

## TECHNICAL SPECIFICATION - ELECTRICAL

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### **1. SUBSTATION ELECTRICAL EQUIPMENT**

#### **1.1. GENERAL**

This is a general specification and covers the equipment required for substation construction. Any equipment listed which does not apply to this particular project shall be disregarded. The Drawings shall be used to determine the exact quantity and type of equipment intended for use on this project.

#### **1.2. SCOPE**

This Section covers labor, equipment, and material requirements for the installation of the substation electrical equipment. The Contractor shall erect in place, test, and leave ready for service, the facilities shown on the Drawings and herein specified. The Contractor shall also have responsibilities for receiving, off-loading, and transporting certain structures, equipment, and miscellaneous materials as called for in this Specification. The Contractor shall furnish and install materials and equipment only as specified or approved by the Project Engineer.

#### **1.3. STANDARDS**

The installation covered by these Specifications shall conform to the practices set forth in the latest edition of the National Electrical Code (NEC) and the National Electrical Safety Code (NESC), unless otherwise specified in these Plans and Specifications.

#### **1.4. MATERIALS**

- 1.4.1. All Contractor furnished materials, unless otherwise indicated, shall be new, of the first quality and of the proper type for use intended. When applicable, all material will be in accordance with the latest published NEMA Standards and/or carry the approval of the Underwriter's Laboratories.
- 1.4.2. The use of a manufacturer's trade name and catalog number is intended to indicate preference. Products of reputable manufacture, equal quality, and functional type may be used only after stamped approval by the Project Engineer.
- 1.4.3. Owner furnished items, with a general description of the items and their storage location, are listed in the Attachments at the end of this Specification. The Contractor shall coordinate the receiving of the items with the JEA Contract Administrator. It is the Contractor's responsibility, unless otherwise specified, to furnish labor and equipment for loading, for transporting, and for off-loading the items at the job site.
- 1.4.4. All material and equipment stored on the substation site or other areas including Owner furnished material and equipment, shall be in the care, custody, and control of the Contractor. The Contractor shall be responsible for any necessary repairs or replacement of materials and equipment damaged, lost, or stolen while in the care and custody of the Contractor.

#### **1.5. OUTDOOR SUBSTATION STRUCTURES**

The Contractor shall install all substation structures as indicated on the Drawings. Assembly of the structures shall be in accordance with the Manufacturer's assembly drawings, unless otherwise specified.

- 1.5.1. The Owner's Supplier shall furnish the substation structures as a part of the "Structures and Materials" package. It is the Contractor's responsibility, unless otherwise specified in the Appendix, to furnish labor and equipment for receiving, off-loading, and storing these structures at the job site.
- 1.5.2. It shall be the Contractor's responsibility to notify the Owner of any damage to the structures and errors in the structure fabrication before and during the installation, so that the Owner may coordinate with the Manufacturer and make good any such damage to the equipment.
- 1.5.3. Detailed structural assembly drawings may be inspected at the JEA office in Jacksonville, Florida, by contacting the Project Engineer.
- 1.5.4. The steel structures, as shown on the Drawings, will be furnished by the Owner and are fabricated for bolted field assembly. Mounting holes for equipment have been included in the fabrication of the structures.
- 1.5.5. The Contractor shall include in the bid and be responsible for the correction of minor errors and minor modifications in the structures in order to provide for a complete installation as indicated on the Drawings.

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Corrections shall include but not be limited to the following: reaming misaligned holes, punching new holes, and clipping or punching support angles as required. Approximately 100 punched holes shall be considered minor modifications. All modifications shall be cold galvanized to resist corrosion.

- 1.5.6. Any equipment mounted on the structures by the Contractor (e.g. AC panels, outlet boxes, etc.) shall be mounted utilizing galvanized or stainless steel materials and hardware. Whenever practical, the Contractor shall mount miscellaneous equipment to the structures using non-penetrating methods such as back-to-back unistrut. All holes drilled to mount such equipment shall be cold galvanized to resist corrosion.
- 1.5.7. The Contractor shall provide and install a bit-u-mastic coating for the bases of all aluminum structures which come into direct contact with concrete foundations.
- 1.5.8. The Contractor shall install lighting fixtures mounted on the lightning probe poles and on the takeoff structures complete with conduit, wiring, light fixtures, and switches, in locations as shown on the Drawings. Light fixtures will be furnished by the Owner, as indicated in the Attachments at the end of these Specifications. Conduit, switches, and wiring as specified on the Drawings shall be furnished by the Contractor.
- 1.5.9. Erection of the lightning probe poles shall be in accordance with the Manufacturer's assembly drawings.
- 1.5.10. The Contractor shall install perimeter lighting poles complete with anchor bases, arms, conduit, wiring, light fixtures, and photocells in locations as shown on the Drawings. Lighting poles, anchor bases, arms, light fixtures, and photocells will be furnished by the Owner, as indicated in the Attachments at the end of these Specifications.
- 1.5.11. All substation structures and equipment are stored at the Substation Packager's facility. The Contractor shall plan and make provisions for receiving, unloading, and storing on site all related structures and equipment.
- 1.5.12. The Contractor shall provide dry storage containers, as required, for all items (including but not limited to cardboard boxes, fragile items, etc.) requiring inside storage until assembly and installation by the Contractor. Tarps and/or covers placed on top of the material and stored outdoors do not qualify as dry storage in this Contract.

### **1.6. POWER TRANSFORMERS**

- 1.6.1. The Owner will be responsible for delivery and offloading the power transformer(s) onto the foundation unless the Contractor fails to have the transformer foundation(s) ready as per the Specific Instructions. The Owner will provide the Contractor the desired delivery date when available. The Contractor shall prepare the site and foundation as directed to facilitate off-loading (see Specific Instructions for additional transformer installation requirements). An approximate delivery date for the transformer is listed in the Specific Instructions of these Specifications. Crane and Rigging in Jacksonville, Florida, is the only company approved to lift, transport, and set power transformers for JEA.
- 1.6.2. The Contractor shall schedule the installation of the transformer foundation to allow for a minimum two (2) week curing time prior to the receipt and installation of the transformer. This will require the Contractor to schedule the installation of the transformer foundation well in advance of the estimated delivery date of the transformer, due to the inherent uncertainties involved in shipping large transformers. Early foundation construction times, and the corresponding longer curing times are strongly recommended.
- 1.6.3. The Owner, the Equipment Manufacturer's Contractor, or representative acting as an agent for the Owner, will be responsible for assembly of the power transformer and will furnish and operate the filtering equipment, vacuum drying equipment, provide the insulating oil, and fill the transformer. The Contractor shall provide adequate working space and access to temporary construction power to allow assembly and vacuum oil filling of the power transformer.
- 1.6.4. In no instance is a Contractor's employee or agent to enter a transformer manhole unless accompanied by the Owner's representative and only after suitable oxygen analysis has been conducted on the internal equipment environment.
- 1.6.5. The power transformer shall be under the care and custody of the Contractor while on the substation site. The Contractor shall be responsible for any minor repairs, as deemed necessary by the Project Engineer, to the finish of the power transformer that may have been damaged while in the care and custody of the Contractor.
- 1.6.6. Connections to the power transformer by means of bus or conductor will be the responsibility of the Contractor.

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- 1.6.7. The foundation, conduit, control and power cabling, grounding, and associated work will be the responsibility of the Contractor.
- 1.6.8. All associated primary wiring, secondary wiring, control wiring, and grounding connections shall be furnished and installed by the Contractor in accordance with the Manufacturer's assembly instructions and JEA substation equipment interconnection drawings.

### 1.7. CIRCUIT BREAKERS

The Contractor shall be responsible for either transporting the circuit breakers to the substation site from their storage location at an arbitrary location within Duval County, Florida, or receiving all circuit breakers directly from the Manufacturer at the job site at the discretion of JEA.

