractor - Any DBE submitted at the time of bid that is being used to meet the DBE goal by submission of a Letter of Intent. Or any DBE used as a replacement for a previously committed DBE firm.

Contract Goal Requirement - The approved DBE participation at time of award, but not greater than the advertised contract goal.

DBE Goal - A portion of the total contract, expressed as a percentage, that is to be performed by committed DBE subcontractor(s).

Disadvantaged Business Enterprise (DBE) - A firm certified as a Disadvantaged Business Enterprise through the North Carolina Unified Certification Program.

Goal Confirmation Letter - Written documentation from the **City of Fayetteville** to the bidder confirming the Contractor's approved, committed DBE participation along with a listing of the committed DBE firms.

Local Government Agency – The City of Fayetteville, North Carolina, the entity letting the contract. When this provision refers to the Department or NCDOT, it shall also mean the City of Fayetteville, acting alone as Owner, or jointly with the Department/ NCDOT.

Manufacturer - A firm that operates or maintains a factory or establishment that produces on the premises, the materials or supplies obtained by the Contractor.

Regular Dealer - A firm that owns, operates, or maintains a store, warehouse, or other establishment in which the materials or supplies required for the performance of the contract are bought, kept in stock, and regularly sold to the public in the usual course of business. A regular dealer engages in, as its principal business and in its own name, the purchase and sale or lease of the products in question. A regular dealer in such bulk items as steel, cement, gravel, stone, and petroleum products need not keep such products in stock, if it owns and operates distribution equipment for the products. Brokers and packagers are not regarded as manufacturers or regular dealers within the meaning of this section.

North Carolina Unified Certification Program (NCUCP) - A program that provides comprehensive services and information to applicants for DBE certification, such that an applicant is required to apply only once for a DBE certification that will be honored by all recipients of USDOT funds in the state and not limited to the Department of Transportation only. The Certification Program is in accordance with 49 CFR Part 26.

Standard Specifications - The general term comprising all directions, provisions, and requirements contained or referred to in the *North Carolina Department of Transportation Standard Specifications for Roads and Structures* and any subsequent revisions or additions to such book.

United States Department of Transportation (USDOT) - Federal agency responsible for issuing regulations (49 CFR Part 26) and official guidance for the DBE program.

Forms Referenced in this Provision

DBE-IS Subcontractor Payment Information – Form for reporting the payments made to all DBE firms working on the project.

RF-1 DBE Replacement Request Form – Form for replacing a committed DBE.

JC-1 Joint Check Notification Form – Form and procedures for joint check notification. The form acts as a written joint check agreement among the parties providing full and prompt disclosure of the expected use of joint checks.

Letter of Intent - Form signed by the Contractor and the DBE subcontractor, manufacturer or regular dealer that affirms that a portion of said contract is going to be performed by the signed DBE for the amount listed at the time of bid.

Listing of DBE Subcontractors Form - Form for entering DBE subcontractors on a project that will meet this DBE goal. This form is for paper bids only.

Subcontractor Quote Comparison Sheet - Spreadsheet for showing all subcontractor quotes in the work areas where DBEs quoted on the project. This sheet is submitted with good faith effort packages.

DBE Goal

The following DBE goal for participation by Disadvantaged Business Enterprises is established for this contract:

Disadvantaged Business Enterprises **8.4%**

The Contractor shall exercise all necessary and reasonable steps to ensure that DBEs participate in at least the percent of the contract as set forth above as the DBE goal.

Directory of Transportation Firms (Directory)

Real-time information is available about firms doing business with the Department and firms that are certified through NCUCP in the Directory of Transportation Firms. Only firms identified in the Directory as DBE certified shall be used to meet the DBE goal. The Directory can be found at the following link.

<https://partner.ncdot.gov/VendorDirectory/default.html>

The listing of an individual firm in the directory shall not be construed as an endorsement of the firm's capability to perform certain work.

Listing of DBE Subcontractors

At the time of bid, bidders shall submit all DBE participation that they anticipate to use during the life of the contract. Only those identified to meet the DBE goal will be considered committed, even though the listing shall include both committed DBE subcontractors and additional DBE subcontractors. Additional DBE subcontractor participation submitted at the time of bid will be used toward the overall race-neutral goal. Only those firms with current DBE certification at the time of bid opening will be acceptable for listing in the bidder's submittal of DBE participation. The Contractor shall indicate the following required information:

Blank forms will not be deemed to represent zero participation. Bids submitted that do not have DBE participation indicated on the appropriate form will not be read publicly during the opening of bids. The Department **and the City of Fayetteville** will not consider these bids for award and the proposal will be rejected.

- (1) Bidders, at the time the bid proposal is submitted, shall submit a listing of DBE participation, including the names and addresses on *Listing of DBE Subcontractors* contained elsewhere in the contract documents in order for the bid to be considered responsive. Bidders shall indicate the total dollar value of the DBE participation for the contract.

- (2) If bidders have no DBE participation, they shall indicate this on the *Listing of DBE Subcontractors* by entering the word "None" or the number "0." This form shall be completed in its entirety.
- (3) The bidder shall be responsible for ensuring that the DBE is certified at the time of bid by checking the Directory of Transportation Firms. If the firm is not certified at the time of the bid-letting, that DBE's participation will not count towards achieving the DBE goal.

DBE Prime Contractor

When a certified DBE firm bids on a contract that contains a DBE goal, the DBE firm is responsible for meeting the goal or making good faith efforts to meet the goal, just like any other bidder. In most cases, a DBE bidder on a contract will meet the DBE goal by virtue of the work it performs on the contract with its own forces. However, all the work that is performed by the DBE bidder and any other DBE subcontractors will count toward the DBE goal. The DBE bidder shall list itself along with any DBE subcontractors, if any, in order to receive credit toward the DBE goal.

For example, if the DBE goal is 45% and the DBE bidder will only perform 40% of the contract work, the prime will list itself at 40%, and the additional 5% shall be obtained through additional DBE participation with DBE subcontractors or documented through a good faith effort.

DBE prime contractors shall also follow Sections A or B listed under *Listing of DBE Subcontractor* just as a non-DBE bidder would.

Written Documentation – Letter of Intent

The bidder shall submit written documentation for each DBE that will be used to meet the DBE goal of the contract, indicating the bidder's commitment to use the DBE in the contract. This documentation shall be submitted on the form titled *Letter of Intent*.

The documentation shall be received in the office of the Airport Director no later than 12:00 noon of the sixth calendar day following opening of bids, unless the sixth day falls on Saturday, Sunday or an official state holiday. In that situation, it is due in the office of the Airport Director no later than 12:00 noon on the next official state business day.

If the bidder fails to submit the Letter of Intent from each committed DBE to be used toward the DBE goal, or if the form is incomplete (i.e. both signatures are not present), the DBE participation will not count toward meeting the DBE goal. If the lack of this participation drops the commitment below the DBE goal, the Contractor shall submit evidence of good faith efforts, completed in its entirety, to the Airport Director no later than 12:00 noon on the eighth calendar day following opening of bids, unless the eighth day falls on Saturday, Sunday or an official state holiday. In that situation, it is due in the

office of the Airport Director no later than 12:00 noon on the next official state business day.

Submission of Good Faith Effort

If the bidder fails to meet or exceed the DBE goal, the apparent lowest responsive bidder shall submit to the City of Fayetteville documentation of adequate good faith efforts made to reach the DBE goal.

One complete set and 3 copies of this information shall be received in the office of the Airport Director no later than 12:00 noon of the sixth calendar day following opening of bids, unless the sixth day falls on Saturday, Sunday or an official state holiday. In that situation, it is due in the office of the Airport Director no later than 12:00 noon on the next official state business day.

Note: Where the information submitted includes repetitious solicitation letters, it will be acceptable to submit a representative letter along with a distribution list of the firms that were solicited. Documentation of DBE quotations shall be a part of the good faith effort submittal. This documentation may include written subcontractor quotations, telephone log notations of verbal quotations, or other types of quotation documentation.

Consideration of Good Faith Effort for Projects with DBE Goals More Than Zero

Adequate good faith efforts mean that the bidder took all necessary and reasonable steps to achieve the goal which, by their scope, intensity, and appropriateness, could reasonably be expected to obtain sufficient DBE participation. Adequate good faith efforts also mean that the bidder actively and aggressively sought DBE participation. Mere *pro forma* efforts are not considered good faith efforts.

The Department **and the City of Fayetteville** will consider the quality, quantity, and intensity of the different kinds of efforts a bidder has made. Listed below are examples of the types of actions a bidder will take in making a good faith effort to meet the goal and are not intended to be exclusive or exhaustive, nor is it intended to be a mandatory checklist.

- (A) Soliciting through all reasonable and available means (e.g. attendance at pre-bid meetings, advertising, written notices, use of verifiable electronic means through the use of the NCDOT Directory of Transportation Firms) the interest of all certified DBEs who have the capability to perform the work of the contract. The bidder must solicit this interest within at least 10 days prior to bid opening to allow the DBEs to respond to the solicitation. Solicitation shall provide the opportunity to DBEs within the market area where the project is located (NCDOT Highway Division 6 and the surrounding Divisions). The bidder must determine with certainty if the DBEs are interested by taking appropriate steps to follow up initial solicitations.

- (B) Selecting portions of the work to be performed by DBEs in order to increase the likelihood that the DBE goals will be achieved.
 - (1) Where appropriate, break out contract work items into economically feasible units to facilitate DBE participation, even when the prime contractor might otherwise prefer to perform these work items with its own forces.
 - (2) Negotiate with subcontractors to assume part of the responsibility to meet the contract DBE goal when the work to be sublet includes potential for DBE participation (2nd and 3rd tier subcontractors).
- (C) Providing interested DBEs with adequate information about the plans, specifications, and requirements of the contract in a timely manner to assist them in responding to a solicitation.
- (D)
 - (1) Negotiating in good faith with interested DBEs. It is the bidder's responsibility to make a portion of the work available to DBE subcontractors and suppliers and to select those portions of the work or material needs consistent with the available DBE subcontractors and suppliers, so as to facilitate DBE participation. Evidence of such negotiation includes the names, addresses, and telephone numbers of DBEs that were considered; a description of the information provided regarding the plans and specifications for the work selected for subcontracting; and evidence as to why additional agreements could not be reached for DBEs to perform the work.
 - (2) A bidder using good business judgment would consider a number of factors in negotiating with subcontractors, including DBE subcontractors, and would take a firm's price and capabilities as well as contract goals into consideration. However, the fact that there may be some additional costs involved in finding and using DBEs is not in itself sufficient reason for a bidder's failure to meet the contract DBE goal, as long as such costs are reasonable. Also, the ability or desire of a prime contractor to perform the work of a contract with its own organization does not relieve the bidder of the responsibility to make good faith efforts. Bidding contractors are not, however, required to accept higher quotes from DBEs if the price difference is excessive or unreasonable.
- (E) Not rejecting DBEs as being unqualified without sound reasons based on a thorough investigation of their capabilities. The bidder's standing within its industry, membership in specific groups, organizations, or associates and political or social affiliations (for example, union vs. non-union employee status) are not legitimate causes for the rejection or non-solicitation of bids in the bidder's efforts to meet the project goal.

- (F) Making efforts to assist interested DBEs in obtaining bonding, lines of credit, or insurance as required by the recipient or bidder.
- (G) Making efforts to assist interested DBEs in obtaining necessary equipment, supplies, materials, or related assistance or services.
- (H) Effectively using the services of available minority/women community organizations; minority/women contractors' groups; Federal, State, and local minority/women business assistance offices; and other organizations as allowed on a case-by-case basis to provide assistance in the recruitment and placement of DBEs. Contact within 7 days from the bid opening NCDOT's Business Development Manager in the Business Opportunity and Work Force Development Unit to give notification of the bidder's inability to get DBE quotes.
- (I) Any other evidence that the bidder submits which shows that the bidder has made reasonable good faith efforts to meet the DBE goal.

In addition, the Department **and the City of Fayetteville** may take into account the following:

- (1) Whether the bidder's documentation reflects a clear and realistic plan for achieving the DBE goal.
- (2) The bidders' past performance in meeting the DBE goals.
- (3) The performance of other bidders in meeting the DBE goal. For example, when the apparent successful bidder fails to meet the DBE goal, but others meet it, you may reasonably raise the question of whether, with additional reasonable efforts the apparent successful bidder could have met the goal. If the apparent successful bidder fails to meet the DBE goal, but meets or exceeds the average DBE participation obtained by other bidders, the Department **and the City of Fayetteville** may view this, in conjunction with other factors, as evidence of the apparent successful bidder having made a good faith effort.

If the City of Fayetteville does not award the contract to the apparent lowest responsive bidder, the City of Fayetteville reserves the right to award the contract to the next lowest responsive bidder that can satisfy to the Department **and the City of Fayetteville** that the DBE goal can be met or that an adequate good faith effort has been made to meet the DBE goal.

Non-Good Faith Appeal

The City of Fayetteville will notify the contractor verbally and in writing of non-good faith. A contractor may appeal a determination of non-good faith made by the Airport Director. If a contractor wishes to appeal the determination made by the Airport Director, they shall

provide written notification to the Airport Director **and the City of Fayetteville**. The appeal shall be made within 2 business days of notification of the determination of non-good faith.

Counting DBE Participation Toward Meeting DBE Goal

(A) Participation

The total dollar value of the participation by a committed DBE will be counted toward the contract goal requirement. The total dollar value of participation by a committed DBE will be based upon the value of work actually performed by the DBE and the actual payments to DBE firms by the Contractor.

(B) Joint Checks

Prior notification of joint check use shall be required when counting DBE participation for services or purchases that involves the use of a joint check. Notification shall be through submission of Form JC-1 (*Joint Check Notification Form*) and the use of joint checks shall be in accordance with the Department's Joint Check Procedures.

(C) Subcontracts (Non-Trucking)

A DBE may enter into subcontracts. Work that a DBE subcontracts to another DBE firm may be counted toward the contract goal requirement. Work that a DBE subcontracts to a non-DBE firm does not count toward the contract goal requirement. If a DBE contractor or subcontractor subcontracts a significantly greater portion of the work of the contract than would be expected on the basis of standard industry practices, it shall be presumed that the DBE is not performing a commercially useful function. The DBE may present evidence to rebut this presumption to the Department **and the City of Fayetteville**. The Department's decision on the rebuttal of this presumption is subject to review by the Federal Aviation Administration but is not administratively appealable to USDOT.

(D) Joint Venture

When a DBE performs as a participant in a joint venture, the Contractor may count toward its contract goal requirement a portion of the total value of participation with the DBE in the joint venture, that portion of the total dollar value being a distinct clearly defined portion of work that the DBE performs with its forces.

(E) Suppliers

A contractor may count toward its DBE requirement 60 percent of its expenditures for materials and supplies required to complete the contract and obtained from a

DBE regular dealer and 100 percent of such expenditures from a DBE manufacturer.

(F) Manufacturers and Regular Dealers

A contractor may count toward its DBE requirement the following expenditures to DBE firms that are not manufacturers or regular dealers:

- (1) The fees or commissions charged by a DBE firm for providing a *bona fide* service, such as professional, technical, consultant, or managerial services, or for providing bonds or insurance specifically required for the performance of a DOT-assisted contract, provided the fees or commissions are determined to be reasonable and not excessive as compared with fees and commissions customarily allowed for similar services.
- (2) With respect to materials or supplies purchased from a DBE, which is neither a manufacturer nor a regular dealer, count the entire amount of fees or commissions charged for assistance in the procurement of the materials and supplies, or fees or transportation charges for the delivery of materials or supplies required on a job site (but not the cost of the materials and supplies themselves), provided the fees are determined to be reasonable and not excessive as compared with fees customarily allowed for similar services.

Commercially Useful Function

(A) DBE Utilization

The Contractor may count toward its contract goal requirement only expenditures to DBEs that perform a commercially useful function in the work of a contract. A DBE performs a commercially useful function when it is responsible for execution of the work of the contract and is carrying out its responsibilities by actually performing, managing, and supervising the work involved. To perform a commercially useful function, the DBE shall also be responsible with respect to materials and supplies used on the contract, for negotiating price, determining quality and quantity, ordering the material and installing (where applicable) and paying for the material itself. To determine whether a DBE is performing a commercially useful function, the Department will evaluate the amount of work subcontracted, industry practices, whether the amount the firm is to be paid under the contract is commensurate with the work it is actually performing and the DBE credit claimed for its performance of the work, and any other relevant factors.

(B) DBE Utilization in Trucking

The following factors will be used to determine if a DBE trucking firm is performing a commercially useful function.

- (1) The DBE shall be responsible for the management and supervision of the entire trucking operation for which it is responsible on a particular contract, and there shall not be a contrived arrangement for the purpose of meeting DBE goals.
- (2) The DBE shall itself own and operate at least one fully licensed, insured, and operational truck used on the contract.
- (3) The DBE receives credit for the total value of the transportation services it provides on the contract using trucks it owns, insures, and operates using drivers it employs.
- (4) The DBE may subcontract the work to another DBE firm, including an owner-operator who is certified as a DBE. The DBE who subcontracts work to another DBE receives credit for the total value of the transportation services the subcontracted DBE provides on the contract.
- (5) The DBE may also subcontract the work to a non-DBE firm, including from an owner-operator. The DBE who subcontracts the work to a non-DBE is entitled to credit for the total value of transportation services provided by the non-DBE subcontractor not to exceed the value of transportation services provided by DBE-owned trucks on the contract. Additional participation by non-DBE subcontractors receives credit only for the fee or commission it receives as a result of the subcontract arrangement. The value of services performed under subcontract agreements between the DBE and the Contractor will not count towards the DBE contract requirement.
- (6) A DBE may lease truck(s) from an established equipment leasing business open to the general public. The lease must indicate that the DBE has exclusive use of and control over the truck. This requirement does not preclude the leased truck from working for others during the term of the lease with the consent of the DBE, so long as the lease gives the DBE absolute priority for use of the leased truck. This type of lease may count toward the DBE's credit as long as the driver is under the DBE's payroll.
- (7) Subcontracted/leased trucks shall display clearly on the dashboard the name of the DBE that they are subcontracted/leased to and their own company name if it is not identified on the truck itself. Magnetic door signs are not permitted.

DBE Replacement

When a Contractor has relied on a commitment to a DBE firm (or an approved substitute DBE firm) to meet all or part of a contract goal requirement, the contractor shall not terminate the DBE for convenience. This includes, but is not limited to, instances in which

the Contractor seeks to perform the work of the terminated subcontractor with another DBE subcontractor, a non-DBE subcontractor, or with the Contractor's own forces or those of an affiliate. A DBE may only be terminated after receiving the Department's written approval based upon a finding of good cause for the termination. The prime contractor must give the DBE firm five (5) calendar days to respond to the prime contractor's notice of termination and advise the prime contractor and the Department of the reasons, if any, why the firm objects to the proposed termination of its subcontract and why the Department should not approve the action.

All requests for replacement of a committed DBE firm shall be submitted to the Airport Director for approval on Form RF-1 (*DBE Replacement Request*). If the Contractor fails to follow this procedure, the Contractor may be disqualified from further bidding for a period of up to 6 months.

The Contractor shall comply with the following for replacement of a committed DBE:

(A) Performance Related Replacement

When a committed DBE is terminated for good cause as stated above, an additional DBE that was submitted at the time of bid may be used to fulfill the DBE commitment. A good faith effort will only be required for removing a committed DBE if there were no additional DBEs submitted at the time of bid to cover the same amount of work as the DBE that was terminated.

If a replacement DBE is not found that can perform at least the same amount of work as the terminated DBE, the Contractor shall submit a good faith effort documenting the steps taken. Such documentation shall include, but not be limited to, the following:

- (1) Copies of written notification to DBEs that their interest is solicited in contracting the work defaulted by the previous DBE or in subcontracting other items of work in the contract.
- (2) Efforts to negotiate with DBEs for specific subbids including, at a minimum:
 - (a) The names, addresses, and telephone numbers of DBEs who were contacted.
 - (b) A description of the information provided to DBEs regarding the plans and specifications for portions of the work to be performed.
- (3) A list of reasons why DBE quotes were not accepted.
- (4) Efforts made to assist the DBEs contacted, if needed, in obtaining bonding or insurance required by the Contractor.

(B) Decertification Replacement

- (1) When a committed DBE is decertified by the Department after the DBE has executed a subcontract, the City will not require the Contractor to solicit replacement DBE participation equal to the remaining work to be performed by the decertified firm. The participation equal to the remaining work performed by the decertified firm will count toward the contract goal requirement.
- (2) When a committed DBE is decertified prior to DBE executing a subcontract, the Contractor shall take all necessary and reasonable steps to replace the DBE subcontractor with another DBE subcontractor to perform at least the same amount of work to meet the DBE goal requirement. If a DBE firm is not found to do the same amount of work, a good faith effort must be submitted to FAYETTEVILLE REGIONAL AIRPORT (see A herein for required documentation).

Changes in the Work

When the Owner makes changes that result in the reduction or elimination of work to be performed by a committed DBE, the Contractor will not be required to seek additional participation. When the Owner makes changes that result in additional work to be performed by a DBE based upon the Contractor's commitment, the DBE shall participate in additional work to the same extent as the DBE participated in the original contract work.

When the Owner makes changes that result in extra work, which has more than a minimal impact on the contract amount, the Contractor shall seek additional participation by DBEs unless otherwise approved by the Airport Director.

When the Owner makes changes that result in an alteration of plans or details of construction, and a portion or all of the work had been expected to be performed by a committed DBE, the Contractor shall seek participation by DBEs unless otherwise approved by the Airport Director.

When the Contractor requests changes in the work that result in the reduction or elimination of work that the Contractor committed to be performed by a DBE, the Contractor shall seek additional participation by DBEs equal to the reduced DBE participation caused by the changes.

Reports and Documentation

The Department and the City of Fayetteville will require copies of actual subcontract agreements involving DBE subcontractors.

When using transportation services to meet the contract commitment, the Contractor shall submit a proposed trucking plan. The plan shall be submitted prior to beginning

construction on the project. The plan shall include the names of all trucking firms proposed for use, their certification type(s), the number of trucks owned by the firm, as well as the individual truck identification numbers, and the line item(s) being performed.

Within 30 calendar days of entering into an agreement with a DBE for materials, supplies or services, the Contractor shall furnish the Owner a copy of the agreement. The documentation shall also indicate the percentage (60% or 100%) of expenditures claimed for DBE credit.

Reporting Disadvantaged Business Enterprise Participation

The Contractor shall provide the Airport Director with an accounting of payments made to all DBE firms, including material suppliers and contractors at all levels (prime, subcontractor, or second tier subcontractor). This accounting shall be furnished to the Airport Director for any given month by the end of the following month. Failure to submit this information accordingly may result in the following action:

- (A) Withholding of money due in the next partial pay estimate; or
- (B) Removal by the Department of an approved contractor from the prequalified bidders' list or the removal of other entities from the approved subcontractors list.

While each contractor (prime, subcontractor, 2nd tier subcontractor) is responsible for accurate accounting of payments to DBEs, it shall be the prime contractor's responsibility to report all monthly and final payment information in the correct reporting manner.

Failure on the part of the Contractor to submit the required information in the time frame specified may result in the disqualification of that contractor and any affiliate companies from further bidding until the required information is submitted.

Failure on the part of any subcontractor to submit the required information in the time frame specified may result in the disqualification of that contractor and any affiliate companies from being approved for work on future projects until the required information is submitted.

Contractors reporting transportation services provided by non-DBE lessees shall evaluate the value of services provided during the month of the reporting period only.

At any time, the Airport Director can request written verification of subcontractor payments.

The Contractor shall report the accounting of payments on the Department's DBE-IS (*Subcontractor Payment Information*) with each invoice. Invoices will not be processed for payment until the DBE-IS is received.

Failure to Meet Contract Requirements

Failure to meet contract requirements in accordance with Subarticle 102-15(J) of the 2012 Standard Specifications may be cause for the Department to disqualify the Contractor from further bidding for a specified length of time.

Additional Project Requirements

For this project, the Contractor shall provide additional management and documentation of project DBE participation data to assist the Owner with implementation of the airport's DBE Program, as follows.

The Contractor shall provide, prior to Notice-to-proceed, a detailed written description of the work to be performed by each committed DBE firm, to include specific work element(s), location(s) on the project and time frame(s) within the overall project schedule. For trucking/hauling DBE participation, describe in detail the material to be hauled and the start and end points (locations) of each hauling operation.

DBE payments shall be reported on the designated forms. Copies of dated DBE invoices, cancelled checks and/or other financial records shall be submitted as back-up documentation.

Prior to final acceptance of the work, the Contractor shall submit a signed and notarized statement from each committed DBE as to the total of all payments received for this contract.

In addition to DBE payment reporting, the Contractor shall prepare and submit a monthly written DBE participation progress report, listing the DBE firms which performed work on the project in the prior month, along with the dates, nature and status of that work; listing the project DBE participation for the following month (including firm name(s) and nature of work); provide dated photos and/or other records documenting when DBE equipment and workers are on site and delivery of goods by DBE suppliers or haulers; provide documentation of commercially useful function, including trucking documents; provide any information regarding DBE participation challenges, including non-performance, pending termination and replacement issues; describe any participation impacts of pending contract changes; describe any scheduling changes which may affect the relative timing of participation; and any other project considerations which could affect DBE participation. Failure to provide thorough and timely documentation and reporting may be cause for the Owner to delay processing of payments to the Contractor.



DBE GOOD FAITH EFFORTS DOCUMENTATION

THIS INFORMATION MUST BE SUBMITTED WITH YOUR BID PROPOSAL IF YOUR BID DOES NOT
MEET THE PROJECT DBE REQUIREMENTS, OR WHEN REQUESTED BY
FAYETTEVILLE REGIONAL AIRPORT

CONTRACT NAME _____

DEPARTMENT _____ FAYETTEVILLE REGIONAL AIRPORT

DATE BID SUBMITTED _____

BIDDER'S NAME _____

SIGNATURE _____

TITLE _____

DBE GOAL FROM BID PROPOSAL _____

DBE GOOD FAITH EFFORTS DOCUMENTATION

CONTRACT NAME _____ SUBMITTED _____

IF THE MBE/WBE GOAL ESTABLISHED FOR THIS CONTRACT HAS NOT BEEN MET OR FAYETTEVILLE REGIONAL AIRPORT REQUESTS THE SUBMITTAL THEREOF, THE BIDDER IS REQUIRED TO SUBMIT GOOD FAITH EFFORTS AS OUTLINED IN THIS DOCUMENT.

THE BIDDER ACKNOWLEDGES AND CERTIFIES THAT THIS FORM ACCURATELY REPRESENTS THE INFORMATION CONTAINED HEREIN.

BIDDER _____ SIGNATURE _____

TITLE _____

NAMES OF CERTIFIED DBEs AND THE DATES ON WHICH THEY WERE SOLICITED TO BID ON THIS PROJECT

INCLUDE THE ITEMS OF WORK OFFERED AND THE DATES AND METHODS USED FOR FOLLOWING UP INITIAL SOLICITATIONS TO DETERMINE WHETHER OR NOT DBEs WERE INTERESTED.

NAMES AND FED. TAX ID. OF DBEs SOLICITED	DATE OF INITIAL SOLICITATION	ITEM(S) OF WORK	FOLLOW-UP METHODS AND DATES

NOTE: ATTACH ADDITIONAL PAGES IF NECESSARY ATTACH COPIES OF SOLICITATIONS, TELEPHONE RECORDS, FAX CONFIRMATIONS, ELECTRONIC INFORMATION, ETC.

DBE GOOD FAITH EFFORTS DOCUMENTATION

CONTRACT NAME _____ SUBMITTED _____

IF THE DBE GOAL ESTABLISHED FOR THIS CONTRACT HAS NOT BEEN MET OR FAYETTEVILLE REGIONAL AIRPORT REQUESTS THE SUBMITTAL THEREOF, THE BIDDER IS REQUIRED TO SUBMIT GOOD FAITH EFFORTS AS OUTLINED IN THIS DOCUMENT.

THE BIDDER ACKNOWLEDGES AND CERTIFIES THAT THIS FORM ACCURATELY REPRESENTS THE INFORMATION CONTAINED HEREIN.

BIDDER _____ SIGNATURE _____

TITLE _____

ITEM(S) OF WORK THAT THE BIDDER MADE AVAILABLE TO DBE FIRMS

IDENTIFY THOSE ITEM(S) OF WORK THAT THE BIDDER MADE AVAILABLE TO DBE FIRMS OR THOSE ITEM(S) THE BIDDER IDENTIFIED AND DETERMINED TO SUBDIVIDE INTO ECONOMICALLY FEASIBLE UNITS TO FACILITATE MBE/WBE PARTICIPATION. FOR EACH ITEM LISTED, SHOW THE DOLLAR VALUE AND PERCENTAGE OF THE TOTAL CONTRACT AMOUNT. IT IS THE BIDDER'S RESPONSIBILITY TO DEMONSTRATE THAT SUFFICIENT WORK TO MEET THE GOAL WAS MADE AVAILABLE TO MBE/WBE FIRMS.

ITEM(S) OF WORK MADE AVAILABLE	BIDDER NORMALLY PERFORMS ITEM(S) (Y/N)	ITEM(S) BROKEN DOWN TO FACILITATE PARTICIPATION (Y/N)	AMOUNT IN DOLLARS	PERCENTAGE OF CONTRACT

NOTE: ATTACH ADDITIONAL PAGES IF NECESSARY

DBE GOOD FAITH EFFORTS DOCUMENTATION

CONTRACT NAME _____ SUBMITTED _____

IF THE DBE GOAL ESTABLISHED FOR THIS CONTRACT HAS NOT BEEN MET OR FAYETTEVILLE REGIONAL AIRPORT REQUESTS THE SUBMITTAL THEREOF, THE BIDDER IS REQUIRED TO SUBMIT GOOD FAITH EFFORTS AS OUTLINED IN THIS DOCUMENT.

THE BIDDER ACKNOWLEDGES AND CERTIFIES THAT THIS FORM ACCURATELY REPRESENTS THE INFORMATION CONTAINED HEREIN.

BIDDER _____ SIGNATURE _____

TITLE _____

ADDITIONAL INFORMATION REGARDING ITEM(S) OF WORK THAT THE BIDDER MADE AVAILABLE TO DBE FIRMS (Continued From Sheet 4)

ITEM(S) OF WORK MADE AVAILABLE, NAMES OF SELECTED FIRMS AND DBE STATUS, DBEs THAT PROVIDED QUOTES, PRICE QUOTE FOR EACH FIRM, AND THE PRICE DIFFERENCE FOR EACH DBE IF THE SELECTED FIRM IS NOT A DBE.

ITEM(S) OF WORK MADE AVAILABLE (CONT.)	NAME OF SELECTED FIRM AND FED. TAX ID	DBE OR NON-DEB	NAME OF REJECTED FIRM(S)	QUOTE IN DOLLARS	PRICE DIFFERENCE IN DOLLARS

NOTE: ATTACH ADDITIONAL PAGES IF NECESSARY.

IF THE FIRM SELECTED FOR THE ITEM IS NOT A DBE, PROVIDE THE REASON(S) FOR THE SELECTION ON A SEPARATE PAGE AND ATTACH.

PROVIDE NAMES, ADDRESSES, AND TELEPHONE NUMBERS FOR THE FIRMS LISTED ABOVE.

DBE GOOD FAITH EFFORTS DOCUMENTATION

CONTRACT ID. NO. _____ DATE SUBMITTED _____

IF THE DBE GOAL ESTABLISHED FOR THIS CONTRACT HAS NOT BEEN MET OR FAYETTEVILLE REGIONAL AIRPORT REQUESTS THE SUBMITTAL THEREOF, THE BIDDER IS REQUIRED TO SUBMIT GOOD FAITH EFFORTS AS OUTLINED IN THIS DOCUMENT.

THE BIDDER ACKNOWLEDGES AND CERTIFIES THAT THIS FORM ACCURATELY REPRESENTS THE INFORMATION CONTAINED HEREIN.

BIDDER _____ SIGNATURE _____

TITLE _____

ADVERTISEMENTS OR PROOFS OF PUBLICATION

NAMES AND DATES OF EACH PUBLICATION IN WHICH A REQUEST FOR DBE PARTICIPATION FOR THE PROJECT WAS PLACED BY THE BIDDER. ATTACH COPIES OF PUBLISHED ADVERTISEMENTS OR PROOFS OF PUBLICATION.

PUBLICATIONS	DATES OF ADVERTISEMENT

DBE GOOD FAITH EFFORTS DOCUMENTATION

CONTRACT ID. NO. _____ DATE SUBMITTED _____

IF THE DBE GOAL ESTABLISHED FOR THIS CONTRACT HAS NOT BEEN MET OR FAYETTEVILLE REGIONAL AIRPORT REQUESTS THE SUBMITTAL THEREOF, THE BIDDER IS REQUIRED TO SUBMIT GOOD FAITH EFFORTS AS OUTLINED IN THIS DOCUMENT.

THE BIDDER ACKNOWLEDGES AND CERTIFIES THAT THIS FORM ACCURATELY REPRESENTS THE INFORMATION CONTAINED HEREIN.

BIDDER _____ SIGNATURE _____

TITLE _____

NAMES OF AGENCIES CONTACTED TO PROVIDE ASSISTANCE

NAMES OF AGENCIES AND THE DATES THESE AGENCIES WERE CONTACTED TO PROVIDE ASSISTANCE IN CONTACTING, RECRUITING, AND USING DBE FIRMS. IF THE AGENCIES WERE CONTACTED IN WRITING, ATTACH COPIES OF SUPPORTING DOCUMENTS.

NAME OF AGENCY	METHOD AND DATE OF CONTACT	RESULTS

NOTE: ATTACH ADDITIONAL PAGES IF NECESSARY.

DBE GOOD FAITH EFFORTS DOCUMENTATION

CONTRACT ID. NO. _____ DATE SUBMITTED _____

IF THE DBE GOAL ESTABLISHED FOR THIS CONTRACT HAS NOT BEEN MET OR FAYETTEVILLE REGIONAL AIRPORT REQUESTS THE SUBMITTAL THEREOF, THE BIDDER IS REQUIRED TO SUBMIT GOOD FAITH EFFORTS AS OUTLINED IN THIS DOCUMENT.

THE BIDDER ACKNOWLEDGES AND CERTIFIES THAT THIS FORM ACCURATELY REPRESENTS THE INFORMATION CONTAINED HEREIN.

BIDDER _____ SIGNATURE _____

TITLE _____

TECHNICAL ASSISTANCE AND INFORMATION PROVIDED TO MBE/WBEs

EFFORTS MADE TO PROVIDE INTERESTED DBEs WITH ADEQUATE INFORMATION ABOUT THE PLANS, SPECIFICATIONS, AND REQUIREMENTS OF THE BID DOCUMENTS TO ASSIST THE DBEs IN RESPONDING TO A SOLICITATION.

IDENTIFY THE MBE/WBEs ASSISTED, THE INFORMATION PROVIDED, AND THE DATE OF CONTACT. ATTACH COPIES OF SUPPORTING DOCUMENTS.

DBEs ASSISTED	INFORMATION PROVIDED	DATE OF CONTACT

DBE GOOD FAITH EFFORTS DOCUMENTATION

CONTRACT ID. NO. _____ DATE SUBMITTED _____

IF THE DBE GOAL ESTABLISHED FOR THIS CONTRACT HAS NOT BEEN MET OR FAYETTEVILLE REGIONAL AIRPORT REQUESTS THE SUBMITTAL THEREOF, THE BIDDER IS REQUIRED TO SUBMIT GOOD FAITH EFFORTS AS OUTLINED IN THIS DOCUMENT.

THE BIDDER ACKNOWLEDGES AND CERTIFIES THAT THIS FORM ACCURATELY REPRESENTS THE INFORMATION CONTAINED HEREIN.

BIDDER _____ SIGNATURE _____

TITLE _____

EFFORTS MADE TO ASSIST DBEs OBTAIN BONDING, LINES OF CREDIT, INSURANCE, ETC.

EFFORTS MADE TO PROVIDE INTERESTED DBEs IN OBTAINING BONDING, LINES OF CREDIT, INSURANCE, NECESSARY EQUIPMENT, SUPPLIES, MATERIALS, OR RELATED ASSISTANCE OR SERVICES, EXCLUDING SUPPLIES AND EQUIPMENT THE SUBCONTRACTOR PURCHASES OR LEASES FROM THE PRIME CONTRACTOR OR ITS AFFILIATES.

DBEs ASSISTED	ASSISTANCE OFFERED	DATES SERVICES OFFERED AND/OR PROVIDED

NOTE: ATTACH ADDITIONAL PAGES IF NECESSARY

PROJECT NO.: _____ F. A. NO.: _____ COUNTY: _____

CONTRACT NO.: _____ T.I.P. NO.: _____

(Subcontractor Name and Address)

SUBMITTED BY: SUBCONTRACTOR: _____ BY: _____ TITLE: _____	RECOMMENDED BY: CONTRACTOR: _____ BY: _____ TITLE: _____

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INSTRUCTIONS FOR COMPLETING
“DBE SUBCONTRACT CERTIFICATION” (FORMS RS-1-D)
RACE CONSCIOUS / GOALS REQUIRED

1. Fill out the blank portions of the “DBE Subcontract Certification” (Form RS-1-D).
2. The negotiated unit or lump sum price must be the actual price agreed upon between the Contractor and the Subcontractor.
3. This form shall be completed and attached to the “Request for Subcontract” (Form RS-1-A) or “Request for Second Tier Subcontract” (Form RS-1-B), whenever the proposed Subcontractor is certified DBE Subcontractor.
4. In lieu of attaching “DBE Subcontract Certification” (Form RS-1-D), a copy of the actual subcontract agreement between the Contractor and the Subcontractor can be submitted.
5. Signatures are required.

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City of Fayetteville Fayetteville Regional Airport

DBE VENDOR COMMITMENTS/AWARDS

Airport ID:

Vendor ID:

Awarded By Name	Awarded By Report ID	Vendor/Subcontractor Name	Vendor/Subcontractor Report ID	Service / Item Description	Anticipated Utilization (\$)
				TOTAL	
SUBMITTED BY:		SUB RECIPIENT:		BY:	TITLE:

AV-POSTBID (AV-509) (10/06)

CITY OF FAYETTEVILLE
FAYETTEVILLE REGIONAL AIRPORT

DBE VENDOR PAYMENTS

Airport Name:

Airport ID:

Project Number:

PO No:

Vendor ID:

Payor Name	Payor Report ID	Vendor/Subcontractor Name	Vendor/Subcontractor Report ID	Amount Paid to Vendor/Subcontractor this Invoice	Date Paid to Vendor/Subcontractor this Invoice
			TOTAL		
SUBMITTED BY:		SUB RECIPIENT:	BY:		TITLE:

AV-VENPAY (AV-510) (10/06)



LETTER OF INTENT TO PERFORM AS A SUBCONTRACTOR

CONTRACT: Fayetteville Regional Airport
Airline Terminal Improvements Part 2

NAME OF BIDDER:

The undersigned intends to perform work in connection with the above contract upon execution of the bid and subsequent award of contract by the City of Fayetteville as:

Name of MBE/WBE/DBE Subcontractor _____

Address _____

City _____ State _____ Zip _____

Please check all that apply: Minority Business

Enterprise (MBE) _____

Women Business Enterprise (WBE) _____

Disadvantaged Business Enterprise (DBE) _____

The MBE /WBE /DBE status of the above named subcontractor is certified by the North Carolina Department of Transportation. The above named subcontractor is prepared to perform the work described below, in connection with the above contract upon award and execution of the contract by the City of Fayetteville. The above named subcontractor is prepared to perform the described work at the estimated Commitment Total for Subcontractor Price indicated below.

Commitment Total based on estimated Unit Prices and Quantities: Amount \$ _____

Work to be performed:

The above named bidder and subcontractor mutually accepts the Commitment Total shown above. This commitment total is based on estimated quantities of contract and sub-contract work and most likely will vary up or down as the project is completed. Final compensation will be based on actual quantities of work performed and accepted during the pursuance of work. The above listed amount represents the entire dollar amount quoted based on estimated quantities. No conversations, verbal agreements, and/or other forms of non-written representations shall serve to add, delete, or modify the terms as stated.