- 1.7.1. The following tasks must be performed if the breakers are being shipped directly to the job site:
  - A. The Contractor may assume that the Owner's Manufacturer shall have the breakers available for shipping in time to meet the scheduled circuit breaker shipping dates which are shown in the Project Schedule in the Attachments of these Specifications.
  - B. As the project progresses, the Contractor shall notify the Project Engineer in writing (or by electronic mail) at least two (2) weeks in advance of the date of the Contractor's readiness for the breakers. This should be at the time of foundation pouring, to assure sufficient time for curing, and should conform to the breaker delivery dates listed in the Project Schedule in the Attachments of these Specifications.
  - C. The Owner's Manufacturer will then ship the breakers directly to the job site and deliver it on the date specified by the Contractor, +/- five (5) business days.
  - D. The Contractor shall then have employees and equipment on-site during business hours, throughout this five day window, to off-load the breakers within one (1) hour of the shipper's arrival. The Contractor shall then take responsibility of the breakers, and may choose whether to set the breakers directly onto the pad or to set the breakers in an approved storage area. Approved storage areas shall mean any storage location approved by the JEA Contract Administrator for this specific purpose.
  - E. The Contractor shall be responsible to ground the circuit breakers (including each high-voltage bushing) immediately upon arrival at the job site. This may be done by means of a temporary attachment to the ground grid, when approved by the JEA Contract Administrator. The Contractor shall also run temporary AC power to the heater in the control panel of each breaker.
- 1.7.2. The Contractor shall be responsible for some minor assembly of the breakers at the job site. This assembly, which shall be supervised by JEA personnel, shall include assembly of supports, attachments of control panel doors, etc. The Owner shall supply the Contractor with one (1) copy of the Manufacturer's assembly instructions. The Contractor shall closely follow these instructions.
- 1.7.3. The Owner, the Equipment Manufacturer's Contractor, or representative acting as an agent for the Owner, will furnish and operate the filtering equipment, vacuum drying equipment or SF-6 gas handling equipment, and provide the insulating oil or SF-6 gas. The Owner will be responsible for filling and final adjustment of the circuit breakers.
- 1.7.4. The Contractor shall be responsible for the placement of the circuit breakers on the foundations. The Contractor shall install the circuit breakers such that the lowest point of any energized parts is not less than the appropriate above grade clearance for personnel safety (NESC) above the foundation elevation.
- 1.7.5. Connections to the circuit breakers, by means of bus or conductor, will be the responsibility of the Contractor.
- 1.7.6. The foundation, conduit, control and power cabling, grounding, and associated work will be the responsibility of the Contractor.
- 1.7.7. All associated primary wiring, secondary wiring, and control wiring, and grounding connections shall be installed by the Contractor in accordance with the Manufacturer's assembly instructions, unless directed otherwise on the construction drawings.

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### 1.8. SWITCHES & LOAD BREAK DEVICES

- 1.8.1. The Contractor shall install group-operated switches, ground switches, load break devices, hookstick disconnect switches, and fuse disconnect switches as indicated on the Drawings.
- 1.8.2. The group-operated switches, ground switches, load break devices, hookstick disconnect switches, and fuse disconnect switches will be furnished by the Owner's Supplier as a part of the "Structure and Materials" package. The Contractor shall receive, off-load, and store these switches in the same manner as described for the "Structures and Materials" package, unless otherwise directed.
- 1.8.3. The Contractor shall adjust and align all switch blades and contacts according to the Manufacturer's recommendations.
- 1.8.4. All load break devices shall be installed according to the Manufacturer's recommendations. The Contractor shall be responsible for the re-alignment of switch blades and contacts.
- 1.8.5. All operating handles shall be aligned such that the mechanism may be locked in the "OPEN" or "CLOSED" position.
- 1.8.6. The minimum clearance between contacts of each pole in the open position shall be adjusted to meet the requirements of NESC and NEMA standards.
- 1.8.7. The Owner's responsibility will be limited to inspection and acceptance of switch and operator alignment. Final alignment or adjustment shall be by the Contractor.
- 1.8.8. The Contractor shall ensure that all control and power (AC and DC) cables are installed and in service prior to the requesting that JEA perform testing and final checkout.

### 1.9. INSULATORS, BUSWORK, & CONNECTORS

- 1.9.1. The station type insulators, bus, conductor, and connectors shall be furnished by the Owner's Supplier as listed in the Bill of Materials as a part of the "Structures and Materials" package and installed by the Contractor in accordance with the Manufacturer's assembly instructions. The Contractor shall receive, off-load, and store this equipment in the same manner as described for the "Structures and Materials" package, unless otherwise directed. That includes providing dry storage for the material, boxes, crates, cartons, etc. not suited for outdoor storage.
- 1.9.2. The Contractor shall install station type insulators, bus, conductor, and connectors as indicated on the Drawings.
- 1.9.3. Any chipped or damaged insulators shall be brought to the Owner's attention prior to installation. The Contractor shall repair minor insulator damage after review of the damage and approval of the Contractor's proposed repair process is made by the Project Engineer.
- 1.9.4. The minimum clearance between bus and overhead conductors of different phases and from conductors to ground shall be as indicated on the Drawings. Where not specifically indicated, the minimum clearances shall be as per ANSI and IEEE requirements.
- 1.9.5. The Contractor shall install all bus, conductors, and connectors as indicated on the Drawings. All items on the substation structures, including hardware, will be furnished by the Owner's Supplier unless noted otherwise on the Bill of Materials or on the Drawings.
- 1.9.6. The welding of aluminum bus shall adhere to the following requirements:
  - A. The welding process and all welding operators shall be qualified in accordance with the Aluminum Association Aluminum Construction Manual, "Specifications for Aluminum Structures", Section 7/2/4 (Qualification of Welding Procedure and Welding Operators).
  - B. All joints to be welded shall be free of moisture and hydrocarbons. Degreasing shall be done with a non-toxic solvent. Sufficient time must be allowed for the evaporation of the solvent prior to welding. Wire brushing with a stainless steel wire brush should be employed after solvent cleaning to remove all oxide films, water stains, etc.
  - C. All aluminum welds shall be by the gas metal-arc (MIG) or the gas tungsten-arc (TIG) welding process.

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- D. The working area should be substantially draft-free and protected from atmospheric contamination.
  - E. All welds shall be made with clean metal and the completed weld shall have a smooth finish and shall indicate good fusion with the parent metal.
  - F. All connections shall be checked for the proper edge penetration and alignment before, during, and after the weld is made. The cross sectional area of the weld should not be less than that of the smallest member being joined.
  - G. To repair a defective weld, the defective portion must be entirely removed. The area to be repaired should be re-cleaned as described herein and the weld made in a manner similar to the original.
  - H. Tackwelding should be used to prevent misalignment of the members being joined during the welding process.
- 1.9.7. Tinned connectors shall be installed when a copper to aluminum connection is made. The tinned connectors shall be furnished by the Owner.
- 1.10. INSTRUMENT TRANSFORMERS & LIGHTNING ARRESTERS
- 1.10.1. The instrument transformers and lightning arresters will be furnished by the Owner's Supplier as a part of the "Structures and Materials" package. The Contractor shall receive, off-load, and store these materials in the same manner as described for the "Structures and Materials" package, unless otherwise directed.
  - 1.10.2. The Contractor shall install outdoor instrument transformers as indicated on the Drawings. All wiring shall be as listed in the Cable Schedule and Conduit Schedule.
  - 1.10.3. The Owner will furnish, operate, and supervise the filtering equipment and oil for the instrument transformers as required.
  - 1.10.4. The Contractor shall install lightning arresters as indicated on the Drawings.
  - 1.10.5. All associated primary wiring, secondary wiring, instrument and control wiring, and grounding connections shall be installed by the Contractor in accordance with the Manufacturer's instructions, unless stated otherwise in the Drawings.
  - 1.10.6. Tinned connectors shall be installed when a copper to aluminum connection is made. The tinned connectors shall be furnished by the Owner.
- 1.11. STATION SERVICE, AUTOMATIC TRANSFER SWITCH & ELECTRICAL PANELS
- 1.11.1. The Contractor shall be responsible for transporting and installing the Owner furnished distribution type transformers in the locations as shown on the Drawings. The transformers are located at the JEA Commonwealth Service Center and will be taken out of stock. JEA will furnish and the Contractor shall install the medium voltage station service transformers.
  - 1.11.2. Less than 600V low voltage class transformers are not normally stocked by JEA. These transformers shall be furnished and installed by the Contractor as shown on the Drawings.
  - 1.11.3. The Contractor shall be responsible for transporting and installing the automatic transfer switch if specified on the Station Service Drawing. The transfer switch shall be ASCO Type 7000 and be furnished by the Owner complete with a NEMA 3R enclosure. The Contractor shall furnish and install galvanized unistrut channels and stainless steel mounting hardware as required to mount the transfer switch to the structure mounting brackets.
  - 1.11.4. The Contractor shall furnish and install all new AC electrical panels on the load side of the automatic transfer switch as shown on the Drawings, unless directed otherwise. The Contractor shall also furnish and install the internal circuit breakers, ground bus, and associated hardware (as required) to complete the wiring shown on the panel drawing. The Contractor shall also furnish and install the galvanized unistrut channel and stainless steel mounting hardware as required to mount the panel to the structure mounting brackets.
  - 1.11.5. The Contractor shall be responsible for furnishing the necessary terminals, connectors, etc., to terminate cables at the ATS and splices (as required).