This document shall not serve in any manner as an actual subcontract between the two parties. A separate subcontractor agreement will describe in detail the contractual obligations of the bidder and the MBE/WBE/DBE subcontractor.

Affirmation

The above named MBE/ WBE/ DBE subcontractor affirms that it will perform the portion(s) of the contract for the estimated dollar value as stated above.

Name of MBE/ WBE/ DBE Subcontractor

Name of Bidder

Signature / Title

Signature / Title

Date

Date

PROHIBITION OF SEGREGATED FACILITIES

- (a) The Contractor agrees that it does not and will not maintain or provide for its employees any segregated facilities at any of its establishments, and that it does not and will not permit its employees to perform their services at any location under its control where segregated facilities are maintained. The Contractor agrees that a breach of this clause is a violation of the Equal Opportunity clause in this contract.
- (b) "Segregated facilities," as used in this clause, means any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees, that are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, sex, or national origin because of written or oral policies or employee custom. The term does not include separate or single-user rest rooms or necessary dressing or sleeping areas provided to assure privacy between the sexes.
- (c) The Contractor shall include this clause in every subcontract and purchase order that is subject to the Equal Opportunity clause of this contract.

Signature of Contractor

Date

Title

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S. C. 1001.

(Reference: 41 CFR § 60)

TRADE RESTRICTION CERTIFICATION

By submission of an offer, the Offeror certifies that with respect to this solicitation and any resultant contract, the Offeror:

- a. is not owned or controlled by one or more citizens of a foreign country included in the list of countries that discriminate against U.S. firms as published by the Office of the United States Trade Representative (U.S.T.R.);
- b. has not knowingly entered into any contract or subcontract for this project with a person that is a citizen or national of a foreign country included on the list of countries that discriminate against U.S. firms as published by the U.S.T.R.; and
- c. has not entered into any subcontract for any product to be used on the Federal on the project that is produced in a foreign country included on the list of countries that discriminate against U.S. firms published by the U.S.T.R.

This certification concerns a matter within the jurisdiction of an agency of the United States of America and the making of a false, fictitious, or fraudulent certification may render the maker subject to prosecution under Title 18, United States Code, Section 1001.

The Offeror/Contractor must provide immediate written notice to the Owner if the Offeror/Contractor learns that its certification or that of a subcontractor was erroneous when submitted or has become erroneous by reason of changed circumstances. The Contractor must require subcontractors provide immediate written notice to the Contractor if at any time it learns that its certification was erroneous by reason of changed circumstances.

Unless the restrictions of this clause are waived by the Secretary of Transportation in accordance with 49 CFR 30.17, no contract shall be awarded to an Offeror or subcontractor:

- (1) who is owned or controlled by one or more citizens or nationals of a foreign country included on the list of countries that discriminate against U.S. firms published by the U.S.T.R. or
- (2) whose subcontractors are owned or controlled by one or more citizens or nationals of a foreign country on such U.S.T.R. list or
- (3) who incorporates in the public works project any product of a foreign country on such U.S.T.R. list;

Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render, in good faith, the certification required by this provision. The knowledge and information of a contractor is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

The Offeror agrees that, if awarded a contract resulting from this solicitation, it will

incorporate this provision for certification without modification in in all lower tier subcontracts. The contractor may rely on the certification of a prospective subcontractor that it is not a firm from a foreign country included on the list of countries that discriminate against U.S. firms as published by U.S.T.R, unless the Offeror has knowledge that the certification is erroneous.

This certification is a material representation of fact upon which reliance was placed when making an award. If it is later determined that the Contractor or subcontractor knowingly rendered an erroneous certification, the Federal Aviation Administration may direct through the Owner cancellation of the contract or subcontract for default at no cost to the Owner or the FAA.

This certification concerns a matter within the jurisdiction of an agency of the United States of America and the making of a false, fictitious, or fraudulent certification may render the maker subject to prosecution under Title 18, United States Code, Section 1001.

Signature of Contractor

Date

Title

(Reference: 49 U.S.C. § 50104; 49 CFR part 30)

CERTIFICATION OF OFFERER/BIDDER REGARDING DEBARMENT
(Bidder or Offeror Certification)

By submitting a bid/proposal under this solicitation, the bidder or offeror certifies that neither it nor its principals are presently debarred or suspended by any Federal department or agency from participation in this transaction.

CERTIFICATION OF LOWER TIER CONTRACTORS REGARDING DEBARMENT
(Lower Tier Contract Certification)

The successful bidder, by administering each lower tier subcontract that exceeds \$25,000 as a “covered transaction”, must verify each lower tier participant of a “covered transaction” under the project is not presently debarred or otherwise disqualified from participation in this federally assisted project. The successful bidder will accomplish this by:

1. Checking the System for Award Management at website: <http://www.sam.gov>
2. Collecting a certification statement similar to the Certificate Regarding Debarment and Suspension (Bidder or Offeror), above.
3. Inserting a clause or condition in the covered transaction with the lower tier contract

If the FAA later determines that a lower tier participant failed to disclose to a higher tier participant that it was excluded or disqualified at the time it entered the covered transaction, the FAA may pursue any available remedies, including suspension and debarment of the non-compliant participant.

Signature of Contractor

Date

Title

(Reference: 2 CFR part 180 (Subpart C), 2 CFR part 1200, DOT Order 4200.5)

LOBBYING AND INFLUENCING FEDERAL EMPLOYEES

The bidder or offeror certifies by signing and submitting this bid or proposal, to the best of his or her knowledge and belief, that:

1. No Federal appropriated funds have been paid or will be paid, by or on behalf of the Bidder or Offeror, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
2. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.
3. The undersigned shall require that the language of this certification be included in the award documents for all sub-awards at all tiers (including subcontracts, sub-grants, and contracts under grants, loans, and cooperative agreements) and that all sub-recipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

Signature of Contractor

Date

Title

(Reference: 31 U.S.C. § 1352 – Byrd Anti-Lobbying Amendment; 2 CFR part 200, Appendix II(J); 49 CFR part 20, Appendix A)

CERTIFICATE OF BUY AMERICAN COMPLIANCE FOR TOTAL FACILITY

As a matter of bid responsiveness, the bidder or offeror must complete, sign, date, and submit this certification statement with their proposal. The bidder or offeror must indicate how they intend to comply with 49 USC § 50101 by selecting one of the following certification statements. These statements are mutually exclusive. Bidder must select one or the other (i.e. not both) by inserting a checkmark (✓) or the letter "X".

- ☐ Bidder or offeror hereby certifies that it will comply with 49 USC. 50101 by:
- a) Only installing steel and manufactured products produced in the United States; or
 - b) Installing manufactured products for which the FAA has issued a waiver as indicated by inclusion on the current FAA Nationwide Buy American Waivers Issued listing; or
 - c) Installing products listed as an Excepted Article, Material or Supply in Federal Acquisition Regulation Subpart 25.108.

By selecting this certification statement, the bidder or offeror agrees:

- 1. To provide to the Owner evidence that documents the source and origin of the steel and manufactured product.
 - 2. To faithfully comply with providing US domestic products.
 - 3. To refrain from seeking a waiver request after establishment of the contract, unless extenuating circumstances emerge that the FAA determines justified.
- ☐ The bidder or offeror hereby certifies it cannot comply with the 100% Buy American Preferences of 49 USC § 50101(a) but may qualify for either a Type 3 or Type 4 waiver under 49 USC § 50101(b). By selecting this certification statement, the apparent bidder or offeror with the apparent low bid agrees:
- 1. To submit to the Owner within 15 calendar days of the bid opening, a formal waiver request and required documentation that support the type of waiver being requested.
 - 2. That failure to submit the required documentation within the specified timeframe is cause for a non-responsive determination that may result in rejection of the proposal.
 - 3. To faithfully comply with providing US domestic products at or above the approved US domestic content percentage as approved by the FAA.
 - 4. To furnish US domestic product for any waiver request that the FAA rejects.
 - 5. To refrain from seeking a waiver request after establishment of the contract, unless extenuating circumstances emerge that the FAA determines justified.

REQUIRED DOCUMENTATION

Type 3 Waiver - The cost of components and subcomponents produced in the United

States is more that 60% of the cost of all components and subcomponents of the “facility”.
The required documentation for a type 3 waiver is:

Listing of all manufactured products that are not comprised of 100% US domestic content
(Excludes products listed on the FAA Nationwide Buy American Waivers Issued listing
and products excluded by Federal Acquisition Regulation Subpart 25.108; products of
unknown origin must be considered as non-domestic products in their entirety)

Cost of non-domestic components and subcomponents, excluding labor costs associated
with final assembly and installation at project location.

Percentage of non-domestic component and subcomponent cost as compared to total
“facility” component and subcomponent costs, excluding labor costs associated with final
assembly and installation at project location.

Type 4 Waiver - Total cost of project using US domestic source product exceeds the total
project cost using non-domestic product by 25%. The required documentation for a type
4 of waiver is:

- a) Detailed cost information for total project using US domestic product
- b) Detailed cost information for total project using non-domestic product

False Statements: Per 49 USC § 47126, this certification concerns a matter within the
jurisdiction of the Federal Aviation Administration and the making of a false, fictitious or
fraudulent certification may render the maker subject to prosecution under Title 18, United
States Code.

Date

Signature

Company Name

Title

FORM OF NON-COLLUSION AFFIDAVIT

(This Affidavit is Part of the Proposal)

STATE OF _____

COUNTY OF _____

being first duly sworn, deposes and says that he/she is

(Sole owner, a partner, president, secretary, etc.)

of _____
the party making the foregoing Proposal that such Proposal is genuine and not collusive or sham; that said Offeror has not colluded, conspired, connived, or agreed directly or indirectly, with any Offeror or person, to put in a sham Proposal, or that such other person shall refrain from submitting a proposal and has not in any manner, directly or indirectly sought by agreement or collusion, or communication or conference, with any person, to fix the proposal price of affiant or any other Offeror, or to fix any overhead, profit or cost element of said proposal price, or of that of any other Offeror or to secure any advantage against OWNER any person interested in the proposed Contract; and that all statements in said Proposal are true; and further, that such Offeror has not, directly or indirectly submitted this proposal, or the contents thereof, or divulged information or data relative to any association or to any member or agent thereof.

Signature of Offeror

Sworn to and subscribed before me this _____ day of _____, 2019.

(Official Seal)

Official Signature of Notary

_____, Notary Public
Notary's Printed or Typed Name

My Commission expires _____, 20

Appendix Federal Contract Provisions

General

This project is funded in part with federal grant funds under the Airport Improvement Program (AIP) administered by the Federal Aviation Administration (FAA). The Contract Provisions contained herein have been developed from the FAA guidance document entitled “Required Contract Provisions for Airport Improvement Program and for Obligated Sponsors,” dated January 2016. These provisions shall apply to all work of this contract, and shall apply to all subcontracts and sub- agreements as follows:

- 1) The contractor and all subcontractors shall insert these contract provisions in each lower tier contract (e.g. subcontract or sub-agreement).
- 2) The contractor and all subcontractors shall incorporate the applicable requirements of these contract provisions by reference for work done under any purchase orders, rental agreements and other agreements for supplies or services.
- 3) The prime contractor shall be responsible for compliance with these contract provisions by any subcontractor, lower-tier subcontractor or service provider.

Failure to Comply with Provisions

Contractor failure to comply with the terms of these contract provisions may be sufficient grounds to:

- 1) Withhold progress payments or final payment;
- 2) Terminate the contract for cause;
- 3) Seek suspension/debarment; or
- 4) Take other action determined to be appropriate by the sponsor or the FAA.

A – CONTRACT PROVISIONS

A1 to A25

A1 ACCESS TO RECORDS AND REPORTS

A1.1 SOURCE

2 CFR § 200.333

2 CFR § 200.336

FAA Order 5100.38

A1.2 CONTRACT CLAUSE

ACCESS TO RECORDS AND REPORTS

The Contractor must maintain an acceptable cost accounting system. The Contractor agrees to provide the sponsor, the Federal Aviation Administration, and the Comptroller General of the United States or any of their duly authorized representatives, access to any books, documents, papers, and records of the contractor which are directly pertinent to the specific contract for the purpose of making audit, examination, excerpts and transcriptions. The Contractor agrees to maintain all books, records and reports required under this contract for a period of not less than three years after final payment is made and all pending matters are closed.

A2 AFFIRMATIVE ACTION REQUIREMENT

A2.1 SOURCE

41 CFR part 60-4

Executive Order 11246

A2.2 CONTRACT CLAUSE

NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION to ENSURE EQUAL EMPLOYMENT OPPORTUNITY

1. The Offeror's or Bidder's attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Opportunity Construction Contract Specifications" set forth herein.
2. The goals and timetables for minority and female participation, expressed in percentage terms for the contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

Timetables

Goals for minority participation for each trade: 26.2%

Goals for female participation in each trade: 6.9%

These goals are applicable to all of the contractor's construction work (whether or not it is Federal or federally-assisted) performed in the covered area. If the contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for such geographical area where the work is actually performed. With regard to this second area, the contractor also is subject to the goals for both its federally involved and non-federally involved construction.

The Contractor's compliance with the Executive Order and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in 41 CFR 60-4.3(a), and its efforts to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, the Executive Order and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

3. The Contractor shall provide written notification to the Director of the Office of Federal Contract Compliance Programs (OFCCP) within 10 working days of award of any construction subcontract in excess of \$10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the name, address, and telephone number of the subcontractor; employer identification number of the subcontractor; estimated dollar amount of the subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the subcontract is to be performed.

4. As used in this notice and in the contract resulting from this solicitation, the "covered area" is **the City of Fayetteville, Cumberland County, North Carolina.**

A3 BREACH OF CONTRACT TERMS

A3.1 SOURCE

2 CFR § 200 Appendix II(A)

A3.2 CONTRACT CLAUSE

BREACH OF CONTRACT TERMS

Any violation or breach of terms of this contract on the part of the contractor or its subcontractors may result in the suspension or termination of this contract or such other action that may be necessary to enforce the rights of the parties of this agreement.

Owner will provide *Contractor* written notice that describes the nature of the breach and corrective actions the *Contractor* must undertake in order to avoid termination of the contract. Owner reserves the right to withhold payments to Contractor until such time the Contractor corrects the breach or the Owner elects to terminate the contract. The Owner's notice will identify a specific date by which the *Contractor* must correct the breach. Owner may proceed with termination of the contract if the *Contractor* fails to correct the breach by deadline indicated in the Owner's notice.

The duties and obligations imposed by the Contract Documents and the rights and remedies available thereunder are in addition to, and not a limitation of, any duties, obligations, rights and remedies otherwise imposed or available by law.

A4 BUY AMERICAN PREFERENCE

A4.1 SOURCE

Title 49 USC § 50101

A4.2 CONTRACT CLAUSE

A4.2.1 Buy American Preference Statement

BUY AMERICAN PREFERENCE

The contractor agrees to comply with 49 USC § 50101, which provides that Federal funds may not be obligated unless all steel and manufactured goods used in AIP funded projects are produced in the United States, unless the FAA has issued a waiver for the product; the product is listed as an Excepted Article, Material Or Supply in Federal Acquisition Regulation subpart 25.108; or is included in the FAA Nationwide Buy American Waivers Issued list.

A bidder or offeror must complete and submit the Buy America certification included herein with their bid or offer. The Owner will reject as nonresponsive any bid or offer that does not include a completed Certificate of Buy American Compliance.

A4.2.2 Certificate of Buy American Compliance – Total Facility

CERTIFICATE OF BUY AMERICAN COMPLIANCE FOR TOTAL FACILITY

As a matter of bid responsiveness, the bidder or offeror must complete, sign, date, and submit this certification statement with their proposal. The bidder or offeror must indicate how they intend to comply with 49 USC § 50101 by selecting one of the following certification statements. These statements are mutually exclusive. Bidder must select one or the other (i.e. not both) by inserting a checkmark (✓) or the letter “X”.

- ☐ Bidder or offeror hereby certifies that it will comply with 49 USC. 50101 by:
- a) Only installing steel and manufactured products produced in the United States; or
 - b) Installing manufactured products for which the FAA has issued a waiver as indicated by inclusion on the current FAA Nationwide Buy American Waivers Issued listing; or
 - c) Installing products listed as an Excepted Article, Material or Supply in Federal Acquisition Regulation Subpart 25.108.

By selecting this certification statement, the bidder or offeror agrees:

- 1. To provide to the Owner evidence that documents the source and origin of the steel and manufactured product.
- 2. To faithfully comply with providing US domestic products.
- 3. To refrain from seeking a waiver request after establishment of the contract, unless extenuating circumstances emerge that the FAA determines justified.

- ☐ The bidder or offeror hereby certifies it cannot comply with the 100% Buy American Preferences of 49 USC § 50101(a) but may qualify for either a Type 3 or Type 4 waiver under 49 USC § 50101(b). By selecting this certification statement, the apparent bidder or offeror with the apparent low bid agrees:

1. To submit to the Owner within 15 calendar days of the bid opening, a formal waiver request and required documentation that support the type of waiver being requested.
2. That failure to submit the required documentation within the specified timeframe is cause for a non-responsive determination that may result in rejection of the proposal.
3. To faithfully comply with providing US domestic products at or above the approved US domestic content percentage as approved by the FAA.
4. To furnish US domestic product for any waiver request that the FAA rejects.
5. To refrain from seeking a waiver request after establishment of the contract, unless extenuating circumstances emerge that the FAA determines justified.

Required Documentation

Type 3 Waiver - The cost of components and subcomponents produced in the United States is more than 60% of the cost of all components and subcomponents of the “facility”. The required documentation for a type 3 waiver is:

- a) Listing of all manufactured products that are not comprised of 100% US domestic content (Excludes products listed on the FAA Nationwide Buy American Waivers Issued listing and products excluded by Federal Acquisition Regulation Subpart 25.108; products of unknown origin must be considered as non-domestic products in their entirety)
- b) Cost of non-domestic components and subcomponents, excluding labor costs associated with final assembly and installation at project location.
- c) Percentage of non-domestic component and subcomponent cost as compared to total “facility” component and subcomponent costs, excluding labor costs associated with final assembly and installation at project location.

Type 4 Waiver – Total cost of project using US domestic source product exceeds the total project cost using non-domestic product by 25%. The required documentation for a type 4 of waiver is:

- a) Detailed cost information for total project using US domestic product
- b) Detailed cost information for total project using non-domestic product

False Statements: Per 49 USC § 47126, this certification concerns a matter within the jurisdiction of the Federal Aviation Administration and the making of a false, fictitious or fraudulent certification may render the maker subject to prosecution under Title 18, United States Code.

Date

Signature

Company Name

Title

A5 CIVIL RIGHTS - GENERAL

A5.1 SOURCE

49 USC § 47123

A5.2 CONTRACT CLAUSE

A5.2.1 Sponsor Contracts

GENERAL CIVIL RIGHTS PROVISIONS

The contractor agrees to comply with pertinent statutes, Executive Orders and such rules as are promulgated to ensure that no person shall, on the grounds of race, creed, color, national origin, sex, age, or disability be excluded from participating in any activity conducted with or benefiting from Federal assistance.

This provision binds the contractor and subtier contractors from the bid solicitation period through the completion of the contract. This provision is in addition to that required of Title VI of the Civil Rights Act of 1964.

A6 CIVIL RIGHTS – TITLE VI ASSURANCE

A6.1 SOURCE

49 USC § 47123

FAA Order 1400.11

A6.2 CONTRACT CLAUSE

A6.2.1 Title VI Solicitation Notice

Title VI Solicitation Notice:

The **City of Fayetteville**, in accordance with the provisions of Title VI of the Civil Rights Act of 1964 (78 Stat. 252, 42 U.S.C. §§ 2000d to 2000d-4) and the Regulations, hereby notifies all bidders that it will affirmatively ensure that any contract entered into pursuant to this advertisement, disadvantaged business enterprises will be afforded full and fair opportunity to submit bids in response to this invitation and will not be discriminated against on the grounds of race, color, or national origin in consideration for an award.

A6.2.2 Title VI Clauses for Compliance with Nondiscrimination Requirements

Compliance with Nondiscrimination Requirements

During the performance of this contract, the contractor, for itself, its assignees, and successors in interest (hereinafter referred to as the “contractor”) agrees as follows:

1. **Compliance with Regulations:** The contractor (hereinafter includes consultants) will comply with the Title VI List of Pertinent Nondiscrimination Acts And Authorities, as they may be amended from time to time, which are herein incorporated by reference and made a part of this contract.
2. **Non-discrimination:** The contractor, with regard to the work performed by it during the contract, will not discriminate on the grounds of race, color, or national origin in the selection and retention of subcontractors, including procurements of materials and leases of equipment. The contractor will not participate directly or indirectly in the discrimination prohibited by the Nondiscrimination Acts and Authorities, including employment practices when the contract covers any activity, project, or program set forth in Appendix B of 49 CFR part 21.
3. **Solicitations for Subcontracts, Including Procurements of Materials and Equipment:** In all solicitations, either by competitive bidding, or negotiation made by the contractor for work to be performed under a subcontract, including procurements of materials, or leases of equipment, each potential subcontractor or supplier will be notified by the contractor of the contractor’s obligations under this contract and the Nondiscrimination Acts And Authorities on the grounds of race, color, or national origin.
4. **Information and Reports:** The contractor will provide all information and reports required by the Acts, the Regulations, and directives issued pursuant thereto and will permit access to its books, records, accounts, other sources of information, and its facilities as may be determined by the sponsor or the Federal Aviation Administration to be pertinent to ascertain compliance with such Nondiscrimination Acts And Authorities and instructions. Where any information required of a contractor is in the exclusive possession of another who fails or refuses to furnish the information, the contractor will so certify to the sponsor or the Federal Aviation Administration, as appropriate, and will set forth what efforts it has made to obtain the information.
5. **Sanctions for Noncompliance:** In the event of a contractor’s noncompliance with the Non-discrimination provisions of this contract, the sponsor will impose such contract sanctions as it or the Federal Aviation Administration may determine to be appropriate, including, but not limited to:
 - a. Withholding payments to the contractor under the contract until the contractor complies; and/or
 - b. Cancelling, terminating, or suspending a contract, in whole or in part.

6. **Incorporation of Provisions:** The contractor will include the provisions of paragraphs one through six in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Acts, the Regulations and directives issued pursuant thereto. The contractor will take action with respect to any subcontract or procurement as the sponsor or the Federal Aviation Administration may direct as a means of enforcing such provisions including sanctions for noncompliance. Provided, that if the contractor becomes involved in, or is threatened with litigation by a subcontractor, or supplier because of such direction, the contractor may request the sponsor to enter into any litigation to protect the interests of the sponsor. In addition, the contractor may request the United States to enter into the litigation to protect the interests of the United States.

A6.2.3 Title VI List of Pertinent Nondiscrimination Acts and Authorities

Title VI List of Pertinent Nondiscrimination Acts and Authorities

During the performance of this contract, the contractor, for itself, its assignees, and successors in interest (hereinafter referred to as the “contractor”) agrees to comply with the following non-discrimination statutes and authorities; including but not limited to:

- Title VI of the Civil Rights Act of 1964 (42 U.S.C. § 2000d *et seq.*, 78 stat. 252), (prohibits discrimination on the basis of race, color, national origin);
- 49 CFR part 21 (Non-discrimination In Federally-Assisted Programs of The Department of Transportation—Effectuation of Title VI of The Civil Rights Act of 1964);
- The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, (42 U.S.C. § 4601), (prohibits unfair treatment of persons displaced or whose property has been acquired because of Federal or Federal-aid programs and projects);
- Section 504 of the Rehabilitation Act of 1973, (29 U.S.C. § 794 *et seq.*), as amended, (prohibits discrimination on the basis of disability); and 49 CFR part 27;
- The Age Discrimination Act of 1975, as amended, (42 U.S.C. § 6101 *et seq.*), (prohibits discrimination on the basis of age);
- Airport and Airway Improvement Act of 1982, (49 USC § 471, Section 47123), as amended, (prohibits discrimination based on race, creed, color, national origin, or sex);
- The Civil Rights Restoration Act of 1987, (PL 100-209), (Broadened the scope, coverage and applicability of Title VI of the Civil Rights Act of 1964, The Age Discrimination Act of 1975 and Section 504 of the Rehabilitation Act of 1973, by expanding the definition of the terms “programs or activities” to include all of the programs or activities of the Federal-aid recipients, sub-recipients and contractors, whether such programs or activities are Federally funded or not);
- Titles II and III of the Americans with Disabilities Act of 1990, which prohibit discrimination on the basis of disability in the operation of public entities, public and private transportation systems, places of public accommodation, and certain testing entities (42 U.S.C. §§ 12131 – 12189) as implemented by Department of Transportation regulations at 49 CFR parts 37 and 38;
- The Federal Aviation Administration’s Non-discrimination statute (49 U.S.C. § 47123) (prohibits discrimination on the basis of race, color, national origin, and sex);
- Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, which ensures non-discrimination against minority populations by discouraging programs, policies, and activities with disproportionately high and adverse human health or environmental effects on minority and low-income populations;
- Executive Order 13166, Improving Access to Services for Persons with Limited English Proficiency, and resulting agency guidance, national origin discrimination includes discrimination because of limited English proficiency (LEP). To ensure compliance with Title VI, you must take reasonable steps to ensure that LEP persons have meaningful access to your programs (70 Fed. Reg. at 74087 to 74100);

- Title IX of the Education Amendments of 1972, as amended, which prohibits you from discriminating because of sex in education programs or activities (20 U.S.C. 1681 et seq).

A7 CLEAN AIR AND WATER POLLUTION CONTROL

A7.1 SOURCE

2 CFR § 200, Appendix II(G)

A7.2 CONTRACT CLAUSE

CLEAN AIR AND WATER POLLUTION CONTROL

Contractor agrees to comply with all applicable standards, orders, and regulations issued pursuant to the Clean Air Act (42 U.S.C. § 740-7671q) and the Federal Water Pollution Control Act as amended (33 U.S.C. § 1251-1387). The Contractor agrees to report any violation to the Owner immediately upon discovery. The Owner assumes responsibility for notifying the Environmental Protection Agency (EPA) and the Federal Aviation Administration.

Contractor must include this requirement in all subcontracts that exceeds \$150,000.

A8 CONTRACT WORKHOURS AND SAFETY STANDARDS ACT REQUIREMENTS

A8.1 SOURCE

2 CFR § 200, Appendix II(E)

A8.2 CONTRACT CLAUSE

CONTRACT WORKHOURS AND SAFETY STANDARDS ACT REQUIREMENTS

1. Overtime Requirements.

No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic, including watchmen and guards, in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

2. Violation; Liability for Unpaid Wages; Liquidated Damages.

In the event of any violation of the clause set forth in paragraph (1) of this clause, the contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (1) of this clause, in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (1) of this clause.

3. Withholding for Unpaid Wages and Liquidated Damages.

The Federal Aviation Administration (FAA) or the Owner shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other Federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph 2 of this clause.

4. Subcontractors.

The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraphs (1) through (4) and also a clause requiring the subcontractor to include these clauses in any lower tier

subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (1) through (4) of this clause.

A9 COPELAND “ANTI-KICKBACK” ACT

A9.1 SOURCE

2 CFR § 200, Appendix II(D)

29 CFR Parts 3 & 5

A9.2 CONTRACT CLAUSE

COPELAND “ANTI-KICKBACK” ACT

Contractor must comply with the requirements of the Copeland “Anti-Kickback” Act (18 U.S.C. 874 and 40 U.S.C. 3145), as supplemented by Department of Labor regulation 29 CFR part 3. Contractor and subcontractors are prohibited from inducing, by any means, any person employed on the project to give up any part of the compensation to which the employee is entitled. The Contractor and each Subcontractor must submit to the Owner, a weekly statement on the wages paid to each employee performing on covered work during the prior week. Owner must report any violations of the Act to the Federal Aviation Administration.

A10 DAVIS-BACON REQUIREMENTS

A10.1 SOURCE

2 CFR § 200, Appendix II(D)

29 CFR Part 5

A10.2 CONTRACT CLAUSE

DAVIS-BACON REQUIREMENTS

1. Minimum Wages

(i) All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by the Secretary of Labor under the Copeland Act (29 CFR Part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalent thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in 29 CFR Part 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: *Provided*, that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under (1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can easily be seen by the workers.

(ii)(A) The contracting officer shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The contracting officer shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

(1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(2) The classification is utilized in the area by the construction industry; and

(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(B) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, D.C. 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(C) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to subparagraphs (1)(ii) (B) or (C) of this paragraph, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, *Provided*, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

2 Withholding.

The Federal Aviation Administration or the sponsor shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld from the contractor under this contract or any other Federal contract with the same prime contractor, or any other Federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of work, all or part of the wages required by the contract, the Federal Aviation Administration may, after

written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

3. Payrolls and basic records.

(i) Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual costs incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(ii)(A) The contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the Federal Aviation Administration if the agency is a party to the contract, but if the agency is not such a party, the contractor will submit the payrolls to the applicant, sponsor, or owner, as the case may be, for transmission to the Federal Aviation Administration. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead the payrolls shall only need to include an individually identifying number for each employee (*e.g.* , the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at <http://www.dol.gov/esa/whd/forms/wh347instr.htm> or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the Federal Aviation Administration if the agency is a party to the contract, but if the agency is not such a party, the contractor will submit them to the applicant, sponsor, or owner, as the case may be, for transmission to the Federal Aviation Administration, the contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the sponsoring government agency (or the applicant, sponsor, or owner).

(B) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be provided under 29 CFR § 5.5(a)(3)(ii), the appropriate information is being maintained under 29 CFR § 5.5 (a)(3)(i) and that such information is correct and complete;

(2) That each laborer and mechanic (including each helper, apprentice and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations 29 CFR Part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph (3)(ii)(B) of this section.

(D) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under Section 1001 of Title 18 and Section 231 of Title 31 of the United States Code.

(iii) The contractor or subcontractor shall make the records required under paragraph (3)(i) of this section available for inspection, copying or transcription by authorized representatives of the sponsor, the Federal Aviation Administration or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the Federal agency may, after written notice to the contractor, sponsor, applicant or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

4. Apprentices and Trainees.

(i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Bureau of Apprenticeship and Training, or with a State Apprenticeship Agency recognized by the Bureau, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Bureau of Apprenticeship and Training or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the

registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Bureau of Apprenticeship and Training, or a State Apprenticeship Agency recognized by the Bureau, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate that is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) Equal Employment Opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR Part 30.

5. Compliance with Copeland Act Requirements.

The contractor shall comply with the requirements of 29 CFR Part 3, which are incorporated by reference in this contract.

6. Subcontracts.

The contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR Part 5.5(a)(1) through (10) and such other clauses as the Federal Aviation Administration may by appropriate instructions require, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR Part 5.5.

7. Contract Termination: Debarment.

A breach of the contract clauses in paragraph 1 through 10 of this section may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

8. Compliance With Davis-Bacon and Related Act Requirements.

All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR Parts 1, 3, and 5 are herein incorporated by reference in this contract.

9. Disputes Concerning Labor Standards.

Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR Parts 5, 6 and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

10. Certification of Eligibility.

(i) By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

General Decision Number: **NC160025 01/08/2016** NC25

Superseded General Decision Number: NC20150025

State: North Carolina

Construction Type: Building

County: Cumberland County in North Carolina.

BUILDING CONSTRUCTION PROJECTS (does not include single family homes or apartments up to and including 4 stories).

Note: Under Executive Order (EO) 13658, an hourly minimum wage of \$10.15 for calendar year 2016 applies to all contracts subject to the Davis-Bacon Act for which the solicitation was issued on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least \$10.15 (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2016. The EO minimum wage rate will be adjusted annually. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number Publication Date
0 01/08/2016

CARP0312-001 05/01/2013

	Rates	Fringes
CARPENTER, Excludes Drywall Hanging, and Form Work.....	\$ 22.85	8.25

* IRON0848-005 12/01/2014

	Rates	Fringes
IRONWORKER, STRUCTURAL.....	\$ 23.00	12.00

PLUM0421-001 07/01/2013

	Rates	Fringes
PLUMBER/PIPEFITTER.....	\$ 24.85	9.65

SUNC2011-006 08/24/2011

	Rates	Fringes
BRICKLAYER	\$ 19.00	0.00
CARPENTER (Drywall Hanging Only)	\$ 13.83	0.00
CARPENTER (Form Work Only)	\$ 13.38	1.80
CEMENT MASON/CONCRETE FINISHER.....	\$ 15.80	0.00
ELECTRICIAN	\$ 20.64	6.68
HVAC MECHANIC (HVAC Duct Installation Only)	\$ 17.37	1.82
LABORER: Common or General	\$ 10.54	0.52
LABORER: Landscape & Irrigation.....	\$ 9.13	0.28
LABORER: Pipelayer.....	\$ 13.35	2.80
LABORER: Mason Tender-Brick/Cement/Concrete	\$ 12.00	0.00
OPERATOR: Backhoe/Excavator/Trackhoe.....	\$ 18.47	2.41
OPERATOR: Bulldozer	\$ 16.00	1.87
OPERATOR: Crane	\$ 19.77	4.48
OPERATOR: Forklift	\$ 13.86	0.00
OPERATOR: Grader/Blade.....	\$ 15.72	1.49
OPERATOR: Loader.....	\$ 16.17	0.25
PAINTER: Brush, Roller and Spray	\$ 12.35	0.00
ROOFER.....	\$ 11.75	1.06

SHEET METAL WORKER, Excludes HVAC Duct Installation	\$ 15.81	1.40
TRUCK DRIVER	\$ 13.38	1.48

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than "SU" or "UAVG" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the "SU" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- an existing published wage determination
- a survey underlying a wage determination
- a Wage and Hour Division letter setting forth a position on a wage determination matter
- a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

END OF GENERAL DECISION

A11 DEBARMENT AND SUSPENSION

A11.1 SOURCE

2 CFR part 180 (Subpart C)

2 CFR part 1200

DOT Order 4200.5

A11.2 CONTRACT CLAUSE

A11.2.1 Bidder or Offeror Certification

CERTIFICATION OF OFFERER/BIDDER REGARDING DEBARMENT

By submitting a bid/proposal under this solicitation, the bidder or offeror certifies that neither it nor its principals are presently debarred or suspended by any Federal department or agency from participation in this transaction.

A11.2.2 Lower Tier Contract Certification

CERTIFICATION OF LOWER TIER CONTRACTORS REGARDING DEBARMENT

The successful bidder, by administering each lower tier subcontract that exceeds \$25,000 as a “covered transaction”, must verify each lower tier participant of a “covered transaction” under the project is not presently debarred or otherwise disqualified from participation in this federally assisted project. The successful bidder will accomplish this by:

1. Checking the System for Award Management at website: <http://www.sam.gov>
2. Collecting a certification statement similar to the Certificate Regarding Debarment and Suspension (Bidder or Offeror), above.
3. Inserting a clause or condition in the covered transaction with the lower tier contract

If the FAA later determines that a lower tier participant failed to disclose to a higher tier participant that it was excluded or disqualified at the time it entered the covered transaction, the FAA may pursue any available remedies, including suspension and debarment of the non-compliant participant.

A12 DISADVANTAGED BUSINESS ENTERPRISE

A12.1 SOURCE

49 CFR part 26

A12.2 CONTRACT PROVISIONS

A12.2.1 Solicitation Language (Project Goal)

The Owner's award of this contract is conditioned upon Bidder or Offeror satisfying the good faith effort requirements of 49 CFR §26.53.

As a condition of bid responsiveness, the Bidder or Offeror must submit the following information with their proposal on the forms provided herein:

- (1) The names and addresses of Disadvantaged Business Enterprise (DBE) firms that will participate in the contract;
- (2) A description of the work that each DBE firm will perform;
- (3) The dollar amount of the participation of each DBE firm listed under (1)
- (4) Written statement from Bidder or Offeror that attests their commitment to use the DBE firm(s) listed under (1) to meet the Owner's project goal;
- (5) If Bidder or Offeror cannot meet the advertised project DBE goal; evidence of good faith efforts undertaken by the Bidder or Offeror as described in appendix A to 49 CFR Part 26.

The successful Bidder or Offeror must provide written confirmation of participation from each of the DBE firms the Bidder or Offeror lists in their commitment. This Bidder or Offeror must submit the DBE's written confirmation of participation within 5 days of receiving the Owners notice of award.

A12.2.2 Contract Clause

DISADVANTAGED BUSINESS ENTERPRISES

Contract Assurance (§ 26.13) - The contractor or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of DOT assisted contracts. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy, as the recipient deems appropriate.

Prompt Payment (§26.29) - The prime contractor agrees to pay each subcontractor under this prime contract for satisfactory performance of its contract no later than 30 days from the receipt of each payment the prime contractor receives from the City of Fayetteville. The prime contractor agrees further to return retainage payments to each subcontractor within 30 days after the subcontractor's work is satisfactorily completed. Any delay or postponement of payment from the above referenced time frame

may occur only for good cause following written approval of the City of Fayetteville. This clause applies to both DBE and non-DBE subcontractors.

A12.2.3 RACE/GENDER NEUTRAL LANGUAGE

The requirements of 49 CFR part 26 apply to this contract. It is the policy of the City of Fayetteville to practice nondiscrimination based on race, color, sex or national origin in the award or performance of this contract. The Owner encourages participation by all firms qualifying under this solicitation regardless of business size or ownership.

A13 DISTRACTED DRIVING

A13.1 SOURCE

Executive Order 13513

DOT Order 3902.10

A13.2 CONTRACT CLAUSE

TEXTING WHEN DRIVING

In accordance with Executive Order 13513, "Federal Leadership on Reducing Text Messaging While Driving" (10/1/2009) and DOT Order 3902.10 "Text Messaging While Driving" (12/30/2009), the FAA encourages recipients of Federal grant funds to adopt and enforce safety policies that decrease crashes by distracted drivers, including policies to ban text messaging while driving when performing work related to a grant or sub-grant.

In support of this initiative, the Owner encourages the Contractor to promote policies and initiatives for its employees and other work personnel that decrease crashes by distracted drivers, including policies that ban text messaging while driving motor vehicles while performing work activities associated with the project. The Contractor must include the substance of this clause in all sub-tier contracts exceeding \$3,500 and involve driving a motor vehicle in performance of work activities associated with the project.

A14 ENERGY CONSERVATION REQUIREMENTS

A14.1 SOURCE

2 CFR § 200, Appendix II(H)

A14.2 CONTRACT CLAUSE

ENERGY CONSERVATION REQUIREMENTS

Contractor and Subcontractor agree to comply with mandatory standards and policies relating to energy efficiency as contained in the state energy conservation plan issued in compliance with the Energy Policy and Conservation Act (42 U.S.C. 6201*et seq*).

A15 EQUAL EMPLOYMENT OPPORTUNITY (E.E.O.)

A15.1 SOURCE

2 CFR 200, Appendix II(C)

41 CFR § 60-1.4

41 CFR § 60-4.3

Executive Order 11246

A15.2 MANDATORY CONTRACT CLAUSE

A15.2.1 E.E.O. Contract Clause

EQUAL OPPORTUNITY CLAUSE

During the performance of this contract, the contractor agrees as follows:

(1) The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, sexual orientation, gender identity or national origin. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.

(2) The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive considerations for employment without regard to race, color, religion, sex, or national origin.

(3) The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the said labor union or workers' representatives of the contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(4) The contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.

(5) The contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the administering agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

(6) In the event of the contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this contract may be canceled, terminated, or

suspended in whole or in part and the contractor may be declared ineligible for further Government contracts or federally assisted construction contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

(7) The contractor will include the portion of the sentence immediately preceding paragraph (1) and the provisions of paragraphs (1) through (7) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance: *Provided, however*, That in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the administering agency the contractor may request the United States to enter into such litigation to protect the interests of the United States.

A15.2.2 EEO Specification

STANDARD FEDERAL EQUAL EMPLOYMENT OPPORTUNITY CONSTRUCTION CONTRACT SPECIFICATIONS

1. As used in these specifications:

- a. "Covered area" means the geographical area described in the solicitation from which this contract resulted;
- b. "Director" means Director, Office of Federal Contract Compliance Programs (OFCCP), U.S. Department of Labor, or any person to whom the Director delegates authority;
- c. "Employer identification number" means the Federal social security number used on the Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941;
- d. "Minority" includes:
 - (1) Black (all) persons having origins in any of the Black African racial groups not of Hispanic origin);
 - (2) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin regardless of race);
 - (3) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); and
 - (4) American Indian or Alaskan native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).