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- 1.11.6. The Contractor shall be responsible for furnishing and installing the substation electrical panels, cabinets, and junction boxes. The exact quantity, locations and sizes of the panels, cabinets, and junction boxes shall be as shown on the Drawings. All substation AC panels shall be enclosed in stainless steel enclosures.
- 1.11.7. The AC power panelboards shall be Square D Co. Type NQOD. All panelboards shall be enclosed in a NEMA 3R enclosure and shall also include housings with a lockable cover and/or door.
- 1.11.8. The Contractor shall be responsible for furnishing and installing the main and branch circuit breakers in all yard panels. The main breakers and branch circuit breakers shall be conventional bolt-on type circuit breakers rated in accordance with the Drawings. The wiring and labeling of each panel breaker shall be as shown on the Drawings and in accordance with other applicable Sections of these Specifications.
- 1.11.9. The Contractor shall be responsible for securely mounting substation electrical panels to the substation structures. Mounting brackets may have been incorporated into the structure design. The Contractor shall furnish and install galvanized unistrut channels and stainless steel mounting hardware as required to mount the electrical panels, cabinets, and junction boxes to the structure mounting brackets. Should any alteration or modification be necessary for the mounting of electrical panels, the Contractor shall submit details of the proposed alteration to the Project Engineer in writing for approval prior to installation.
- 1.12. SUBSTATION RECEPTACLES
  - 1.12.1. The substation receptacles shall be furnished by the Contractor.
  - 1.12.2. The Contractor shall be responsible for installing the yard receptacles and the vacuum pump receptacles. Installation and wiring of each receptacle shall be in accordance with the Drawings. Details for mounting the substation receptacles (if applicable) are included in the Drawings.
  - 1.12.3. The 120V (single phase) yard receptacles shall be standard grounding type duplex receptacles mounted in a weatherproof outlet box with a weatherproof cover, Crouse-Hinds catalog number WLRD-1 or approved equal.
  - 1.12.4. The 240V (single phase) truck receptacles shall be Thomas & Betts/Russellstoll Type SCA, catalog number 3323-78 or approved equal.
  - 1.12.5. The 240V (three phase) vacuum pump receptacles shall be Thomas & Betts/Russellstoll Type SCA, catalog number 3324-78 or approved equal.
  - 1.12.6. All above grade conduit to the receptacles shall be either rigid galvanized steel or UV resistant PVC, Schedule 40.
- 1.13. SUBSTATION RELAY BOXES
  - 1.13.1. The Contractor shall be responsible for furnishing and installing the bus differential boxes, potential transformer fuse boxes, terminal blocks, fuse blocks, test switches, and heaters (as specified). The exact quantities, locations, sizes, and types of boxes, blocks, switches, and heaters shall be as shown on the Drawings. The bus differential and PT fuse boxes shall be stainless steel.
  - 1.13.2. The Contractor shall be responsible for securely mounting the substation relay boxes to the substation structures. Mounting brackets may have been incorporated into the structure design for most of these boxes. The Contractor shall furnish and install galvanized unistrut channels and stainless steel mounting hardware as required to mount the relay boxes to the structure mounting brackets. Details for mounting and wiring the substation relay boxes (if applicable) are included in the Drawings. Should any alteration or modification be necessary for mounting the relay boxes, the Contractor shall submit details of the proposed alteration to the Project Engineer for approval prior to installation.
  - 1.13.3. Unless otherwise specified or as shown on the Drawings, all above grade conduit to the relay boxes shall be either rigid galvanized steel or UV resistant PVC, Schedule 40. Installation and termination of control and instrument wiring shall be in accordance with the Specifications and Drawings.
- 1.14. CONSTRUCTION STATION SERVICE
  - 1.14.1. The Contractor shall be responsible for installing and maintaining a temporary station service facility for new construction and additions to existing stations where adequate facilities are not available.
  - 1.14.2. The Contractor shall be responsible for following standard permitting and application procedures to obtain the construction service. Where the installation of a power transformer or autotransformer is required, the



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construction service shall be 3-phase. The Contractor's service is to be metered and shall comply with JEA requirements for meter can, weather-head, and disconnect.

- 1.14.3. The Contractor shall provide the necessary conduit, cable, entrance head, meter, disconnect switch, panels, outlets, etc. to sufficiently supply electric service to the field office, construction outlets, and permanent low-voltage receptacles for station check-out.
- 1.14.4. The Owner will provide the distribution lateral, temporary span poles, distribution transformers, and service drop as required for the construction station service.
- 1.14.5. The Owner will be responsible for the total metered electric charges of the construction service during the term of the Construction Contract.
- 1.14.6. The Contractor shall provide a 200A disconnect in a NEMA 3R enclosure to run conduit and cables to the permanent station service facilities for use in equipment check-out by the Owner. The Contractor shall furnish and install conduit to the cable trench, or permanent facilities, and install single conductor 4/0 RHW cable to the ATS or AC panels (as required). This requirement is in addition to the Contractor's service and shall be provided as soon as the low-voltage equipment is in place (see the Specific Instructions for Sequence of Work).  
**NOTE:** Termination of the permanent station service transformers to the ATS or low-voltage electrical panels shall not be performed until after the temporary service has been disconnected.
- 1.14.7. The Contractor will be required to remove the construction service pole and the construction service once the substation is energized and the permanent station service is in operation. Additionally, the Contractor shall apply for removal of the service drop and transformer bank.

## **2. GROUND GRID & BONDING SYSTEM**

### **2.1. GENERAL**

- 2.1.1. This is a general specification and covers the requirements and procedures for the installation of, or addition to, the station ground grid system. Any material or equipment listed which does not apply to this particular project shall be disregarded. The Drawings shall be referenced for specific requirements concerning the quantity, type, and installation of the material to complete the station ground grid system.
- 2.1.2. The Contractor shall be responsible for providing the Owner with an accurate "As Built" drawing of the station ground grid (as specified in the Specific Instructions).

### **2.2. SCOPE**

This Section covers the labor, equipment, and material requirements for the installation of, or addition to, the station ground grid system. The Contractor shall install the ground grid, ground rods, and ground wells as shown on the Drawings and herein specified. The Contractor shall also be responsible for the connection of all substation electrical equipment, control building electrical equipment, substation structures, fences and gates to the station ground grid system as shown on the Drawings and herein specified.

### **2.3. MATERIALS**

- 2.3.1. The Contractor shall refer to the Drawings for material requirements to complete the station ground grid system. The Contractor shall furnish materials and equipment only as specified or approved by the Project Engineer.
  - A. All Contractor furnished materials, unless otherwise specified, shall be new, of first quality and of the proper type for the use intended.
  - B. The Owner shall furnish above grade structure and equipment grounding connectors, unless otherwise indicated. The above grade structure and equipment grounding connectors will be furnished by the Owner's Supplier as a part of the "Structures and Materials" package. The Contractor shall receive, off-load, and store these items in the same manner as described for the "Structures and Materials" package. The Contractor shall furnish the below and above grade ground grid conductor; below grade connectors; the equipment, structures, manhole, and fence grounding conductor; and all fence grounding connectors.