2. Whenever the contractor, or any subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of \$10,000 the

provisions of these specifications and the Notice which contains the applicable goals for minority and female participation and which is set forth in the solicitations from which this contract resulted.

3. If the contractor is participating (pursuant to 41 CFR 60-4.5) in a Hometown Plan approved by the U.S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area (including goals and timetables) shall be in accordance with that Plan for those trades which have unions participating in the Plan. Contractors shall be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each contractor or subcontractor participating in an approved plan is individually required to comply with its obligations under the EEO clause and to make a good faith effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other contractors or subcontractors toward a goal in an approved Plan does not excuse any covered contractor's or subcontractor's failure to take good faith efforts to achieve the Plan goals and timetables.

4. The contractor shall implement the specific affirmative action standards provided in paragraphs 7a through 7p of these specifications. The goals set forth in the solicitation from which this contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. Covered construction contractors performing construction work in a geographical area where they do not have a Federal or federally assisted construction contract shall apply the minority and female goals established for the geographical area where the work is being performed. Goals are published periodically in the Federal Register in notice form, and such notices may be obtained from any Office of Federal Contract Compliance Programs office or from Federal procurement contracting officers. The contractor is expected to make substantially uniform progress in meeting its goals in each craft during the period specified.

5. Neither the provisions of any collective bargaining agreement nor the failure by a union with whom the contractor has a collective bargaining agreement to refer either minorities or women shall excuse the contractor's obligations under these specifications, Executive Order 11246 or the regulations promulgated pursuant thereto.

6. In order for the non-working training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees shall be employed by the contractor during the training period and the contractor shall have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees shall be trained pursuant to training programs approved by the U.S. Department of Labor.

7. The contractor shall take specific affirmative actions to ensure equal employment opportunity. The evaluation of the contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The contractor shall document these efforts fully and shall implement affirmative action steps at least as extensive as the following:

- a. Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which the contractor's employees are assigned to work. The contractor, where possible, will assign two or more women to each construction project. The contractor shall specifically ensure that all foremen, superintendents, and other onsite supervisory personnel are

aware of and carry out the contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at such sites or in such facilities.

b. Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.

c. Maintain a current file of the names, addresses, and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source, or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the contractor by the union or, if referred, not employed by the contractor, this shall be documented in the file with the reason therefore along with whatever additional actions the contractor may have taken.

d. Provide immediate written notification to the Director when the union or unions with which the contractor has a collective bargaining agreement has not referred to the contractor a minority person or female sent by the contractor, or when the contractor has other information that the union referral process has impeded the contractor's efforts to meet its obligations.

e. Develop on-the-job training opportunities and/or participate in training programs for the area which expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the contractor's employment needs, especially those programs funded or approved by the Department of Labor. The contractor shall provide notice of these programs to the sources compiled under 7b above.

f. Disseminate the contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the contractor in meeting its EEO obligations; by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.

g. Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination, or other employment decisions including specific review of these items with onsite supervisory personnel such as superintendents, general foremen, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.

h. Disseminate the contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the contractor's EEO policy with other contractors and subcontractors with whom the contractor does or anticipates doing business.

- i. Direct its recruitment efforts, both oral and written, to minority, female, and community organizations, to schools with minority and female students; and to minority and female recruitment and training organizations serving the contractor's recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the contractor shall send written notification to organizations, such as the above, describing the openings, screening procedures, and tests to be used in the selection process.
 - j. Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer, and vacation employment to minority and female youth both on the site and in other areas of a contractor's workforce.
 - k. Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR Part 60-3.
 - l. Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel, for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.
 - m. Ensure that seniority practices, job classifications, work assignments, and other personnel practices do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the EEO policy and the contractor's obligations under these specifications are being carried out.
 - n. Ensure that all facilities and company activities are non-segregated except that separate or single user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.
 - o. Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.
 - p. Conduct a review, at least annually, of all supervisor's adherence to and performance under the contractor's EEO policies and affirmative action obligations.
8. Contractors are encouraged to participate in voluntary associations, which assist in fulfilling one or more of their affirmative action obligations (7a through 7p). The efforts of a contractor association, joint contractor union, contractor community, or other similar groups of which the contractor is a member and participant, may be asserted as fulfilling any one or more of its obligations under 7a through 7p of these specifications provided that the contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the contractor's minority and female workforce participation, makes a good faith effort to meet its individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the contractor. The obligation to comply, however, is the contractor's and failure of such a group to fulfill an obligation shall not be a defense for the contractor's noncompliance.
9. A single goal for minorities and a separate single goal for women have been established. The contractor, however, is required to provide equal employment opportunity and to take affirmative action

for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, if the particular group is employed in a substantially disparate manner (for example, even though the contractor has achieved its goals for women generally,) the contractor may be in violation of the Executive Order if a specific minority group of women is underutilized.

10. The contractor shall not use the goals and timetables or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.

11. The contractor shall not enter into any subcontract with any person or firm debarred from Government contracts pursuant to Executive Order 11246.

12. The contractor shall carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause, including suspension, termination, and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Office of Federal Contract Compliance Programs. Any contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order 11246, as amended.

13. The contractor, in fulfilling its obligations under these specifications, shall implement specific affirmative action steps, at least as extensive as those standards prescribed in paragraph 7 of these specifications, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the Director shall proceed in accordance with 41 CFR 60-4.8.

14. The contractor shall designate a responsible official to monitor all employment related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the Government, and to keep records. Records shall at least include for each employee, the name, address, telephone number, construction trade, union affiliation if any, employee identification number when assigned, social security number, race, sex, status (e.g., mechanic, apprentice, trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.

15. Nothing herein provided shall be construed as a limitation upon the application of other laws which establish different standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

A16 FEDERAL FAIR LABOR STANDARDS ACT (FEDERAL MINIMUM WAGE)

A16.1 SOURCE

29 U.S.C. § 201, et seq

A16.2 CONTRACT CLAUSE

All contracts and subcontracts that result from this solicitation incorporate by reference the provisions of 29 CFR part 201, the Federal Fair Labor Standards Act (FLSA), with the same force and effect as if given in full text. The FLSA sets minimum wage, overtime pay, recordkeeping, and child labor standards for full and part time workers.

The *contractor* has full responsibility to monitor compliance to the referenced statute or regulation. The *contractor* must address any claims or disputes that arise from this requirement directly with the U.S. Department of Labor – Wage and Hour Division

A17 LOBBYING AND INFLUENCING FEDERAL EMPLOYEES

A17.1 SOURCE

31 U.S.C. § 1352 – Byrd Anti-Lobbying Amendment

2 CFR part 200, Appendix II(J)

49 CFR part 20, Appendix A

A17.2 CONTRACT CLAUSE

CERTIFICATION REGARDING LOBBYING

The bidder or offeror certifies by signing and submitting this bid or proposal, to the best of his or her knowledge and belief, that:

- (1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the Bidder or Offeror, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
- (2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, “Disclosure Form to Report Lobbying,” in accordance with its instructions.
- (3) The undersigned shall require that the language of this certification be included in the award documents for all sub-awards at all tiers (including subcontracts, sub-grants, and contracts under grants, loans, and cooperative agreements) and that all sub-recipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

A18 PROHIBITION of SEGREGATED FACILITIES

A18.1 SOURCE

41 CFR § 60

A18.2 CONTRACT CLAUSE

PROHIBITION of SEGREGATED FACILITIES

(a) The Contractor agrees that it does not and will not maintain or provide for its employees any segregated facilities at any of its establishments, and that it does not and will not permit its employees to perform their services at any location under its control where segregated facilities are maintained. The Contractor agrees that a breach of this clause is a violation of the Equal Opportunity clause in this contract.

(b) “Segregated facilities,” as used in this clause, means any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees, that are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, sex, or national origin because of written or oral policies or employee custom. The term does not include separate or single-user rest rooms or necessary dressing or sleeping areas provided to assure privacy between the sexes.

(c) The Contractor shall include this clause in every subcontract and purchase order that is subject to the Equal Opportunity clause of this contract.

A19 OCCUPATIONAL SAFETY AND HEALTH ACT OF 1970

A19.1 SOURCE

20 CFR part 1910

A19.2 CONTRACT CLAUSE

All contracts and subcontracts that result from this solicitation incorporate by reference the requirements of 29 CFR Part 1910 with the same force and effect as if given in full text. Contractor must provide a work environment that is free from recognized hazards that may cause death or serious physical harm to the employee. The Contractor retains full responsibility to monitor its compliance and their subcontractor's compliance with the applicable requirements of the Occupational Safety and Health Act of 1970 (20 CFR Part 1910). Contractor must address any claims or disputes that pertain to a referenced requirement directly with the U.S. Department of Labor – Occupational Safety and Health Administration.

A20 PROCUREMENT OF RECOVERED MATERIALS

A20.1 SOURCE

2 CFR § 200.322

40 CFR part 247

A20.2 CONTRACT CLAUSE

Procurement of Recovered Materials

Contractor and subcontractor agree to comply with Section 6002 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act, and the regulatory provisions of 40 CFR Part 247. In the performance of this contract and to the extent practicable, the Contractor and subcontractors are to use of products containing the highest percentage of recovered materials for items designated by the Environmental Protection Agency (EPA) under 40 CFR Part 247 whenever:

- a) The contract requires procurement of \$10,000 or more of a designated item during the fiscal year; or,
- b) The contractor has procured \$10,000 or more of a designated item using Federal funding during the previous fiscal year.

The list of EPA-designated items is available at www.epa.gov/epawaste/conserve/tools/cpg/products/.

Section 6002(c) establishes exceptions to the preference for recovery of EPA-designated products if the contractor can demonstrate the item is:

- a) Not reasonably available within a timeframe providing for compliance with the contract performance schedule;
- b) Fails to meet reasonable contract performance requirements; or
- c) Is only available at an unreasonable price.

A21 RIGHT TO INVENTIONS

A21.1 SOURCE

2 CFR § 200, Appendix II(F)

37 CFR §401

A21.2 CONTRACT CLAUSE

RIGHTS TO INVENTIONS

Contracts or agreements that include the performance of experimental, developmental, or research work must provide for the rights of the Federal Government and the Owner in any resulting invention as established by 37 CFR part 401, Rights to Inventions Made by Non-profit Organizations and Small Business Firms under Government Grants, Contracts, and Cooperative Agreements. This contract incorporates by reference the patent and inventions rights as specified within in the 37 CFR §401.14. Contractor must include this requirement in all sub-tier contracts involving experimental, developmental or research work.

A22 SEISMIC SAFETY

A22.1 SOURCE

49 CFR part 41

A22.2 CONTRACT CLAUSE

A22.2.1 Construction Contracts

Seismic Safety

The contractor agrees to ensure that all work performed under this contract, including work performed by subcontractors, conforms to a building code standard that provides a level of seismic safety substantially equivalent to standards established by the National Earthquake Hazards Reduction Program (NEHRP). Local building codes that model their code after the current version of the International Building Code (IBC) meet the NEHRP equivalency level for seismic safety.

A23 TERMINATION OF CONTRACT

A23.1 SOURCE

2 CFR § 200 Appendix II(B)

FAA Advisory Circular 150/5370-10, Section 80-09

A23.2 CONTRACT CLAUSE

A23.2.1 Termination for Convenience

Termination for Convenience (Construction & Equipment Contracts)

The Owner may terminate this contract in whole or in part at any time by providing written notice to the Contractor. Such action may be without cause and without prejudice to any other right or remedy of Owner. Upon receipt of a written notice of termination, except as explicitly directed by the Owner, the Contractor shall immediately proceed with the following obligations regardless of any delay in determining or adjusting amounts due under this clause:

1. Contractor must immediately discontinue work as specified in the written notice.
2. Terminate all subcontracts to the extent they relate to the work terminated under the notice.
3. Discontinue orders for materials and services except as directed by the written notice.
4. Deliver to the owner all fabricated and partially fabricated parts, completed and partially completed work, supplies, equipment and materials acquired prior to termination of the work and as directed in the written notice.
5. Complete performance of the work not terminated by the notice.
6. Take action as directed by the owner to protect and preserve property and work related to this contract that Owner will take possession.

Owner agrees to pay Contractor for:

- a) completed and acceptable work executed in accordance with the contract documents prior to the effective date of termination;
- b) documented expenses sustained prior to the effective date of termination in performing work and furnishing labor, materials, or equipment as required by the contract documents in connection with uncompleted work;
- c) reasonable and substantiated claims, costs and damages incurred in settlement of terminated contracts with Subcontractors and Suppliers; and
- d) reasonable and substantiated expenses to the contractor directly attributable to Owner's termination action

Owner will not pay Contractor for loss of anticipated profits or revenue or other economic loss arising out of or resulting from the Owner's termination action.

The rights and remedies this clause provides are in addition to any other rights and remedies provided by law or under this contract.

A23.2.2 Termination for Default

Termination for Default (Construction)

Section 80-09 of FAA Advisory Circular 150/5370-10 establishes conditions, rights and remedies associated with Owner termination of this contract due default of the Contractor.

Termination for Default (Equipment)

The Owner may, by written notice of default to the Contractor, terminate all or part of this Contract if the Contractor:

1. Fails to commence the Work under the Contract within the time specified in the Notice- to-Proceed;
2. Fails to make adequate progress as to endanger performance of this Contract in accordance with its terms;
3. Fails to make delivery of the equipment within the time specified in the Contract, including any Owner approved extensions;
4. Fails to comply with material provisions of the Contract;
5. Submits certifications made under the Contract and as part of their proposal that include false or fraudulent statements;
6. Becomes insolvent or declares bankruptcy;

If one or more of the stated events occur, the Owner will give notice in writing to the Contractor and Surety of its intent to terminate the contract for cause. At the Owner's discretion, the notice may allow the Contractor and Surety an opportunity to cure the breach or default.

If within [10] days of the receipt of notice, the Contractor or Surety fails to remedy the breach or default to the satisfaction of the Owner, the Owner has authority to acquire equipment by other procurement action. The Contractor will be liable to the Owner for any excess costs the Owner incurs for acquiring such similar equipment.

Payment for completed equipment delivered to and accepted by the Owner shall be at the Contract price. The Owner may withhold from amounts otherwise due the Contractor for such completed equipment, such sum as the Owner determines to be necessary to protect the Owner against loss because of Contractor default.

Owner will not terminate the Contractor's right to proceed with the Work under this clause if the delay in completing the work arises from unforeseeable causes beyond the control and without the fault or negligence of the Contractor. Examples of such acceptable causes include: acts of God, acts of the Owner, acts of another Contractor in the performance of a contract with the Owner, and severe weather events that substantially exceed normal conditions for the location.

If, after termination of the Contractor's right to proceed, the Owner determines that the Contractor was not in default, or that the delay was excusable, the rights and obligations of the parties will be the same as if the Owner issued the termination for the convenience the Owner.

The rights and remedies of the Owner in this clause are in addition to any other rights and remedies provided by law or under this contract.

A24 TRADE RESTRICTION CERTIFICATION

A24.1 SOURCE

49 USC § 50104

49 CFR part 30

A24.2 CONTRACT CLAUSE

TRADE RESTRICTION CERTIFICATION

By submission of an offer, the Offeror certifies that with respect to this solicitation and any resultant contract, the Offeror -

- a. is not owned or controlled by one or more citizens of a foreign country included in the list of countries that discriminate against U.S. firms as published by the Office of the United States Trade Representative (U.S.T.R.);
- b. has not knowingly entered into any contract or subcontract for this project with a person that is a citizen or national of a foreign country included on the list of countries that discriminate against U.S. firms as published by the U.S.T.R; and
- c. has not entered into any subcontract for any product to be used on the Federal on the project that is produced in a foreign country included on the list of countries that discriminate against U.S. firms published by the U.S.T.R.

This certification concerns a matter within the jurisdiction of an agency of the United States of America and the making of a false, fictitious, or fraudulent certification may render the maker subject to prosecution under Title 18, United States Code, Section 1001.

The Offeror/Contractor must provide immediate written notice to the Owner if the Offeror/Contractor learns that its certification or that of a subcontractor was erroneous when submitted or has become erroneous by reason of changed circumstances. The Contractor must require subcontractors provide immediate written notice to the Contractor if at any time it learns that its certification was erroneous by reason of changed circumstances.

Unless the restrictions of this clause are waived by the Secretary of Transportation in accordance with 49 CFR 30.17, no contract shall be awarded to an Offeror or subcontractor:

- (1) who is owned or controlled by one or more citizens or nationals of a foreign country included on the list of countries that discriminate against U.S. firms published by the U.S.T.R. or
- (2) whose subcontractors are owned or controlled by one or more citizens or nationals of a foreign country on such U.S.T.R. list or
- (3) who incorporates in the public works project any product of a foreign country on such U.S.T.R. list;

Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render, in good faith, the certification required by this provision. The knowledge and information of a contractor is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

The Offeror agrees that, if awarded a contract resulting from this solicitation, it will incorporate this provision for certification without modification in all lower tier subcontracts. The contractor may rely on the certification of a prospective subcontractor that it is not a firm from a foreign country included on the list of countries that discriminate against U.S. firms as published by U.S.T.R, unless the Offeror has knowledge that the certification is erroneous.

This certification is a material representation of fact upon which reliance was placed when making an award. If it is later determined that the Contractor or subcontractor knowingly rendered an erroneous certification, the Federal Aviation Administration may direct through the Owner cancellation of the contract or subcontract for default at no cost to the Owner or the FAA.

A25 VETERAN’S PREFERENCE

A25.1 SOURCE

49 USC § 47112(c)

A25.2 CONTRACT CLAUSE

VETERAN’S PREFERENCE

In the employment of labor (excluding executive, administrative, and supervisory positions), the contractor and all sub-tier contractors must give preference to covered veterans as defined within Title 49 United States Code Section 47112. Covered veterans include Vietnam-era veterans, Persian Gulf veterans, Afghanistan-Iraq war veterans, disabled veterans, and small business concerns (as defined by 15 U.S.C. 632) owned and controlled by disabled veterans. This preference only applies when there are covered veterans readily available and qualified to perform the work to which the employment relates.

RFP Number (if applicable): _____

Name of Vendor or Bidder: _____

IRAN DIVESTMENT ACT CERTIFICATION
REQUIRED BY N.C.G.S. 147-86.59

As of the date listed below, the vendor or bidder listed above is not listed on the Final Divestment List created by the State Treasurer pursuant to N.C.G.S. 147-86.58.

The undersigned hereby certifies that he or she is authorized by the vendor or bidder listed above to make the foregoing statement.

Signature

Date

Printed Name

Title

Notes to persons signing this form:

N.C.G.S. 147-86.59(a) requires this certification for bids or contracts with the State of North Carolina, a North Carolina local government, or any other political subdivision of the State of North Carolina. The certification is required at the following times:

- When a bid is submitted
- When a contract is entered into (if the certification was not already made when the ' vendor made its bid)
- When a contract is renewed or assigned

N.C.G.S. 147-86.59(b) requires that contractors with the State, a North Carolina local ; government, or any other political subdivision of the State of North Carolina must not ; ; utilize any subcontractor found on the State Treasurer's Final Divestment List.

The State Treasurer's Final Divestment List can be found on the State Treasurer's website at the address www.nctreasurer.com/Iran and will be updated every 180 days.

Fayetteville Regional Airport – Airline Terminal Improvements – Part 2

Owner: City of Fayetteville
Fayetteville, North Carolina

CONSTRUCTION CONTRACT

THIS CONTRACT, made this _____ day of _____, 2019
by, _____ hereinafter called Contractor, and the City of
Fayetteville, North Carolina, hereinafter called City.

WITNESSETH

THAT WHEREAS, a Contract for **Fayetteville Regional Airport – Airline Terminal Improvements – Part 2** has recently been awarded to Contractor by City at and for \$ _____, a sum equal to the aggregate cost of the work to be done and for labor, materials, equipment, apparatus, and supplies furnished at the prices and rates respectively named therefore in the Proposal attached herewith;

AND WHEREAS, it was provided in said Award that a formal contract would be executed by and between Contractor and City, evidencing the terms of said Award, and agreement on a date to be specified in a written order of City and would complete all work as outlined under SPECIAL PROVISIONS and STANDARD SPECIFICATIONS and would complete all work as required within the schedule as shown in the SPECIAL PROVISIONS.