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The Contractor shall also furnish the grounding system as shown on the Drawings for any "sliding-type" main entrance gate.

### **2.4. GROUND GRID**

- 2.4.1. The Contractor shall furnish the required amount of 19#8 and 7#5 Copperweld conductor and the 500MCM copper conductor for the ground grid, unless otherwise specified. The Contractor shall purchase the grounding material which meets or exceeds JEA material requirements. The 19#8 conductor (JEA #COBCW015) shall be Copperweld, 19-strand #8, 0.643" diameter, 40% conductivity as per ASTM B-227 and B-228, high strength - rated 27,548 lbs. The 7#5 conductor (JEA #COBCW016) shall be Copperweld, 7-strand #5, 0.546" diameter, 40% conductivity as per ASTM B-227 and B-228, high strength - rated 17,949 lbs.
- 2.4.2. The Contractor shall install the ground conductor in the locations indicated on the Drawings and at the depth specified. The Contractor shall install the conductor in an open trench to facilitate proper installation and inspection of the ground grid connections.
- 2.4.3. The Contractor shall notify the Owner of any damaged ground grid conductor before, during, and after installation so the conductor may be replaced.
- 2.4.4. The Contractor shall furnish material (as required) and install all ground rods, ground wells, and grounding connections to complete the ground grid system, as specified.

### **2.5. GROUND RODS AND GROUND WELLS**

- 2.5.1. The Contractor shall furnish and install ground rods and ground wells (as specified) in the locations shown on the Drawings. Rods and wells shall be specified by either the depth or resistance required. Details for ground rod connections (if applicable) are included in the Drawings.
- 2.5.2. Where the installation of ground rods and ground wells is specified by depth or where driving rods in soil of high resistivity, it may be necessary to use casing in the well holes. The Contractor shall make a resistance reading of each ground rod and/or ground well prior to its connection to the station ground grid and report these readings to the Project Engineer for verification of the ground grid design. Connection of the rod to the station ground grid shall be made, only after Owner approval, utilizing the exothermic process. The Contractor shall also include these readings on the "As Built" Drawings.
- 2.5.3. Where the installation of ground rods and ground wells is specified by resistance, the Contractor shall install the ground rods and ground wells to a minimum, base bid depth of fifty (50') feet, unless otherwise specified. The Contractor shall continue until the specified resistance is achieved. A unit price of \$3.75 per foot installed will be used for adjusting the contract price from the base bid depth.
- 2.5.4. All ground rods and ground wells shall maintain a minimum earth cover twenty-four (24") inches below compacted earth grade elevation.
- 2.5.5. Where the installation of ground rods is not specified by resistance or depth, the Contractor shall install ground rods twenty (20') feet deep at all locations as shown on the substation grounding drawing. No ground rods or wells shall be installed under paved roadway areas.

### **2.6. GROUND GRID CONNECTIONS**

- 2.6.1. Ground grid connections (including connections to ground rods and ground wells) shall be made by an approved exothermic process utilizing Cadweld Plus molds and materials manufactured by Cadweld. The Contractor shall use the Cadweld Plus System with the corresponding molds and electronic control unit for weld metal ignition. Molds for each type of connection are to be replaced after a maximum use of fifty (50) welds. Ground grid connections may be made by AMP, or other approved mechanical connectors (only if specified), where the number of connections required is limited.
- 2.6.2. Ground grid connections shall be of the type that avoids cutting and/or splicing of the main grid conductor.
- 2.6.3. A Manufacturer's representative is required to demonstrate the proper installation procedures of the exothermic system being used prior to installation of any ground grid connection. The Contractor shall be responsible for arranging the demonstration. Any Contractor representative that may install the ground grid connections and the JEA Contract Administrator shall be present at the demonstration.

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- 2.6.4. The Contractor shall strictly follow the Manufacturer's installation procedures.
- 2.6.5. All surfaces to be joined by the weld shall be thoroughly cleaned and dried prior to final placement of the mold. Worn, damaged, or incorrectly sized molds which in the opinion of the JEA Contract Administrator do not make satisfactory welds shall be removed from the job site.
- 2.6.6. All welded connections made by the exothermic process shall encompass 100% of the end of the material being welded. Welds which do not meet this requirement shall be remade at the Contractor's expense.
- 2.6.7. All welded connections made by the exothermic process shall be visually inspected by the JEA Contract Administrator and may be subjected to testing. Testing shall be in the form of moderate hammer blows, from which a properly formed connection will easily resist any visible damage. Any connection which fails such a test or which, upon visual inspection, indicates a porous or deformed weld shall be remade at the Contractor's expense. Should different molds or materials be required to facilitate the corrected connection of a failed weld, such material shall be furnished at the Contractor's expense. The use of molds and materials other than specified must be approved for use by the Project Engineer.
- 2.7. TRANSFORMER GROUNDING
  - 2.7.1. The Contractor shall connect the neutral bushing of any power transformer or autotransformer directly to the station ground grid using 500MCM copper conductor. The neutral ground conductor shall extend continuously and be connected to the station ground grid in two (2) places using the connection process specified. The two (2) connections shall be made to the same ground grid run and shall be placed approximately three (3') feet apart.
  - 2.7.2. The Contractor shall connect the transformer tank to the ground grid in at least two (2) locations as shown on the Drawings using 7#5 Copperweld conductor and the connection process specified.
  - 2.7.3. The Owner shall furnish the above grade grounding connectors to be used in connecting the power transformers to the ground grid. The Contractor shall furnish the 500MCM copper and the 7#5 Copperweld grounding conductor to be used in connecting the power transformers to the ground grid system.
- 2.8. SWITCH GROUNDING
  - 2.8.1. All group operated switches shall be furnished by the Owner complete with an operator platform. The operator platform shall be located on the rock surface as indicated by the Drawings and be connected on one side to the station ground grid. A continuous grounding conductor shall extend from the other side of the operator platform through the parallel ground clamp, provided for structure grounding, to the operating mechanism. This conductor shall be connected to the operating pipe by means of a flexible copper braid. The remaining groove of the parallel grounding clamp shall contain a conductor connected directly to the station ground grid. All mechanical connectors used in this installation shall be furnished by the Owner. Details for grounding the operator platform (if applicable) are included in the Drawings.
  - 2.8.2. Every switch structure shall be connected to the station ground grid in at least two (2) locations, as shown on the Drawings. One (1) switch structure ground conductor shall be installed as specified herein.
  - 2.8.3. Grounding switches shall have a continuous ground conductor from the blades to the station ground grid. This conductor shall be routed on the structure column opposite of the operating mechanism to facilitate complete grounding of the switch structure. The operating pipes for both the line and ground switches shall be connected by flexible copper braid as specified herein.
- 2.9. EQUIPMENT GROUNDING
  - 2.9.1. The Contractor shall be responsible for connecting electrical equipment such as circuit breakers, station service transformers, potential transformers, instrument transformers, lightning arrestors, etc., directly to the station ground grid as shown on the Drawings.
  - 2.9.2. Electrical equipment shall be furnished by the Owner, unless otherwise specified. The Contractor shall be responsible for installing the equipment ground conductor on the side of the structure designed to accommodate the ground conductor.
  - 2.9.3. The Owner shall furnish all above grade ground connectors necessary to connect the equipment to the station ground grid, unless otherwise specified. The Contractor shall furnish the 7#5 Copperweld grounding conductor

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and all other material, equipment, and labor necessary to complete the connection of the electrical equipment to the station ground grid.

- 2.9.4. The Contractor shall install the equipment ground conductor such that the continuity of the conductor from the equipment to the station ground grid is maintained as much as practical.
- 2.9.5. The ground conductor installed on the equipment structures shall be sufficient in meeting the requirements of structure grounding.
- 2.9.6. Free standing electrical equipment, such as circuit breakers, shall be connected directly to the station ground grid. The Contractor shall install ground conductors as shown on the Drawings. More than one (1) ground conductor installation may be required in the grounding of free standing electrical equipment.

### **2.10. STRUCTURE GROUNDING**

- 2.10.1. The Contractor shall be responsible for connecting all steel structures directly to the station ground grid as shown on the Drawings.
- 2.10.2. The structures are furnished by the Owner and are designed to accept the ground connectors provided. The Contractor shall be responsible for installing the structure ground conductor on the proper side of the structure to facilitate the connection of the structure to the station ground grid.
- 2.10.3. The Owner shall furnish all above grade ground connectors necessary to connect the structures to the station ground grid, unless otherwise specified. The Contractor shall furnish the 7#5 Copperweld grounding conductor and all other material, equipment, and labor necessary to complete the connection of the steel structures to the station ground grid.
- 2.10.4. The Contractor shall install all structure ground conductors such that they conform to the structure and foundation. Ground conductors on structures with grounded equipment shall conform to the requirements of this Specification.
- 2.10.5. Structures must be grounded to the station grid within the same working day the structure is erected.

### **2.11. CABLE TRENCH AND CONTROL BUILDING GROUNDING**

- 2.11.1. The Contractor shall install the cable trench and control building grounding as specified and shown on the Drawings. The Contractor shall furnish the 7#5 Copperweld conductor necessary to ground the cable trench and control building to the station ground grid and all other required material and labor to complete the installation.
- 2.11.2. The Contractor shall install the cable trench and control building ground conductors. The ground conductors shall run the entire length of the cable trench and connect to the station ground grid at all points of intersection. Two (2) ground conductors shall be brought into the control building through the cable trench and attached to the outside of the cable tray. The Contractor shall furnish and install 7#5 Copperweld cable clips on both sides of the cable trench to support the ground conductors.
- 2.11.3. Connection of the ground conductor to the cable tray shall be made utilizing Burndy Type GC2929CT connection or approved equal. The ground conductor shall be secured to the cable tray at each cable tray fitting or at intervals not exceeding four (4') feet throughout the length of the tray. Provide ground wire lugs and hardware (as required). The cable tray shall NOT be used as a ground path.
- 2.11.4. Control building equipment, including electrical panels shall be connected to the control building ground by means of Anderson Type K3 connector or approved equal.

### **2.12. FENCE AND GATE GROUNDING**

- 2.12.1. The Contractor shall furnish the material and connect the fences to the station ground grid as specified and as shown on the Drawings. Details for grounding the fence and fence gates, if applicable, are included in the Drawings.
- 2.12.2. The Contractor shall connect the fence to the station ground grid at every gate post, every corner post, and intermediate posts at convenient intervals, no more than forty (40') feet apart. The fence and gate posts shall be connected to the station ground grid using 7#5 Copperweld conductors.

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- 2.12.3. The Contractor shall furnish #2 AWG Copperweld conductor and connectors as required to complete the fence grounding. The conductor shall attach to the post with a minimum of three (3) clamp connections and be woven into the fence fabric between these connections to terminate on each strand of barbed wire.
- 2.12.4. Each personnel and equipment swing gate shall have a perimeter ground conductor of 19#8 Copperweld connected to the station ground grid. This conductor shall extend approximately three (3') feet beyond the gate swing, both inward and outward, unless property restrictions prevent the exterior extension.
- 2.12.5. Each swing gate leaf shall be connected to the gate post with a copper welding cable, as specified on the Drawings. The copper welding cable and exothermic weld connections shall be furnished by the Contractor. The Contractor shall connect the welding cable directly to the post and the post grounding conductor.
- 2.12.6. The Contractor shall furnish and install the grounding system as shown on the Drawings for the substation sliding entrance gates.

### **3. RACEWAY**

#### **3.1. GENERAL**

- 3.1.1. This is a general specification and covers the requirements and procedures for the installation of conduits, wireways, manholes, cable trenches, and cable trays used to distribute power and control cables to the equipment in the substation and control building. Any material or equipment listed which does not apply to this particular project shall be disregarded. The Drawings shall be referenced for specific requirements concerning the quantity, type, and installation of material to complete this work.
- 3.1.2. The Contractor shall be responsible for providing the Owner with accurate "As Built" drawings of the conduit, cable trench, and cable tray systems installed (as specified in the Specific Instructions).

#### **3.2. SCOPE**

This Section covers the labor, equipment, and material requirements for the installation of conduits, wireways, manholes, cable trenches, and cable trays in the substation and control building. The Contractor shall furnish all materials necessary and install the conduits, wireways, manholes, cable trenches, and cable trays as shown on the Drawings and specified herein.

#### **3.3. MATERIALS**

The Contractor shall refer to the Drawings for material requirements to complete the installation of the conduits, wireways, manholes, cable trenches, and cable trays as required for the substation raceway system. The Contractor shall furnish materials and equipment only as specified or approved by the Project Engineer.

- 3.3.1. All Contractor furnished materials, unless otherwise specified, shall be new, of first quality, and of the proper type for the use intended.
- 3.3.2. The Contractor shall refer to the "Conduit Schedule" for specific material requirements of individual raceway runs.
- 3.3.3. Unless otherwise specified, UV resistant Schedule 40 PVC shall be permitted for underground conduit runs. All above grade conduit shall be either rigid galvanized steel or UV resistant Schedule 40 PVC, unless otherwise specified or as shown on the Drawings. The inside edge of conduit ends (spigot-end only in the case of belled-end conduit) shall be beveled to eliminate sharp edges and minimize the possibility of cable damage.

#### **3.4. CONDUIT AND WIREWAY**

- 3.4.1. The Contractor shall furnish and install the conduits, as listed in the "Conduit Schedule" and as shown on the Drawings.
- 3.4.2. The Contractor is responsible for all hardware necessary to complete the installation of the conduit system.
- 3.4.3. Conduits shall be installed at the depth shown on the Drawings, with the area backfilled and compacted to same density as surrounding areas. See Civil / Structural Specifications for installation and proofing requirements for the conduit systems, as required.

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- 3.4.4. The Contractor shall form all above grade conduits to conform to the surfaces of the foundations and structures. Rigid galvanized steel conduit shall be formed using a pipe bender. UV resistant Schedule 40 PVC shall be shaped with a Therm-o-Tools Company combo type, Hotbox bender, or approved equal.
- 3.4.5. The Contractor shall furnish and install all indoor conduits, junction boxes, switches, and receptacles as specified in the "Conduit Schedule" and as shown on the Control House Drawings.
- 3.4.6. The Contractor shall furnish and install the wireway as specified in the "Conduit Schedule" and as shown on the Control House Drawings. The wireway shall be NEMA 1 square wireway, smooth, seam free, without knockouts, and shall have removable covers. The wireway and associated fittings shall be finished with baked satin ANSI 61 gray enamel over phosphatized surface. The wireway shall be manufactured from steel not less than 16 gauge and shall conform to NEMA standards. The Contractor shall install the wireway in accordance with the Manufacturer instructions and as indicated on the drawings. All field cuts shall be made with a hacksaw and grounded smooth. Terminations of the wireway run into the cable tray, electrical panels, or electrical equipment shall utilize a panel adapter. Wireway sweeps consisting of two (2) 45 degree bends shall be used in lieu of one (1) 90 degree bend.
- 3.4.7. The Contractor will be responsible for labeling all conduits as listed in the "Conduit Schedule". For details, see Subsection "Labeling" of this Section.
- 3.4.8. The Conduit shall be installed a minimum of 18" below final grade. All conduits within the oil containment area shall route below the bottom of the containment liner.
- 3.4.9. After installation and backfilling of the underground conduits, the constructor shall compact the area to the same density, and with similar material, as the adjacent undisturbed materials.
- 3.4.10. Elbow radius for 2", 3", and 4" control and low voltage power conduits shall be 24" unless otherwise noted.
- 3.4.11. Conduit should be routed as much as practical in accordance with the routes shown on drawing. Any changes to the routing must be provided on a detailed set of As-Builts.
- 3.4.12. The contractor shall be responsible for furnishing and installing all conduits as listed in the conduit schedules unless stated. All materials shall conform to those as specified in the schedules. The constructor shall supply all necessary stainless steel hardware and support channels/fittings for fastening items to surfaces as needed.
- 3.4.13. Above grade conduits not shown, stub up locations combined with relevant details required for above ground routing as necessary. Above grade conduit shall closely conform to the foundation and structure to which it is to be mounted. Liquidtight flexible conduit flexible conduit with malleable iron straight-insulated connector can be used for the above circuit breaker connection.
- 3.5. MANHOLES
  - 3.5.1. The Contractor shall furnish and install all pre-cast manholes, including procurement, delivery, receiving, and unloading the manholes directly from the Manufacturer at the jobsite.
  - 3.5.2. The Contractor shall install the manholes in the Contractor's excavation and furnish conduit, bricks, mortar, base course, and back-fill material; See requirements for installation in the Civil / Structural Specifications.
  - 3.5.3. JEA will furnish cable racks and hooks for the Contractor to install into the manholes.
  - 3.5.4. The Contractor shall furnish and install the remainder of the items necessary for the manhole building, including the grounding ring and connections as shown on the drawings.
- 3.6. PULLBOXES
  - 3.6.1. Unless otherwise noted, JEA shall furnish and contractor shall install all pre-cast pullboxes in the locations shown on the drawings. The final elevation of the pullbox shall be flush with the final grade or rocked elevation, as necessary.
  - 3.6.2. Requirements for installation, including trenching, backfill, compaction, etc. shall be as shown on the drawings and the Civil / Structural Specifications.