NOW, THEREFORE, Contractor doth hereby covenant and agree with City that it will well and faithfully perform and execute such work and furnish such labor, materials, equipment, apparatus and supplies, in accordance with each and every one of the conditions, covenants, stipulations, terms, and provisions contained in said Specifications and Provisions and in accordance with the Plans, at and for a sum equal to the aggregate cost of the work done and labor, materials, equipment, apparatus and supplies furnished at the prices and rates respectively named therefore in the proposal attached thereto, and will well and faithfully comply with and perform each and every obligation imposed upon it by said Plans and Specifications and the terms of said Award.

Contractor shall promptly make payments to all persons supplying materials in the prosecution of the work and to all laborers and others employed thereon.

Contractor shall be responsible for all damages to property of the City of Fayetteville, North Carolina, that may be consequent upon the normal procedure of its work or that may be caused by or result from the negligence of Contractor, its employees or agents, during the progress of or connected with the prosecution of the work, whether within the limits of the work or elsewhere. Contractor must restore all property so injured to a condition as good as it was when Contractor entered upon the work.

Contractor shall furthermore be responsible for and required to make good at its expense any and all damages of whatever nature to persons or property arising during the period of the Contract, caused by carelessness, neglect, or want of due precaution on the part of Contractor, its agents, employees or workmen. Contractor shall also indemnify and

Fayetteville Regional Airport – Airline Terminal Improvements – Part 2

Owner: City of Fayetteville
Fayetteville, North Carolina

save harmless the City of Fayetteville, North Carolina, and the officers and agents thereof from all claims, suits, and proceedings of every name and description which may be brought against the City of Fayetteville, North Carolina, or the officers and agents thereof, for or on account of any injuries or damages to persons or property received or sustained by any person or persons, firm or corporation, or by or in consequence of any materials used in said work or by or on account of any improper material or workmanship in its construction, or by or on account of any accident, or of any other act or omission of Contractor, its agents, employees, servants or workmen.

It is agreed and understood that the Invitation for Bids, Proposal, Standard Specifications, Special Provisions, and the enumerated addenda and drawings are parts and parcels of this Contract to the same extent as if incorporated herein in full.

It is further mutually agreed that if at any time after the execution of this agreement and the surety bonds hereto attached for its faithful performance, City shall deem the surety or sureties upon such bonds to be unsatisfactory, or if, for any reason, such bonds cease to be adequate to cover performance and payment of the work, Contractor shall, at its expense, within five days after the receipt of notice from the City so to do, furnish an additional bond or bonds in such form and amount, and with such surety or sureties as shall be satisfactory to City. In such event, no further payment to Contractor shall be deemed to be due under this agreement until such new or additional security for the faithful performance of the work shall be furnished in manner and form satisfactory to City.

It is further agreed that the Contractor will not discriminate against any employee or applicant because of race, color, creed, sex, or religion.

And City doth hereby covenant and agree with Contractor that it will pay to Contractor, when due payable under the terms of said Specifications and said Award, the above mentioned sum, and that it will well and faithfully comply with and perform each and every obligation imposed upon it by said Specifications and the terms of said Award.

It is also agreed that if the City shall determine that it is in the City's best interest, the City shall notify the Contractor to terminate the work within seven (7) days. The Contractor shall be entitled to compensation for all work properly executed and any expenses incurred in terminating the contract and vacating the construction site. No claim shall be made by the Contractor for any change order or termination, by reason of any variation between the approximate quantities and the quantity of work as done, or for lost profits.

Contractor shall furnish with each pay application on City provided forms, beginning not later than the second application for payment, an affidavit certifying the total cost of materials and North Carolina Sales Tax paid on such materials which are included in the application for payment.

Fayetteville Regional Airport – Airline Terminal Improvements – Part 2

Owner: City of Fayetteville
Fayetteville, North Carolina

Whenever used herein, the singular shall include the plural, the plural the singular and the use of any gender shall be applicable to all genders as the context may require.

IN WITNESS WHEREOF, said Contractor has hereunto set its hand and seal (or) has caused these presents to be signed in its corporate name by its corporate seal to be hereto affixed and attested by its Secretary and the City of Fayetteville, North Carolina, has caused these presents to be signed in its corporate name by its authorized representative and seal to be hereto affixed and duly attested by its City Clerk, by authority of the City Council duly given, all as of the day and year first above written.

(Corporate Seal)

(CONTRACTOR)

(SEAL)

BY: _____

ATTEST:

TITLE: _____

Secretary

CITY OF FAYETTEVILLE, NC

ATTEST:

By: _____

This instrument has been preaudited in the manner required by the Local Government Budget and Fiscal Control Act.

FINANCE OFFICER

This is to certify that I have examined the attached contract documents, that after such examination I am of the opinion that such documents conform to the laws of the State of North Carolina, that the execution of the contract and the contract bonds by **(CONTRACTOR)** are in due and proper form and that the foregoing agreements constitute valid and binding obligations on such parties.

ATTORNEY FOR THE CITY OF FAYETTEVILLE, NC

Fayetteville Regional Airport – Airline Terminal Improvements – Part 2

Owner: City of Fayetteville
Fayetteville, North Carolina

BONDS

PERFORMANCE BOND

Date of Contract: _____

Date of Execution: _____

Name/Address of Principal: _____
(Contractor) _____

Name/Address of Surety: _____

Name/Address of Contracting Body _____

Amount of Bond (Printed): _____

Project: Fayetteville Regional Airport – Airline Terminal Improvements – Part 2

KNOW ALL MEN BY THESE PRESENTS, that we, the PRINCIPAL and SURETY above named, are held and firmly bound unto the above named Contracting Body, hereinafter called the Contracting Body, in the penal sum of the amount stated above for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the Principal entered into a certain contract with the Contracting Body, identified as shown above and hereto attached:

NOW THEREFORE, if the Principal shall well and truly perform and fulfill all the undertakings, covenants, terms, conditions, and agreements of said contract during the original term of said contract and any extensions thereof that may be granted by the Contracting Body, with or without notice to the Surety, and during the life of any guaranty required under the contract, and shall also well and truly perform and fulfill all the undertakings, covenants, terms, conditions, and agreements of any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the Surety being hereby waived, then, this obligation to be void; otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above-bounden parties have executed this instrument under their several seals on the date indicated above, the name and corporate

Fayetteville Regional Airport – Airline Terminal Improvements – Part 2

Owner: City of Fayetteville
Fayetteville, North Carolina

seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

Executed in _____ counterparts.

Witness:

(Contractor: Trade or Corporate Name)

(Proprietorship or Partnership)

By: _____

Attest: (Corporation)

Title: _____
(Owner, Partner, or Corp. Pres.
or Vice Pres. Only)

By: _____

Title: _____
(Corp Sec or Ass't Sec Only)

(Corporate Seal)

(Surety Company)

Witness:

By: _____

Title: _____
(Attorney in Fact)

Countersigned:

(Surety Corporate Seal)

(N.C. Licensed Resident Agent)

(Name and Address - Surety Agency)

(Surety Company Name and NC Regional
or Branch Office Address)

Fayetteville Regional Airport – Airline Terminal Improvements – Part 2

Owner: City of Fayetteville
Fayetteville, North Carolina

PAYMENT BOND

Date of Contract: _____

Date of Execution: _____

Name/Address of Principal: _____
(Contractor) _____

Name/Address of Surety: _____

Name/Address of Contracting Body: _____

Amount of Bond (Printed): _____

Project: Fayetteville Regional Airport – Airline Terminal Improvements – Part 2

KNOW ALL MEN BY THESE PRESENTS, that we, the PRINCIPAL and SURETY above named, are held and firmly bound unto the above named Contracting Body, hereinafter called the Contracting Body, in the penal sum of the amount stated above for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the Principal entered into a certain contract with the Contracting Body, identified as shown above and hereto attached:

NOW THEREFORE, if the Principal shall promptly make payment to all persons supplying labor and material in the prosecution of the work provided for in said contract, and any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the Surety being hereby waived, then, this obligation to be void; otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above-bounden parties have executed this instrument under their several seals on the date indicated above, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

Fayetteville Regional Airport – Airline Terminal Improvements – Part 2

Owner: City of Fayetteville
Fayetteville, North Carolina

Executed in _____ counterparts.

Witness:

(Contractor: Trade or Corporate Name)

(Proprietorship or Partnership)

By: _____

Attest: (Corporation)

Title: _____
(Owner, Partner, or Corp. Pres.
or Vice Pres. Only)

By: _____

Title: _____
(Corp Sec or Ass't Sec Only)

(Corporate Seal)

(Surety Company)

Witness:

By: _____

Title: _____
(Attorney in Fact)

Countersigned:

(Surety Corporate Seal)

(N.C. Licensed Resident Agent)

(Name and Address - Surety Agency)

(Surety Company Name and NC Regional
or Branch Office Address)

Fayetteville Regional Airport – Airline Terminal Improvements – Part 2

Owner: City of Fayetteville
Fayetteville, North Carolina

REQUIRED FORMS (POST AWARD)

Change Order	See Supplemental Gen. Provisions para. 15
Standard Form for Payment Requests	See Supplemental Gen. Provisions para. 18
Sales & Use Tax Certificate	See Supplemental Gen. Provisions para. 22
Claims for Extra Cost/Time	See Supplemental Gen. Provisions para. 23
Release of Claims	See Supplemental Gen. Provisions para. 28

Fayetteville Regional Airport – Airline Terminal Improvements – Part 2

Owner: City of Fayetteville

Fayetteville, North Carolina



**City of Fayetteville
Purchasing Department
433 Hay Street
Fayetteville, NC 28301
(910) 433-1942**

CITY OF FAYETTEVILLE

CONTRACT CHANGE ORDER

Project: Fayetteville Regional Airport – Airline Terminal Improvements – Part 2

Contractor:

Address:

Effective Date:

Contract No.:

Change Order No.:

Account No.:

Previous Total:

Total Change:

Revised Total:

Time Change:

This change order is being written to:

Except as provided herein, all terms and conditions of the contract referenced above, as heretofore changed remains unchanged and in full force and effect.

Contractor Acceptance:

I certify that my bonding company will be notified forth-with that my contract has been changed by the amount of this change order, and that a copy of the approved change order will be mailed upon receipt by me to my surety.

**By: _____
(Signature/Date)**

**_____
Type or Print Name**

City Acceptance:

This instrument has been pre-audited in the manner required by the Local Government and Budget Fiscal Control Act.

Finance Officer (Signature/Date)

City Engineer (Signature/Date)

Contracting Officer (Signature/Date)

Fayetteville Regional Airport – Airline Terminal Improvements – Part 2

Owner: City of Fayetteville
Fayetteville, North Carolina

Title

STANDARD FORM FOR PAYMENT REQUESTS

Company Name:
Company Address:

Project Name:
Project Number:

Company Phone:

Pay Request #

PART A

	SCHEDULED	UNIT	SCHEDULED	PREVIOUS	CURRENT	TOTAL
ITEM#	DESCRIPTION	QUANTITY	PRICE	VALUE	QTY	VALUE
1.						
2.						
3.						
4.						
SUB-TOTAL				SUB-TOTAL		

PART B

	SCHEDULED	UNIT	SCHEDULED	PREVIOUS	CURRENT	TOTAL
ITEM#	DESCRIPTION	QUANTITY	PRICE	VALUE	QTY	VALUE
1.						
2.						
3.						
4.						
SUB-TOTAL				SUB-TOTAL		

TOTAL EARNINGS \$

CONTRACT SUMMARY

Original Contract Value	\$
Change Orders Approved	\$
Current Contract Value	\$
Total Earnings	\$
Less Retainage	\$
Less Previous Payments	\$
Due this estimate	\$
Balance to finish (+ retainage)	\$

Fayetteville Regional Airport – Airline Terminal Improvements – Part 2

Owner: City of Fayetteville
Fayetteville, North Carolina

PROJECT TITLE Fayetteville Regional Airport – Airline Terminal Improvements – Part 2 App # _____

SALES/USE TAX CERTIFICATE

(Use as many sheets as needed/sign affidavit of last sheet per pay estimate)

Analysis of consumed material **Manufactured or Purchased** by you. Sales and/or Use Tax Regulation Number 41 requires that the City of Fayetteville secure from each contractor certified statements setting forth the cost of the materials and supplies manufactured or purchased by you and consumed in construction. This form is provided for you to list the materials consumed in construction. Please complete this form by inserting the information required below.

<u>Vendor Name</u>	<u>Date Purchased</u>	<u>Invoice Number</u>	<u>Amount Less Tax</u>	<u>Sales Tax 4.75% State/2.25% Local</u>	<u>Invoice Total</u>	<u>County Paid</u>
_____	_____	_____	_____	_____/_____	_____	_____
_____	_____	_____	_____	_____/_____	_____	_____
_____	_____	_____	_____	_____/_____	_____	_____
_____	_____	_____	_____	_____/_____	_____	_____
_____	_____	_____	_____	_____/_____	_____	_____
_____	_____	_____	_____	_____/_____	_____	_____
_____	_____	_____	_____	_____/_____	_____	_____
			\$ _____	\$ _____	\$ _____	\$ _____

AFFIDAVIT

This is to certify that sales/use tax was or will be paid as stated above on materials and supplies purchased or manufactured by the **City of Fayetteville, North Carolina**, for the above mentioned project during the period and billed on this payment application # _____

(Contractor)

(Authorized Signature/Date)

(Address)

(Telephone Number)

(City, State, Zip)

(Fax Number)

Date: _____

Page _____ of _____

Fayetteville Regional Airport – Airline Terminal Improvements – Part 2

Owner: City of Fayetteville
Fayetteville, North Carolina

CLAIM FOR EXTRA COST/TIME



PROJECT TITLE: Fayetteville Regional Airport – Airline Terminal Improvements – Part 2

CONTRACTOR: _____

FAX: _____

City of Fayetteville
433 Hay Street
Fayetteville, NC 28301
Phone (910) 433-1942

CLAIM is made for _____ additional dollars/_____ additional days for the following reason:

By: _____ Title: _____

Phone: _____ Date: _____

ACCEPTED/DENIED

By: _____ Title: _____

Phone: _____ Date: _____

If Denied, Explanation or Counter proposal:

Counter Proposal Accepted/Denied City/Contractor

By _____ Title: _____

Phone: _____ Date: _____

Fayetteville Regional Airport – Airline Terminal Improvements – Part 2

Owner: City of Fayetteville
Fayetteville, North Carolina

RELEASE OF CLAIMS

Contract/Purchase Order Number: _____

Title: Fayetteville Regional Airport – Airline Terminal
Improvements – Part 2

Project Number: _____

To the best of my knowledge and belief, I certify that all items, units, quantities, prices of work and materials and NC Sales taxes shown on the attached final invoice are correct; that all work has been performed and materials supplied in accordance with the terms and conditions of the above stated contract, including any and all change orders, between the City of Fayetteville, and (Contractor) _____. I further certify that all subcontracting obligations have been met. Below is a true and correct statement of the contract amount up to and including the last day of the period covered by the attached final invoice, and that no part of the "total amount due" has been received.

(a) Total Contract Cost (Including Change Orders)	\$ _____
(b) Total Amount Previously Paid	\$ _____
(c) Total Amount Due (Including retainage)	\$ _____

In consideration of the above stated sum to be paid by the City of Fayetteville for the noted contract, the undersigned contractor does release and discharge the City of Fayetteville, its officers, agents and employees, of and from all liabilities, obligations and claims whatsoever in law and equity arising out of or by virtue of said contract, except specified claims in stated amounts, or in estimated amounts when the amounts are not susceptible of exact statement by the contractor, as follows:

IN WITNESS WHEREOF, this release has been executed this _____ day of _____, 2019

(Imprint Corporate Seal below this line)

CONTRACTOR

BY: _____

TITLE: _____

ATTEST:

(Secretary)

Fayetteville Regional Airport – Airline Terminal Improvements – Part 2

Owner: City of Fayetteville
Fayetteville, North Carolina

ENGINEERING CERTIFICATION OF CHARGES

I certify this _____ day of _____, 2019, that the attached final invoice is correct for payment, and that to the best of my knowledge and belief, it is a true and correct statement of work performed and materials supplied in accordance with the terms and conditions of the above noted contract.

CITY OF FAYETTEVILLE, NC

BY _____

TITLE _____

Construction Safety and Phasing Plan (CSPP)
Airline Terminal Improvements – Part 2
Fayetteville Regional Airport (FAY)
July 2019

Introduction

The Airline Terminal Improvements project (short reference: “the terminal project”) involves extensive renovation and reconstruction of the existing airline terminal, affecting virtually all areas of the facility. The construction will proceed in phases to allow all terminal functions to remain operational throughout the project. This Construction Safety and Phasing Plan (CSPP) covers the Part 2 construction contract, encompassing the earlier phases of the overall project.

Extensive exterior demolition, reconstruction and expansion elements of the Part 2 contract include demolition and replacement of the existing Main Terminal 2nd story facade with a new addition structure between the north main terminal wall and the drop-off loop road. The Main Terminal drop-off canopy will be replaced along with re-alignment of the loop road to make way for the widened front canopy walk and loop road.

Interior improvements in Part 2 include a permanent relocation of the passenger screening operation; renovations to existing hold room areas, toilet rooms, ticketing and baggage concourses and new public restrooms and outbound baggage screening upfits.

The Part 2 contract will include extensive renovation of electrical, HVAC, plumbing and IT/communications infrastructure, as well as the addition of fire sprinklers throughout the new construction areas of the building. Electrical system improvements include extension of the new service entrance and switchgear completed in Part 1 and a new standby power system addition to the existing system. HVAC improvements include new air handlers, duct work, etc.

Civil improvements included in the Part 2 contract are in support of the building work and include site demolition, earthwork, storm drainage, water line improvements, sanitary sewer improvements, concrete and asphalt pavement, electrical and telecommunications/data utility improvements, pavement marking, signage, and related incidentals. The project will include temporary improvements as necessary to support terminal operations through the construction period.

Fayetteville Regional Airport has two runways. Runway 4-22 is the primary runway. It is 7,709 feet long and is equipped with an ILS. Runway 10-28 is the secondary runway. It is 4,802 feet long and is served by non-precision approaches. The terminal project will not affect either runway.

This Construction Safety and Phasing Plan has been prepared in accordance with FAA

Advisory Circular (AC) 150/5370-2F. The Plan is organized into 18 chapters corresponding to article 204 of Chapter 2 of the AC.

Chapter 1 - COORDINATION

- a. Pre-Design Meeting.** No formal pre-design meeting was held for this project. The project scope, which was developed over the course of a master planning effort, has been coordinated with the ADO. The Safety & Phasing Plan submittal and e-7460 process will initiate formal FAA coordination.
- b. Safety Management System.** FAA ATO has convened SMS conferences for recent construction projects at FAY; the most recent was held on October 15, 2012 for the Runway 4 RSA Improvements & Taxiway 'A' Extension project. It is uncertain whether ATO or FAA Airports will call for an SMS conference for this project.
- c. Pre-Bid Conference.** A pre-bid conference for the project will be held shortly following advertisement for bids.
- d. Pre-Construction Conference.** A pre-construction conference will be held following contract award and prior to Notice-to-Proceed. Invitees will include representatives of the owner, architectural/engineering (A/E) team, contractor, key sub-contractors and suppliers, FAA-ADO, FAA-ATC, FAA-SSC, TSA, airlines and other interested parties.
- e. Construction Progress Meetings.** Progress meetings with representatives of the owner, contractor and A/E team will be held throughout the project. Local FAA ATC and SSC personnel and TSA personnel will be invited. These meetings will generally be held twice per month, but may be more frequent during critical phases of the work. The purpose of these meetings will be scheduling and coordination of the work activities and discussion of operational, safety and security matters. The contractor will be required to have a qualified representative at each of these meetings. Safety, security, schedule and local coordination (ATC/SSC/Airport/NOTAMs, etc.) will be standing agenda items.
- f. Scope or Schedule Changes.** Any work scope and/or schedule changes contemplated will be discussed and coordinated at progress meetings and through correspondence as appropriate prior to implementation. The contractor is required to prepare, submit and regularly update a detailed construction progress schedule for the project. The schedule, and any contemplated changes, will be discussed at the pre-construction conference and all progress meetings.
- g. FAA ATO Coordination.** Construction of the Airline Terminal Improvements – Part 2 project will involve crane work which will partially and intermittently obscure the view from the ATCT, in the general direction of the Runway 10 approach and Runway 4 left downwind. The final permanent roof top geometry of the terminal building should not obscure the area from ATCT view any more than the current

configuration. The additional “shadow area” affects visibility of aircraft on the air carrier and cargo aprons. It is expected that security system camera views of the air carrier apron will be made available in the tower cab. Coordination meetings have taken place and will continue with airport and ATC and SSC representatives.