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### 3.7. PRE-CAST CABLE TRENCH

The trench system shall consist of precast concrete or fiber reinforced precast concrete framing members, side sections, and removable cover sections assembled to form a completely enclosed trench, except with open earth bottom having a 4" bedding of sand.

- 3.7.1. The Contractor shall furnish and install a precast concrete cable trench system as manufactured by TRENWA Products, Inc. (Patent #2862367), 1419 Alexandria Pike; Fort Thomas, Kentucky 41075.
- 3.7.2. The installation of the cable trench shall be in strict accordance with the Drawings, these Specifications, and the Manufacturer assembly drawings.
- 3.7.3. The trench shall be dimensioned as shown on the Drawings. A sixteen (16") inch nominal depth shall be furnished, unless otherwise specified.
- 3.7.4. One-piece trench system with 10'-0" standard lengths shall be furnished.
- 3.7.5. Precast trench covers shall be furnished in sections, sized to permit removal by a single person, and each shall have slots for lifting tools.
- 3.7.6. The trench system shall be designed to support at least 200# per square foot live load. The road crossing sections shall be precast and designed for H-20 loading.
- 3.7.7. Precast trench members shall be cast in steel forms using 3000# or greater high early strength concrete. Members shall be cured for a period of at least fourteen (14) days.
- 3.7.8. The Contractor shall furnish and install all necessary special fittings, offsets, terminations, or other designated fittings (as required).
- 3.7.9. The Contractor shall furnish and install the cable transition ladder assembly with covers for the trench in the length shown on the Drawings for the entrance to the control house.
- 3.7.10. Install the concrete trench system in earth trenches with covers extending above the surrounding crushed rock surfacing approximately three (3") inches. See Site Plan for top of trench elevations.
- 3.7.11. Excavate trenches to a minimum width consistent with the stability of the sides. Excavate completely to the bottom of the framing members and correct any points of over-excavation by returning to grade with mechanically compacted fine earth backfill to form a smooth trench bottom. Remove all excess excavated material as required for proper alignment and elevation of work.
- 3.7.12. Excavation shall conform to other requirements as set forth in the Civil / Structural Specifications. Grounding of the cable trench shall conform to the requirements of this Section.
- 3.7.13. Component members shall be set only on firm, compacted earth, sand, or gravel mix, at an elevation such that the top of the sidewall will be two (2") inches above the final grade (top of crushed rock) for the substation. Prior to setting the trench section, place geotextile fabric the full length of the trench excavation, overlapping a minimum of two (2') feet at each joint of the fabric. The width of the fabric shall be sufficient to cover the bottom and both sides of the cable trench to finish grade. Geotextile fabric shall be Mirafi 140N, a non-woven water permeable fabric as distributed by:
  - H. Moore & Associates, Inc
  - Maislin Drive, Bldg. E
  - Tampa, Florida 33637or approved equal.
- 3.7.14. After setting the component trench sections, back fill along sides with the geotextile fabric flush against the sides. Place a minimum four (4") inches of bedding sand in the trench to form a level bottom, just covering the bottom of the section members.
- 3.7.15. Hand tamp the backfill along the outside walls of the trench. Backfill shall conform to other requirements as set forth in the Civil / Structural Specifications of these Specifications.

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- 3.7.16. At the trench entrance to the control house, set trench section bottom members on the control house foundation support for trench as provided in the foundation construction. Adjust the end elevation of the section to meet that shown on the Drawing details.
- 3.7.17. The Contractor shall furnish and install the cable tray transition compartment as designed for the trench as shown on the Drawings. The cable tray transition compartment shall be sealed to the control house wall.
- 3.7.18. The Contractor shall protect the trench against entrance of construction debris, rock, and earth during the construction and after placing of the sand bedding. The trench shall be cleaned out of any such foreign material prior to placing control cables and just before final placing of covers.
- 3.7.19. The Contractor shall provide the Owner with a new set of Manufacturer's cover removal tools as well as the tools used during construction. The Contractor shall deliver these tools to the Project Representative.

### **3.8. CABLE TRAY**

- 3.8.1. The Contractor shall furnish and install the cable tray system located in the switchboard room. The Contractor shall submit a description and/or shop drawings of the proposed cable tray system for approval. The shop drawings submitted shall include certified flexural and loading data with the Manufacturer's recommendation of maximum span for the design load.
- 3.8.2. Indoor cable trays shall be fabricated from extrusions of aluminum alloy 6063-T5 or 6063-T6. Application shall be in accordance with the ASCE Specifications and AWS Standards. The trays shall be furnished with a six (6") inch depth or four (4") inch depth, as indicated on the Drawings and in nominal twelve (12') foot lengths. Splices shall be of the high pressure bolted type. The design load for the tray installation shall be a minimum 200 lbs. per linear foot for the maximum tray width of thirty-six (36") inches or nine (9") inches, as described on the Drawings, when supported on twelve (12') foot centers.
- 3.8.3. Indoor cable trays shall be of the aluminum ladder type with cross rungs spaced six (6") inches maximum center to center.
- 3.8.4. All rungs, dropouts and other metal surfaces in contact with the cable shall have smooth, rounded edges. The rungs shall be joined to the sides by a homogeneous union method, weld on swage.
- 3.8.5. Cable tray supports shall be provided at intervals not to exceed the Manufacturer's recommendations for maximum span for the design load and type of tray being supported. In no case shall the spans exceed that shown on the Drawings.
- 3.8.6. All necessary splice plates, bolts, nuts, lock washers, etc., shall be furnished compatible for use with the type metal tray provided.
- 3.8.7. Provide ground wire lugs and hardware as required. The cable tray shall NOT be used as a ground path. Grounding of the cable tray shall conform to the requirements of this Section.

## **4. MEDIUM VOLTAGE CABLE (26KV)**

- 4.1.1. JEA will furnish, pull, and terminate all power feeder cable from the substation outgoing terminals to the manholes and all splicing and connections thereafter.

## **5. CONTROL CABLE & LOW-VOLTAGE ELECTRICAL CABLE**

### **5.1. CABLE SCHEDULE**

- 5.1.1. The Contractor shall pull and terminate all cables as listed in the Cable Schedule. All control cable, shielded control cable and instrument cable will be provided by Owner. All other cables listed shall be provided by the Contractor.
- 5.1.2. Cable lengths listed in the Cable Schedule are approximate. The Contractor shall be responsible for verification of all cable lengths prior to cutting.
- 5.1.3. The Contractor is responsible for providing the Owner with accurate "As Built" revisions of the Cable Schedule, Conduit Schedule, and related Drawings, as specified in the Specific Instructions.



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5.1.4. All low-voltage electrical cable furnished by the Contractor shall be as specified in the Cable Schedule. Where multiple conductor cable is specified, the Contractor shall furnish and install multiple conductor cable. Cable lengths listed in the Cable Schedule are approximate. The Contractor shall supply cable as necessary to complete the work.

5.1.5. The Contractor will be responsible for labeling all cables as listed in the Cable Schedule. For details, see Subsection "Labeling" of this Section.