Chapter 2 - PHASING

a. Phase Elements

In order to maintain public access and terminal operations, construction will be completed in phases. The phasing is described in the project civil and architectural plans.

b. Construction Safety Drawings

The project aviation safety plan and notes are presented on the civil plans.

Chapter 3 - AREAS AND OPERATIONS AFFECTED BY THE CONSTRUCTION ACTIVITY

a. Identification of Affected Areas

The air operations areas directly affected by the Airline Terminal Improvements – Part 2 project construction are limited primarily to the south side of the Main Terminal Building. A portion of the air carrier apron will be closed to accommodate the work. Temporary apron and gate layout plans have been developed and included in the project plan set to support airline operations.

b. Mitigation of Effects

The project plans depict construction phasing and temporary measures to be implemented through the construction period to allow all terminal functions to be maintained.

Advance communication with airport management, the airlines, TSA and other terminal tenants has been on-going over the past six years and will continue through the construction period.

Chapter 4 - PROTECTION OF NAVIGATION AIDS (NAVAIDS)

Navigation Aids will not be directly impacted by project construction. Utility power and telecommunications infrastructure which serves the terminal area, including the airline terminal, airfield lighting vault, ARFF station, the ATCT and FAA base building, will be affected by the project. The utility power distribution system in the terminal area is

robust with redundant 3-phase feeds and has been recently upgraded. All served facilities have standby power capabilities for critical functions. Coordination with the electrical utility (Fayetteville Public Works Commission, PWC) and the local telephone utility (Century Link) has been initiated and will continue to minimize the potential for service disruption.

Chapter 5 - CONTRACTOR ACCESS

a. Location of Stockpiled Construction Materials

All stockpiles of materials or equipment shall be located in the contractor staging areas and stockpile areas as shown on the plans or as coordinated with the airport. Staging and stockpile areas are shown on the Plans. All loose items within the staging areas shall be secured at all times. Prior to leaving work each day, the Contractor shall return all construction materials and equipment to the staging areas or secured work areas.

The Contractor shall dispose of existing concrete and other construction debris off Airport property in a properly permitted location.

b. Vehicle and Pedestrian Operations

- 1) **Construction site parking.** Personal cars shall be parked outside of secured airfield areas.
- 2) **Construction equipment parking.** Prior to leaving work each day, Contractor shall return all equipment to the staging areas, secure work areas or other locations as coordinated with the Owner.
- 3) **Access and haul roads.** Access roads to be used under this Contract shall be those designated and approved by the Owner. In general, the Contractor shall confine his equipment and hauling where practical to existing roads on the Airport. If exiting pavement or road surface is damage by the Contractor's operations, it shall be repaired to its original condition at the Contractor's expense. Metal track vehicles will not be permitted to operate on or across existing pavement without protective matting to prevent marring of the pavement surface.

The Contractor shall conduct his operations in such a manner as to assure that such operations do not impede access to any area of the airfield at any time for the airport's aircraft rescue and firefighting (ARFF) vehicles and other emergency vehicles. ARFF vehicle access shall be a standing agenda item for all progress meetings. The Contractor shall cooperate fully and immediately with any directives issued by airport or Fire Department safety personnel relative to emergency access.

- 4) **Marking and lighting of vehicles.** All vehicles operating in the AOA shall be lighted or flagged in accordance with FAA Advisory Circular 150/5210-5, Painting,

Marking, and Lighting of Vehicles Used on an Airport. Copies of the Advisory Circular will be made available upon request.

- 5) **Description of proper vehicle operations.** All construction vehicles must be cleared for access by Airport Management.
- 6) **Required escorts.** All Contractor personnel, including but not limited to, general laborers, subcontractors, drivers, and journeymen working within active air operations areas must at all times remain within visual and voice range of contractor personnel badged by the airport. For the purposes of this project, the air operations areas (AOA) refer to all areas within the airport security fence. SIDA access badges will be required.
- 7) **Training requirements for vehicle drivers.** All vehicle drivers within the air operations areas (AOA) must be properly badged and trained by airport safety officers.
- 8) **Situational awareness.** Personnel, equipment, or other construction-related material are not allowed within the safety area of an open runway or taxiway at any time unless cleared by the airport traffic control tower. For this project, the contractor will not have need for access on active taxiway and runway areas.

Restrict movement of construction vehicles to construction areas by flagging and barricading, erecting temporary fencing, or providing escorts as appropriate.

Ensure that no construction employees, employees of subcontractors or suppliers, or other persons enter any part of the Air Operations Areas (AOA) from the construction site unless authorized.

During construction, adjacent aprons, taxi lanes, taxiways, and runways will be open to aircraft unless otherwise noted. Aircraft have the right of way at all times. Contractor shall be aware of the aircraft movements and the jet blast and/or prop-wash associated with these aircraft. The Contractor shall secure loose items.

c. Two-way radio communications

- 1) **General.** The Contractor shall provide a minimum of two (2) two-way aviation band radios for use when access across active taxiways or runways is needed. For this project, very little need for such access is contemplated. The Contractor shall also supply a cell phone for emergency contact in the event of radio failure.

The Contractor shall be responsible for all required maintenance included battery replacement if needed. If a radio will be out of service for any period of time, a substitute shall be provided.

- 2) **Non-Movement Area Limits.** The air carrier apron is a non-movement area in terms of air traffic control. This means that aircraft, pedestrian and ground vehicle operations on the apron are not controlled by FAA Air Traffic Controllers. The apron entrance/exit taxiways (Taxiway 'F', 'H', and 'R') are part of the movement area; do not enter upon those taxiways without real time radio clearance from ATCT.
- 3) **Areas requiring two-way radio communication with the ATCT.** Prior to moving in close proximity to, entering or crossing an active runway or taxiway, the Contractor must clear such action by two-way radio through the Airport Traffic Control Tower, who will then issue the appropriate advisories to aircraft and construction traffic. Contractor will be required to provide two-way radios. If the control tower is not manned, construction activities should be coordinated through the Fire Department (Station 10). Crossing or entering active runways or taxiways without prior approval from Air Traffic Control Tower will subject Contractor to being fined a minimum \$10,000 per incursion and loss of privilege of moving across active runways and taxiways.
- 4) **Frequencies to be used.** Two-way radio communications with air traffic control tower will be on ground control frequency 121.70 MHZ. Communication with the Airport administrative staff shall be by phone at 910-433-1160 during business hours and with Fire Department personnel at Fire Station 10 (the ARFF station) at 910-433-1624 at other times.

Vehicular traffic crossing active aircraft movement areas (runways and taxiways) and navigational aid critical areas must be controlled by two-way radio with the control tower. The Contractor shall maintain continuous two-way radio contact, on frequency 121.90 MHZ, with the control tower.

d. Airport Security

1) Airport Security Notes are included on the plans:

1. AREA DEFINITIONS AND ACCESS RESTRICTIONS

- A. "SECURED AREA" - THE SECURED AREA IS THE AREA OF THE AIRPORT WHERE MEASURES ARE IN PLACE TO LIMIT ACCESS TO AUTHORIZED PERSONS. THE SECURED AREA BOUNDARY IS DELINEATED BY THE AIRPORT'S PERIMETER FENCE AND THE WALLS OF VARIOUS AIRPORT BUILDINGS, INCLUDING THE AIRLINE TERMINAL BUILDING. ACCESS INSIDE THE SECURED AREA REQUIRES A SIDA/SECURED AREA BADGE ISSUED BY THE AIRPORT OR ESCORT AT ALL TIMES BY AN INDIVIDUAL WITH AN AIRPORT ISSUED SIDA/SECURED AREA BADGE WITH ESCORT PRIVILEGES.

- B. "AIROPERATIONSAREA, AOA" - THEAIROPERATIONSAREA(AOA)ISANYAREAOF THE AIRPORT USED OR INTENDED TO BE USED FOR THE LANDING, TAKEOFF OR SURFACE MOVEMENT OF AIRCRAFT. THE AOA INCLUDES SUCH PAVED AND UNPAVED AREAS THAT ARE USED OR INTENDED TO BE USED FOR THE UNOBSTRUCTEDMOVEMENTOF AIRCRAFT INADDITIONTO THE PAVED RUNWAY, TAXIWAYS AND APRONS. FOR AIRPORT SECURITY PURPOSES, THIS TERM IS SOMETIMES USED TO MEAN THE SECURED AREA.
- C. "SECURITY IDENTIFICATION DISPLAY AREA, SIDA" - THE SECURITY IDENTIFICATION DISPLAY AREA (SIDA) IS THE AREA OF THE AIRPORT WHERE SECURITY MEASURES ASSOCIATED WITH AIRLINE OPERATIONS ARE IN PLACE. THE SIDA INCLUDES THE ENTIRE AIRCARRIER APRON AND PORTIONS OF THE AIRLINE TERMINAL BUILDING. ACCESS INSIDE THE SIDA REQUIRES A SIDA/SECURED AREA BADGE ISSUED BY THE AIRPORT OR ESCORT AT ALL TIMES BY AN INDIVIDUAL WITH AN AIRPORT ISSUED SIDA/SECURED AREA BADGE WITH ESCORT PRIVILEGES. VEHICLES AND EQUIPMENT ENTERING THE SIDA MUST BE INSPECTED BY AUTHORIZED PERSONNEL PRIOR TO SUCH ENTRY.
- D. "STERILE AREA" - THE STERILE AREA IS THAT PORTION OF THE TERMINAL BUILDING BEYOND THE TSA PASSENGER SCREENING STATION. ALL PASSENGERS AND CARRY-ON BAGS IN THE AREA HAVE PASSED THROUGH THE SCREENING STATION LOCALLY (DEPARTING PASSENGERS) OR ELSEWHERE (ARRIVING PASSENGERS). ACCESS INSIDE THE STERILE AREA REQUIRES A SIDA/SECURED AREA BADGE ISSUED BY THE AIRPORT OR ESCORT AT ALL TIMES BY AN INDIVIDUAL WITH AN AIRPORT ISSUED SIDA/SECURED AREA BADGE WITH ESCORT PRIVILEGES.
- E. "NON-SIDA WORK AREA" - FOR THIS CONSTRUCTION PROJECT, NON-SIDA WORK AREAS WILL BE ESTABLISHED WITHIN THE SECURED AREA FOR THE PURPOSE OF SEGREGATING MAJOR CONSTRUCTION WORK AREAS FROM ACTIVE SIDA AIRLINE OPERATIONS AREAS. ACCESS INSIDE THESE NON-SIDA WORK AREAS REQUIRES A SIDA/SECURED AREA BADGE ISSUED BY THE AIRPORT OR ESCORT AT ALL TIMES BY AN INDIVIDUAL WITH AN AIRPORT ISSUED SIDA/SECURED AREA BADGE WITH ESCORT PRIVILEGES. VEHICLES AND EQUIPMENT ENTERING THE NON-SIDA WORK AREAS VIA THE DESIGNATED ACCESS ROUTE FROM AIRPORT GATE 7 WILL NOT REQUIRE INSPECTION PRIOR TO SUCH ENTRY BUT SHALL BE STRICTLY CONTROLLED BY SPECIALLY TRAINED AND SIDA BADGED CONTRACTOR PERSONNEL. THE NON-SIDA WORK AREAS WILL BE DELINEATED BY TEMPORARY FENCE LINES, GATES, AND

PERMANENT AND TEMPORARY WALLS ALL PROVIDED AND MAINTAINED BY THE CONTRACTOR.

- F. "FAA SECURED AREA" - THE FAA SECURED AREA IS AN AREA DELINEATED BY FENCING INTO WHICH ACCESS IS CONTROLLED BY FAA AND NOT BY THE AIRPORT. THE AREA INCLUDES THE AIRPORT TRAFFIC CONTROL TOWER AND RELATED SUPPORT FACILITIES. ANY ACCESS INTO THE FAA SECURE AREA MUST BE COORDINATED WITH FAA.
 - G. "UN-SECURED AREA" - THE UN-SECURED AREA INCLUDES THE AREAS OF THE TERMINAL BUILDING AND AIRPORT GROUNDS FOR WHICH AIRPORT SECURITY ACCESS CONTROL MEASURES ARE NOT IN PLACE ("OUTSIDE THE FENCE"). THIS INCLUDES THE ACCESS ROAD, PARKING LOTS AND PUBLIC AREAS OF THE TERMINAL BUILDING. IT ALSO INCLUDES AREAS OF LIMITED ACCESS SUCH AS AIRPORT OFFICES, CONFERENCE ROOMS, TENANT OFFICES AND LOCKED STORAGE AND MAINTENANCE ROOMS. WHILE AIRPORT ACCESS CONTROL MEASURES ARE NOT IN PLACE FOR THE UN-SECURED AREA, SUCH SECURITY MEASURES AS VIDEO SURVEILLANCE, POLICE PATROLS, LOCK MANAGEMENT AND VIGILANCE BY AIRPORT, TSA AND TENANT PERSONNEL ARE IN PLACE.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ESTABLISHING A BADGE AND SECURITY MANAGEMENT PROGRAM WITH A PRIMARY AND SECONDARY (BACK-UP) BADGE AND SECURITY MANAGER. THESE INDIVIDUALS SHALL BE DESIGNATED BY THE CONTRACTOR AS HAVING SIGNATORY AUTHORITY FOR AIRPORT SECURITY BADGING MATTERS. THIS DESIGNATION SHALL BE IN THE FORM OF A NOTARIZED LETTER TO THE AIRPORT DIRECTOR, ON CONTRACTOR LETTERHEAD, SIGNED BY AN OFFICER OF THE COMPANY. THE SECURITY MANAGERS MUST OBTAIN AND MAINTAIN AIRPORT SIDA/SECURITY BADGES WITH ESCORT PRIVILEGES AND SHALL UNDERGO INITIAL AND ANNUAL SIGNATORY AUTHORITY TRAINING BY THE AIRPORT. THE PROGRAM IS INTENDED TO MANAGE, COORDINATE (WITH AIRPORT MANAGEMENT) AND DOCUMENT: (1) THE SECURING OF AIRPORT SIDA BADGES FOR CONTRACTOR *AND SUBCONTRACTOR* PERSONNEL (THE APPLICATIONS ARE TO BE SIGNED BY THE SIGNATORY AUTHORITY AFTER THE APPLICANT HAS SIGNED THE FORM), (2) AIRPORT SECURITY AND SAFETY RELATED TRAINING, (3) AN INVENTORY OF ACTIVE BADGES, (4) IMMEDIATELY TURNING IN BADGES OF TERMINATED STAFF AND THE STAFF OF TERMINATED SUBCONTRACTORS, (5) REGULAR REVIEW AND UPDATES OF SECURITY MATTERS, INCLUDING BUT NOT LIMITED TO ITEMS (1) THROUGH (4), PROJECT MEETING SECURITY RELATED AGENDA ITEMS, GATE KEEPING AND DOOR MANAGEMENT EFFORTS, TEMPORARY SIDA AND

STERILE AREA LIMITS (INCLUDING TEMPORARY WALLS, FENCES, GATES AND DOORS), DISCIPLINARY AND CORRECTIVE ACTIONS, AND ADVANCE PLANNING FOR CHANGES IN CONSTRUCTION WORK AREAS AND STERILE AREA/SIDA LIMITS.

3. THE CONTRACTOR SHALL COORDINATE WITH THE ARCHITECTURAL TEAM AND AIRPORT MANAGEMENT WITH REGARD TO THE ADVANCE SCHEDULING AND TSA REVIEW AND APPROVAL OF UPCOMING CHANGES IN SECURED AREA, SIDA AND STERILE AREA LIMITS, BOTH INSIDE AND OUTSIDE OF THE TERMINAL BUILDING. ALLOW 45 CALENDAR DAYS FOR TSA REVIEW AND APPROVAL OF SUCH CHANGES.
4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING AT ALL TIMES AN ADEQUATE NUMBER OF PERSONNEL WITH AIRPORT SIDA BADGES WITH ESCORT PRIVILEGES AND COMPLETED TRAINING SUCH THAT ALL WORK CREWS ARE ESCORTED AT ALL TIMES BY BADGED PERSONNEL. ALL UNBADGED PERSONNEL SHALL BE ESCORTED BY BADGED PERSONNEL AND MUST BE WITHIN VISUAL AND VOICE CONTACT RANGE OF THE BADGED ESCORT AT ALL TIMES. ALL BADGED PERSONNEL MUST DISPLAY (WEAR) THEIR BADGE ON THEIR PERSON (BETWEEN THE SHOULDER AND WAIST) AT ALL TIMES WHEN ON SITE, REGARDLESS OF WHETHER THEY ARE PRESENT INSIDE THE SECURED AREA AND REGARDLESS OF WHETHER OR NOT THEY ARE ACTIVELY ESCORTING UNBADGED PERSONNEL. FOR THIS PROJECT, THE MAXIMUM NUMBER OF UNBADGED PERSONNEL COVERED BY A SINGLE BADGE ESCORT SHALL BE SIX (6) WITHIN THE ACTIVE SIDA AND STERILE AREAS AND TWELVE (12) WITHIN NON-SIDA WORK AREAS.
5. TO THE MAXIMUM EXTENT PRACTICABLE, THE CONTRACTOR SHALL ESTABLISH PHYSICAL SEPARATION AND/OR TEMPORARY SIDA AND STERILE AREA LIMITS, AS APPROPRIATE, TO ISOLATE CONSTRUCTION ACTIVITIES FROM ACTIVE AIRPORT OPERATIONS. IT IS UNDERSTOOD, HOWEVER, THAT A SIGNIFICANT AMOUNT OF CONSTRUCTION ACTIVITY MUST TAKE PLACE WITHIN ACTIVE SIDA AND STERILE AREAS. THE CONTRACTOR MUST STRICTLY ADHERE TO PERSONNEL ESCORT AND VEHICLE/EQUIPMENT INSPECTION REQUIREMENTS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONTROLLING AND SECURING MATERIALS, TOOLS AND EQUIPMENT IN SIDA AND STERILE AREAS AND SHALL NOT LEAVE TOOLS, EQUIPMENT AND MATERIALS UNATTENDED UNLESS LOCKED AND/OR SECURED IN A MANNER ACCEPTABLE TO AIRPORT MANAGEMENT.
6. A CONSTRUCTION ACCESS ROUTE FROM AIRPORT GATE 7 AND RUNNING ACROSS THE NORTH GENERAL AVIATION APRON AND A DE-ACTIVATED PORTION OF THE AIR CARRIER APRON IS DEPICTED ON THE PLANS. THE CONTRACTOR SHALL ESTABLISH THE

CONSTRUCTION ACCESS ROUTE AND SHALL FURNISH, INSTALL, MAINTAIN AND ULTIMATELY REMOVE PAVEMENT MARKINGS, LOW PROFILE AVIATION BARRICADES, TEMPORARY GATES, SIGNS, ETC. AS SHOWN. THE ROUTE LAYOUT SEGREGATES CONSTRUCTION TRAFFIC FROM AIRCRAFT TRAFFIC AND OPERATIONS. THE CONSTRUCTION ACCESS ROUTE IS SUBJECT TO CROSSING VEHICULAR TRAFFIC, INCLUDING BUT NOT LIMITED TO ARFF (FIRE) TRUCKS, AIRCRAFT FUELING VEHICLES, FUEL DELIVERY VEHICLES, AIRLINE AND AIRPORT GROUND VEHICLES, BAGGAGE TUGS, AIRPORT VEHICLES AND FAA VEHICLES. CONSTRUCTION VEHICLES SHALL YIELD TO ALL OTHER TRAFFIC.

7. THE CONTRACTOR SHALL PERFORM ALL TEMPORARY WORK ASSOCIATED WITH TEMPORARY AND FINAL CHANGES IN SECURE AREA, SIDA AND STERILE AREA LIMITS AND ACCESS POINTS, INCLUDING ALL WORK NECESSARY TO ERECT TEMPORARY WALLS, FENCES, GATES AND DOORS, CHANGE LOCKS AND SIGNS, RELOCATE SECURITY DEVICES (ELECTRONIC ACCESS CARD READERS, KEYPADS, SURVEILLANCE CAMERAS, LIGHTING, ETC.) TO THE SATISFACTION OF AIRPORT MANAGEMENT.
8. GATE KEEPERS SHALL ALLOW PASSAGE TO AUTHORIZED CONSTRUCTION VEHICLES ONLY. GATE KEEPERS SHALL MAINTAIN A DATE AND TIME LOG OF ALL VEHICLES ENTERING AND DEPARTING, INCLUDING RECORDS OF THE VEHICLE'S CONTROLLING ENTITY (CONTRACTOR, SUBCONTRACTOR, SUPPLIER AND/OR TRANSPORT FIRM) AND VEHICLE NUMBER. CODES, ABBREVIATIONS AND FORMS SHALL BE PREPARED AHEAD OF ACCESS OPERATIONS AND UPDATED AS NEEDED TO FACILITATE THE LOG KEEPING EFFORT. THE GATE KEEPER SHALL BE INSTRUCTED TO CHALLENGE AND TURN AWAY ANY UNAUTHORIZED VEHICLES OR PERSONNEL AND SHALL HAVE IMMEDIATE ACCESS TO A TELEPHONE AND EMERGENCY CONTACT NUMBERS (AIRPORT MANAGEMENT, ARFF STATION AND POLICE) TO IMMEDIATELY REPORT SECURITY INCIDENTS.
9. THE CONTRACTOR SHALL INSTRUCT ALL PERSONNEL REGARDING AIRPORT SECURITY MATTERS, INCLUDING THE NEED FOR VIGILANCE AND IMMEDIATE REPORTING OF UNAUTHORIZED OR SUSPICIOUS PERSONNEL, VEHICLES, EQUIPMENT, MATERIALS OR ACTIVITIES.
10. THE CONTRACTOR SHALL INSPECT TEMPORARY SECURITY LINES (FENCES, GATES, DOORS, WALLS, LOCKING SYSTEMS) ON A DAILY BASIS (AT THE START AND COMPLETION OF EACH WORK SHIFT), SHALL IMMEDIATELY REPORT ANY APPARENT SECURITY BREACHES, SHALL ASSIGN A BADGED GATEKEEPER TO ANY BREACHED AREAS

DISCOVERED, AND SHALL PROMPTLY REPAIR ANY BREACHED AREAS DISCOVERED TO THE SATISFACTION OF AIRPORT MANAGEMENT.

11. VEHICLES, EQUIPMENT AND MATERIALS SHALL NOT BE STORED WITHIN 10 FEET OF ANY EXISTING OR TEMPORARY FENCE LINE SERVING THE SECURED AREA, SIDA, STERILE AREA OR FAA SECURED AREA.
12. IN THAT CONTRACT WORK IS MULTI-YEAR, BADGED CONTRACTOR AND SUBCONTRACTOR PERSONNEL WITH SHALL BE REQUIRED TO UNDERGO ANNUAL RECURRENT TRAINING.

2) Fencing and gates. The Contractor shall coordinate ingress-egress requirements with the Airport Management. All open gates to secured airport areas shall be monitored continuously by Contractor's personnel to control access to the secured area or shall be closed and locked. Contractor personnel shall not allow any unauthorized personnel, vehicles or animals to enter through the construction gate. The Contractor shall be responsible for securing and locking all gates when not in use and at the end of each day's operations. Gate monitors must log in and out all vehicles entering and leaving the project areas.

- 3) Badging requirements.** The project area is located within the Secured Area. This is a closely maintained security area with restricted access. The Contractor will be required to meet all requirements for entering and operating in the Secured Area at all times. It shall be the Contractor's responsibility to become familiar with all requirements for entering and operating in the Secured Area. Further, it will remain the Contractor's responsibility to keep abreast of any changes in requirements, to adhere to current regulations, and to adhere to current regulations for security badging of personnel.

In order to obtain security badges, personnel will be required to furnish a secure area application, ten-year background employment history record, criminal background check, fingerprints, and attend a one-half day safety training class with the Fire Department at Station 10. Electronic fingerprint images will be prepared by airport administrative personnel and forwarded for federal processing. The Contractor shall arrange to have an adequate number of supervisory and other personnel obtain badges to meet this requirement. All supervisory personnel working within the secured airfield area shall possess and clearly display their security identification badge at all times. All supervisory personnel, escort drivers, and flagmen must additionally complete a one-half day driving and communications safety training class with the Fire Department at Station 10. A

sufficient number of properly badged personnel shall be required to be present on site at all times and within visual and audible range to monitor all employees, subcontractors, and suppliers when the Contractor is working within the limits of the secured airfield area.

Contractor should allow for four weeks to obtain required badges and complete safety training; given the tight timeframe for the project notice to proceed, Contractor must initiate the badging process and sign up for safety and driver training for an adequate number of personnel as required to perform the work immediately upon notice of award.

- 4) The Fayetteville Regional Airport is subject to 49 CFR Part 1542, Airport Security, and must meet TSA standards for access control, movement of ground vehicles, and identification of construction contractor and tenant personnel.

Chapter 6 - WILDLIFE MANAGEMENT

a. Trash

The Contractor shall clean all construction areas of litter, loose papers, debris, etc. on a daily basis, or as directed by the Engineer. Food scraps must be collected from construction personnel activity. Prior to the close of daily operations, Contractor shall inspect all active Air Operations Areas and construction areas for litter. All debris shall be cleaned up and properly disposed of prior to release of crews from each shift.

b. Standing water

If wet conditions are encountered during construction, Contractor is responsible for dewatering areas to remove standing water.

c. Tall grass and seeds

All seeding shall comply with the seeding specifications to avoid seed mixtures that will attract wildlife. The Contractor shall protect seeded areas against traffic or other use by warning signs or barricades. Surfaces gullied or otherwise damaged following seeding shall be repaired by regrading and reseeding as directed. The Contractor shall mow, water as directed, and otherwise maintain seeded areas in a satisfactory condition until final inspection and acceptance of the work.

d. Poorly maintained fencing and gates

The airport perimeter fencing and gates shall be carefully protected by the Contractor. Any facilities damaged by the Contractor will be repaired immediately and restored to original condition at Contractor's cost

e. Disruption of existing wildlife habitat

The airport actively manages wildlife. This project is not expected to disrupt any existing wildlife habitat.

Contractor shall notify Airport Management immediately of any wildlife encounters and/or sightings.

Chapter 7 - FOREIGN OBJECT DEBRIS (FOD) MANAGEMENT

1. Waste and loose materials, commonly referred to as FOD, are capable of causing damage to aircraft landing gears, propellers, and jet engines. During construction operations, Contractor is responsible for monitoring and controlling FOD to the satisfaction of Airport Management. Prior to the close of daily operations, Contractor shall inspect all construction areas to ensure that they are clear of FOD.
2. Prior to reopening any construction work area to aircraft traffic, Contractor must perform a walk through with airport personnel and the A/E Project Representative to confirm that the areas are free of FOD or other hazards.
3. When crossing active apron taxi lanes, Contractor must inspect and clean area for FOD after each pass of construction equipment and/or vehicles by use of a sweeper truck or other means acceptable to Airport Management.

Chapter 8 - HAZARDOUS MATERIALS (HAZMAT) MANAGEMENT

1. Contractor shall be responsible for oil management and for expeditious containment and clean-up spills on the airport property resulting from fuel, lubricant or hydraulic fluid leaks from construction vehicles and/or equipment.
2. The Contractor shall furnish to the A/E representative and airport maintenance and safety staff, MSDS sheets for all chemicals used during construction.
3. Transport and handling of other hazardous materials on an airport also requires special procedures. See AC 150/5320-15, Management of Airport Industrial Waste.

Chapter 9 - NOTIFICATION OF CONSTRUCTION ACTIVITIES

a. Maintenance of a list of responsible representatives/points of contact

- 1) The Contractor and all subcontractors shall designate a representative and alternate to contact on a 24-hour basis should problems arise. The point of contact provided must be able to coordinate an immediate response to correct any construction-related activity that may adversely affect the operational safety of the airport. The Contractor shall provide a listing of all contact persons of all supervisory personnel and all subcontractors.
- 2) The Contractor must also provide a safety/construction inspector familiar with airport safety to monitor construction activities.
- 3) The Contractor shall coordinate with FAA-system support, NOAA and airport management when working in areas containing FAA, weather, or airfield lighting cable. Generally, these types of cables are not located in the work areas of this project.

Contacts are:

Airport	Mr. Bradley Whited	910-433-1160
	Mr. Toney Coleman	910-433-1160
FAA Facilities (FAY SSC)	Mr. Jeffrey Brown	910-484-5948
FAA ATCT	Mr. Karl White	910-323-0849

b. Notices to Airmen (NOTAM)

The OWNER will issue the necessary NOTAMS to reflect hazardous and operational conditions. The Contractor shall work with the OWNER to schedule NOTAM issuance and Airport Operations Area (AOA) closures, and shall provide the OWNER with advance notice of the need to issue or close a NOTAM. It is important that NOTAMS be kept current and reflects the actual conditions with respect to construction situations. Active NOTAMS shall be reviewed periodically and revised to reflect the current conditions.

The Contractor shall not begin work unless and until 72 hours prior notice has been given to Airport Management

c. Emergency notification procedures

In an emergency situation the Contractor is to notify Fire Station 10 immediately by phone at 910-433-1624.

d. Coordination with ARFF (Fire Station 10) Personnel

The ARFF building (Fire Station 10) is located adjacent to the air carrier apron opposite Taxiway F. The Station 10 staff will be invited to all project meetings for coordination of safety and security matters.

e. Notification to the FAA

- 1) **Part 77.** If Contractor utilizes cranes, bucket trucks, or other equipment exceeding 25' in height, Contractor is responsible for filing a "Notice of Proposed Construction or Alteration" (FAA Form 7460) with FAA prior to erecting equipment. Contractor should allow at least 30 days for FAA review. Detailed instructions can be found on the FAA website:
<https://oeaaa.faa.gov/oeaaa/external/portal.jsp>.

2) NAVAIDS.

- a) This project is not expected to impact any navigational aids.

Chapter 10 - INSPECTION REQUIREMENTS

a. Daily inspections

- 1) A daily start-up and shut-down checklist will be jointly prepared by the Contractor and Airport Management and included in the Safety Plan Compliance Document (SPCD). The checklist will be followed throughout the project. This checklist shall include, but not be limited to, barricades, flags, haul routes, securing of access gates, clean up, etc. The Contractor's site supervisor and labor crew shall not leave the work site until such time as the Fire Department (Station 10 personnel) has inspected the area and signed off on the daily checklist.
- 2) Frequent inspections will be made by the airport staff during critical phases of the work to ensure that the Contractor is following the recommended airfield safety procedures.

b. Final inspections

- 1) Prior to reopening aircraft apron areas, Contractor must perform a walkthrough of the construction area with airport personnel to confirm that the areas are free of FOD or other hazards.
- 2) Contractor shall be required to remedy any deficiencies immediately, whether caused by negligence, oversight, or project scope change to the satisfaction of Airport Management.

Chapter 11 - UNDERGROUND UTILITIES

- 5) Underground utilities are known to be located in the project areas. Existing underground utilities including but not limited to PWC (utility) power and fiber optic cables, telephone (Century Link), cable TV (Time Warner/Spectrum), water and sewer

(PWC public utility), natural gas, airport/City owned service lines (all utility types), HVAC lines, tenant IT lines (fiber and copper), storm drains and other utilities may be in the path of construction. Locations of utilities as shown on the Plans are approximate only. All utilities and facilities are not necessarily indicated on Plans. It shall be the Contractor's responsibility to locate and protect existing utilities and facilities from damage, and to immediately act to restore lines damaged by construction operations.

- 6) All existing facilities will be carefully protected by the Contractor. Any facilities damaged by the Contractor will be repaired immediately and restored to original condition at the Contractor's expense. If damaged by the Contractor, these and any other above or below ground facilities shall be repaired at the Contractor's expense, to the satisfaction of the OWNER.
- 7) The Contractor shall employ a private utility locator service or shall obtain and utilize cable locating equipment in order to field locate existing cable runs not to be disturbed/replaced by this project.
- 8) It is understood and agreed that the OWNER does not guarantee the accuracy or the completeness of the location information relating to existing utility services, facilities, or structures that may be shown on the plans or encountered in the work. Any inaccuracy or omission in such information shall not relieve the Contractor of his/her responsibility to protect such existing features from damage or unscheduled interruption of service.
- 9) Should the Contractor damage or interrupt the operations of a utility service or facility outside the project limits by accident or otherwise, he shall immediately notify the proper authority and the Architect and shall take all reasonable measures to prevent further damage or interruption of service. The Contractor, in such events, shall cooperate with the utility service or facility owner and the Architect continuously until such damage has been repaired and service restored to the satisfaction of the utility or facility owner.
- 10) The Contractor shall bear all costs of damage and restoration of service to any utility service or facility due to his/her operations whether or not due to negligence or accident. The OWNER reserves the right to deduct such costs from any monies due or which may become due to the Contractor.

Chapter 12 - PENALTIES

1. Crossing or entering active taxiways, runways or adjacent areas without prior approval from Air Traffic Control Tower will subject Contractor to being fined a minimum \$10,000 per incursion and loss of privilege of moving across active Air Operations

Areas. If the control tower is not manned, construction activities should be coordinated through the Fire Department (Station 10).

2. For each incident where cables are located within five feet of the position defined on the ground and are cut or damaged and are not able to perform their required function resulting in the diversion of aircraft or the interruption of the normal flow of air traffic and aircraft operations on the Airport, the sum of \$10,000.00 per incident shall be deducted from any money due the Contractor. An additional \$1,000.00 per day will be deducted from any money due the Contractor until such time as cables are repaired and operational. If no money is due the Contractor, the OWNER shall have the right to recover said sum or sums from the Contractor, from the surety, or from both. The amount of these deductions are to cover liquidated damages to the Sponsor incurred by additional work and other expenses and damages arising from the incident or incidents caused by the Contractor, and such deductions are not to be considered as penalties.

Chapter 13 - SPECIAL CONDITIONS

1. The Contractor's supervisory personnel are expected to become knowledgeable regarding the airport's operational, safety and security requirements, actively participate in project meetings, establish effective communications with airport management and safety personnel (ARFF / Fire Station 10) and TSA and FAA ATC and Tech Ops personnel. The Contractor shall cooperate with the airport, TSA and FAA in operational matters and during emergency response situations.
2. The Airport Traffic Control Tower (ATCT) at FAY is normally open on a 24/7 basis.

Chapter 14 - RUNWAY AND TAXIWAY VISUAL AIDS

- a. This project is not expected to impact taxiways and runways nor the associated visual aids. Taxiway edge lighting is in place on the far side of the apron edge taxi lane.

Chapter 15 - MARKING AND SIGNS FOR ACCESS ROUTES

1. The contractor access routes are shown on the Plans. Access points and on-airport access routes shall be discussed at the pre-con and at progress meetings to address construction needs and airport operational safety and security considerations. Access route physical conditions shall be regularly reviewed. The Contractor is expected to maintain the haul routes in safe, clean, orderly condition at all times. Many of the

routes are also used for public access, maintenance access, security checks and emergency response; these routes must be passable at all times and in all weather conditions.

- 2) The Contractor shall provide and maintain signs and markings for access routes on the airport as needed to control and guide the construction traffic. All signs and markings shall be coordinated with airport staff and reviewed for aircraft safety and security considerations.

Chapter 16 - HAZARD MARKINGS AND LIGHTING

- a) **Purpose.** Hazard marking and lighting prevents pilots from entering areas closed to aircraft, and prevents construction personnel from entering areas open to aircraft. Hazard marking and lighting shall also identify open manholes, small areas under repair, stockpiled material, waste areas, and areas subject to jet blast.

b) Equipment

- 1) **Lighted Fences.** Lighted chain link temporary fences are required to establish segregated work zones on the air carrier. The fences shall be anchored/stabilized against wind, jet blast and prop wash. Provide hazard lighting on the fences as detailed on the plans. The fences shall be positioned well clear of the taxilane OFA (see Chapter 17) and active aircraft parking position safety boxes.
- 2) **Lighted Barricades.** Low profile aviation barricades shall be constructed of 12" white PVC pipe (cut in half) or other approved material that is 6' minimum in length. Spacing shall be 6 feet apart or as directed. See detail on the Plans.
- 3) **Lights must be red.** A steady burning red light shall be centered on each lighted barricade and at specified intervals along temporary fences and must meet the luminance requirements of the State Highway Department. Lights must be securely mounted on barricades and spaced at no more than 10 feet. Lights must be operated between sunset and sunrise and during periods of low visibility whenever the airport is open for operations.
- 4) **Maintenance.** The Contractor must have a person on call 24 hours a day for emergency maintenance of airport hazard lighting and barricades. The Contractor must file the contact person's information with the airport operations. Lighting should be checked for proper operation at least once per day, preferably at dusk.

Chapter 17 – AIRCRAFT PROTECTION

For this project, the Contractor's operations within the AOA are limited to the air carrier apron. The Contractor is not authorized to operate on or near active taxiways and

runways, unless specific and limited access is authorized for highly infrequent activities such as a surveyor referencing a PAC/SAC monument or specially arranged oversize construction deliveries (large crane or Passenger Boarding Bridge components may require airside delivery access). In such cases, the work shall be coordinated under the supervision of appropriately trained and badged individuals.

The air carrier apron is used by a variety of commercial aircraft types, including propeller and jet type commuter aircraft and narrow body airline jet aircraft, all with a maximum wingspan of 118 feet (Airplane Design Group III). An aircraft taxilane is marked along the outer edge of the apron (depicted by taxilane centerline striping (solid yellow) and taxilane edge striping (dashed double yellow). Aircraft follow the taxilane between the 3 apron access taxiways (F, H and R) and the aircraft gate parking positions, and back. Aircraft generally arrive at the gate under their own power and are generally pushed back from the gate by aircraft tug (occasionally, aircraft depart from the gate under their own power).

The Taxi lane Object Free Area (TLOFA) is 162 feet wide (81 feet offset either side of the taxi lane centerline stripe). This is the area which must be kept clear of objects so the aircraft can pass with a small safety margin along the travel path of the wing tip.

No construction may occur within the TLOFA while the taxi lane is open for aircraft operations. Generally, the only construction activity for this project occurring immediately adjacent to the TLOFA is application and subsequent removal of pavement marking for a ground vehicle access corridor.

Generally, construction operations are not anticipated immediately adjacent to active aircraft parking positions. The Contractor's personnel, vehicles and equipment are prohibited from entering into the red outline safety box of any occupied aircraft parking position or within 100 feet (unless separated by temporary fencing) of any aircraft that is maneuvering into or out of the position or which has its engines running except as coordinated in advance with the airline station manager and under coordination in real time with airline ground handling personnel.

During low speed aircraft operation on the apron, five-foot minimum clearance shall be maintained between equipment and materials and any part of an aircraft (includes wingtip overhang). In these situations, flaggers must be used to direct construction equipment, and wing walkers will be necessary to guide aircraft. Wing walkers shall be airline/aviation personnel rather than construction workers.

Use caution with regard to jet blast and prop wash.

Chapter 18 - OTHER LIMITATIONS ON CONSTRUCTION

- a. **Tall equipment.** If Contractor utilizes cranes, bucket trucks, concrete pumps or other equipment exceeding 25' in height, Contractor is responsible for filing a "Notice of proposed Construction" (7460) with FAA prior to erecting equipment. Contractor should allow at least 30 days for FAA review. Detailed instructions can be found on the FAA website: <https://oeaaa.faa.gov/oeaaa/external/portal.jsp>.
- b. **Prohibitions**
 - 1) **No use of open flame welding or torches unless fire safety precautions are provided and airport management has approved their use.**
 - 2) **No use of electrical blasting caps** on or within 1,000 feet of the airport property.
 - 3) **No use of flare pots** within the AOA.

END