### **5.2. SPLICES**

5.2.1. All runs of control cable shall be continuous. Splices in control cable shall NOT be permitted.

5.2.2. Splices made in low-voltage electrical cable should be avoided. When necessary, splices in low-voltage electrical cable shall conform to all applicable NEC and NESC standards.

### **5.3. INTERCONNECTION DRAWINGS**

5.3.1. The control cable Interconnection Drawings will be supplied at a later date by the Owner to show all terminations of the cables as listed on the Conduit and Cable Schedules.

5.3.2. The Contractor shall be responsible for terminating all cables listed on the Conduit and Cable Schedules. The Contractor shall also be responsible for the termination of any jumpers on terminal blocks in the equipment or on the control panels that may be shown on the Interconnection Drawings.

5.3.3. The Bid shall be based on the assumption of a termination at both ends of every conductor in each cable of the Cable Schedule.

5.3.4. The Owner shall terminate all cables to existing control panels which are energized. The Contractor shall pull cables to these panels, fan ends, install terminals, and leave ample cable for making terminations.

### **5.4. CONTROL CABLE TERMINALS**

Ring type compression terminals, which shall be furnished by the Contractor, shall be used at both ends of all control cables and wiring. The ring terminals used shall be non-insulated, tin plated, barrel type with brazed seam and sized for the wire being terminated. Terminal manufacturer's recommendation shall be used to select the termination lug to match the size of the terminal screw and the size of the wire. All terminal lugs shall be crimped using a lug-crimping tool recommended by the lug manufacturer. Care shall be taken to avoid under and over crimping. Each crimp shall be inspected for good connection visually and by applying appropriate tension to the joint.

### **5.5. GROUNDING OF SHIELDED CONTROL CABLE**

A copper shield grounding bus has been provided at the top of each relay control panel for terminating the ground conductor of each shielded control cable. Each ground conductor from the shielded cables will land individually on a terminal space, and be identified with its appropriate cable name. The Owner will provide ground cables from the shield bus to the panel ground. The Contractor shall provide amp type Termi-foil connectors for jumper connections between the control cable shields to the panel ground shield bus. The jumper wire size shall be a stranded #10 AWG.

### **5.6. LENGTH OF CABLES FOR CONTROL PANELS**

All cables pulled to the control panels shall be sized to reach the floor of the panel and back to the top of the relay panel or RTU. The insulation jacket shall then be stripped back to the top of the panel and all cables terminated without cutting individual wires.

## **6. CONTROL HOUSE ELECTRICAL**

### **6.1. SCOPE**

This Section covers the equipment, installation, and wiring necessary for the control house. The Contractor should review the drawings to understand their scope in this regard.

### **6.2. GENERAL**

The Contractor shall furnish and install the low-voltage equipment in locations as shown on the Drawings. The installation of low-voltage wiring of this equipment shall conform to the practices set forth in the latest edition of the NEC, unless

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otherwise specified in these Plans and Specifications. It shall be the Contractor's responsibility to furnish the required quantity of conduit and cable necessary to complete the installation.

### 6.3. EQUIPMENT AND MATERIALS

- 6.3.1. All materials, unless otherwise indicated, shall be new, of the first quality, and of the proper type for the use intended. Where applicable, all material shall be in accordance with the latest published NEMA Standards and/or carry the approval of the Underwriters' Laboratories.
- 6.3.2. The use of a manufacturer's trade name and catalog number is not intended to indicate preference, but only the type and quality of the product desired. Products of reputable manufacturers of equal quality and functional type will be acceptable upon approval of the Project Engineer. Substitutes which tend to lower the quality of the work will not be permitted.

### 6.4. PLACING EQUIPMENT IN SERVICE

Equipment and electrical circuits shall be checked and tested prior to energization. Notification of the JEA Contract Administrator is to be made before energization of the low-voltage electrical equipment so a representative of the JEA Contract Administrator will be present.

### 6.5. CONTROL HOUSE ELECTRICAL PANELS

- 6.5.1. The Contractor shall be responsible for furnishing and installing the control house electrical panels. The exact quantity, locations, and sizes of the panels shall be as shown on the Drawings.
- 6.5.2. The AC panel shall be Square-D Company Type "NQOD" or an approved equal. The panelboard shall be enclosed in a NEMA 1 enclosure and include lightning protection. The panels shall include a lockable cover and/or door.
- 6.5.3. The DC panel shall be Square-D Company I-Line Type "HCN" or an approved equal. The panelboard shall be enclosed in a NEMA 1 enclosure. The panels shall include a lockable cover and/or door.
- 6.5.4. The main breakers and branch circuit breakers shall be conventional bolt on type circuit breakers rated in accordance with the Drawings. The wiring and labeling of each panel breaker shall be as shown on the Drawings.

### 6.6. CONTROL HOUSE LIGHTING AND OUTLETS

- 6.6.1. The Contractor shall furnish and install the following lighting fixtures, see Drawings for quantities and locations:

**NOTE:** All lighting will operate at line voltage of 120 volts.

- A. LED, Lithonia Lighting Type LBL4, 41W, 120V, or approved equal. Mounted at the level shown on the Drawings.
  - B. LED, explosion proof, 200 Watt equivalent, Crouse-Hinds, or approved equal. Ceiling mounted as shown on the Drawings. Use for battery room.
  - C. LED, E-Lite Star EWP-C02H035NB with photo control kit for 120V WL2KPR12, wall mounted, or approved equal. Use for control house outside wall lighting.
  - D. Incandescent, McPhilben ES12N 100W PAWG SD CS emergency lighting unit, wall mounted, or approved equal. Use for control house emergency lighting.
- 6.6.2. The Contractor shall furnish and install the following items as needed to complete the Control House Electrical as shown on the Drawings:
    - A. Receptacle, ground-type duplex, surface mounted.
    - B. Receptacle, ground fault circuit-interrupter, duplex, surface mounted.
    - C. Three way switch, surface mounted.
    - D. Four way switch, surface mounted.
    - E. Single pole switch, surface mounted.
    - F. Junction boxes.
    - G. Conduit, EMT, PVC, and aluminum, as required.
    - H. Weatherproof covers for all outdoor switches and receptacles.

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- I. Smoke detector GE Type 350CX with Form A and C output relays.

### 6.7. CONTROL HOUSE HVAC EQUIPMENT

- 6.7.1. The Contractor shall furnish and install, as shown on the Drawings, Trane 2.5 ton packaged split system heat pump with heat strips as follows:

- (2) Trane TEM4A0B30S31S Air Handler Unit
- (2) Trane 4TTR4030L1 Condensing Unit
- (2) Trane BAYHTR1405000A, 5kW Electric Heater
- (2) Single Stage Heating/Cooling Thermostat
- (2) Trane TAYPLNM100 Plenum Pedestal Upflow

**NOTE:** Refer to the Control House Electrical drawing for exact number and locations of the condensers and air handlers. For further details or contact information about this equipment, contact the Project Engineer.

- A. The Contractor shall furnish and install ducting, return and supply air grills, and permanent type filters associated with the heat pumps above. The Contractor shall also furnish and install a turning vane to efficiently project air into the control house.
- B. For each heat pump specified above, the Contractor shall furnish and install two (2) non-fusible, 2-pole heavy duty disconnect safety switches, 60A, 240VAC, one (1) shall use an indoor NEMA 1 enclosure and one (1) shall use a rain tight NEMA 3R enclosure, the disconnect safety switches shall be manufactured by Square-D Company. After the Contractor has installed each heat pump specified above, the Contractor shall complete the conduit run from the disconnect safety switches to the heat pump units, utilizing a section of liquid-tight flexible conduit sized appropriately for connection to the heat pump units. The Contractor shall then complete the power wiring from the disconnect safety switches to the heat pump units.

- 6.7.2. The Contractor shall furnish and install one (1) wall mounted exhaust fan (Nutone Model #8070SA with Model #834 washable permanent aluminum-mesh filter, or approved equal) in the bathroom. The Contractor shall also furnish and install one (1) wall mounted exhaust fan, explosion-proof, having a capacity of 100 cfm at 0.375 inch wg static pressure with backdraft damper and wall cap in the battery room. Return register with opposed blade dampers shall be provided and adjusted to balance exhaust airflow to 100 cfm. The Contractor shall submit for approval the battery room exhaust fan and associated equipment. Both wall mounted exhaust fan motors shall be suitable for 120V, single phase, 60Hz operation.

### 6.8. BATTERY BANK, CONTROL SWITCHBOARD PANELS & SCADA RTU CABINET

- 6.8.1. The Owner will furnish two (2) battery banks, two (2) tier battery racks and two (2) battery chargers. The Contractor shall transport the above material from the JEA Commonwealth Service Center warehouse to the jobsite, unload, and store them indoors until assembly by the Manufacturer. The Contractor shall move the material to the control house battery room, upon completion of the battery room, for installation by the Manufacturer.
- 6.8.2. The Contractor shall install the battery chargers, conduits, AC and DC cables, and grounding conductors as required by the Plans and Drawings prior to requesting assembly of the battery banks. The Contractor shall provide a four (4) week notice before requesting the assembly of the battery banks by the Manufacturer. The Manufacturer shall install, float charge, test, and approve the battery bank for in-service operation.
- 6.8.3. The Contractor shall request delivery schedule, unload, and install the control switchboard panels (quantity as indicated on the Drawings), as shown on the Drawings. The Contractor shall be responsible for properly leveling the panels and ensuring that all access doors are operable. The Owner will furnish and install all communications, network, and security switchboard panels within the control house. The Contractor shall be responsible for all additional incurred cost by JEA if the Contractor is unable to unload and place the relay panels into the control house upon delivery from the Manufacturer.

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### **6.9. CONTROL HOUSE GROUNDING**

- 6.9.1. The control house grounding shall be furnished and installed by the Contractor as specified and as shown on the Drawings.
- 6.9.2. The control house ground shall be connected to the station ground grid. Two (2) station ground connections shall be brought into the control house through the cable trench and attached to the outside of the cable tray by Burndy Type GC2929CT connectors or approved equal.
- 6.9.3. The control house equipment, including electrical panels, shall be connected to the control house ground by Anderson Type K3 connectors or approved equal.

### **7. RECEIVING AND OFF-LOADING OF STRUCTURES AND MATERIALS**

The Contractor shall be responsible for taking delivery of all Substation Structures and Materials directly from the Owner or the Manufacturer at the job site. This will require that the Contractor perform the following tasks regarding Substation Structures and Materials delivery as the project progresses:

- 7.1.1. The Contractor may assume that the Owner's Manufacturer shall have the Substation Structures and Materials available for shipping in time to meet the scheduled Structures and Materials shipping date which is shown in the Project Schedule in the Attachments of these Specifications.
- 7.1.2. As the site work progresses, the Contractor shall notify the Project Engineer in writing (or by electronic mail) at least two (2) weeks in advance of the date of the Contractor's readiness for all Structures and Materials. However, this scheduled delivery date must be within two (2) weeks of the scheduled Structures and Materials shipping date which is listed in the Project Schedule in the Attachments of these Specifications.
- 7.1.3. The Owner's Manufacturer will then set an approximate schedule for the shipment of all Substation Structures and Materials directly to the job site and deliver on the date specified by the Contractor, +/- five (5) business days (two week window).
- 7.1.4. When the shipper of each shipment is within 48 hours of the Substation site, the shipper will contact the JEA Contract Administrator to schedule a delivery appointment. The Contractor, shipper, and JEA Contract Administrator shall then coordinate a firm appointment.
- 7.1.5. The Contractor shall then have employees and equipment on-site, throughout normal business hours of that day, to off-load all Substation Structures and Materials within two (2) hours of the shipper's arrival. The Contractor shall then take responsibility of all Substation Structures and Materials, and may store the Structures and Materials on-site in an approved storage area. Approved storage area shall mean any storage location approved by the JEA Contract Administrator for this specific purpose.
- 7.1.6. The JEA Contract Administrator and the Contractor shall then count, examine, and sign for all Structures and Materials.

### **8. LABELING**

The Contractor shall be responsible for labeling the following newly-installed substation facilities at the job site. This will require that the Contractor perform the following tasks:

#### **8.1. LABELING OF LARGE TRANSFORMERS AND BREAKERS**

The Contractor shall provide and install all labeling of all newly-installed large transformers and high-voltage circuit breakers in the substation as specified below.

- 8.1.1. The Contractor shall label the transformers and breakers using spray paint and a block stencil with six (6") inch high letters. The equipment designations to be used are shown on the "SINGLE LINE DIAGRAM" Drawing.
- 8.1.2. The Contractor shall prepare the surface of the transformers and breakers prior to painting, in a manner approved by the JEA Contract Administrator. The paint shall be Rust-oleum spray on #7776-830, flat black, or equal as approved by the JEA Contract Administrator.

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- 8.1.3. The labeling shall be applied, at approximately eye level, in two (2) places: on the right hand side of the cabinet door and another location as specified by the JEA Contract Administrator.

### **8.2. LABELING OF HIGH-VOLTAGE SWITCHES**

JEA shall provide and the Contractor shall install labeling on all newly-installed high-voltage substation switches at the job site. These switches include high-voltage hook switches, group-operated switches, circuit switchers, and fused disconnect switches which interconnect to the buswork. The labeling of these switches will require that the Contractor perform the following tasks:

- 8.2.1. The Contractor shall apply labels on the switch support structures as enumerated on the Drawing titled "SINGLE LINE DIAGRAM".
- 8.2.2. The Contractor shall label the switches using reflective labeling to be provided by JEA through the JEA Contract Administrator. Note that the Contractor must notify the JEA Contract Administrator in writing (or by electronic mail) when the Contractor is approximately two (2) weeks away from needing these labels. The JEA Contract Administrator will then pick up the labels from the JEA storeroom and deliver to the Contractor at the job site.
- 8.2.3. The labeling shall be applied at a location to be field located by the JEA Contract Administrator, or a JEA employee who is directed by the JEA Contract Administrator.

### **8.3. LABELING OF LOW-VOLTAGE PANELS**

The Contractor shall provide and install all labeling of all other low-voltage panels installed in the substation as well as low-voltage AC/DC power panels in the control building, as specified below:

- 8.3.1. The Contractor shall label the cover of every newly installed junction box, AC low-voltage supply panels, DC low-voltage supply panels, and others as labeled on the "CONDUIT PLAN" and the "LOW VOLTAGE AC & DC DIAGRAMS" Drawings. This shall also include the AC low-voltage supply panels and DC low-voltage supply panels in the control building.
- 8.3.2. The Contractor shall label the covers using a block stencil with three (3") high letters.
- 8.3.3. The Contractor shall prepare a reasonable portion of the surface of such covers and paint the characters onto the surface. Paint shall be Rust-oleum spray on #7776-830, flat black, or equal as approved by the JEA Contract Administrator.
- 8.3.4. The labeling shall be applied, at approximately eye level, centered on the cover, or other location if approved by the JEA Contract Administrator.
- 8.3.5. The labeling shall also be hand-written inside the panel, to the panel box itself, in a conspicuous location, using a permanent marker. Sharpie Fine Point Series 30000 Black, or approved equal.

### **8.4. LABELING OF LOW-VOLTAGE AC/DC SUPPLY BRANCHES**

The Contractor shall be responsible for labeling of all newly-installed low-voltage AC/DC supply branches at the job site. This will require that the Contractor perform the following tasks:

- 8.4.1. The Contractor shall label the branch circuits of each AC/DC supply branch to agree with the designations as shown on the "LOW VOLTAGE AC & DC DIAGRAMS" Drawing.
- 8.4.2. The Contractor shall label the branch circuits of each AC/DC supply branch in two (2) locations; the panel front surface adjacent to the protection device (breaker) and the branch index sheet provided with the cover of the cabinet.
- 8.4.3. The branch index sheet shall be neatly typed (or clearly printed in ball-point pen) with the branch names shown on the Drawings for these panels. Two (2) copies of this sheet will be produced by the Contractor and provided to either the JEA Contract Administrator or the Project Engineer at the final checkout / inspection.
- 8.4.4. The Contractor shall provide and install labels of each branch on the panel front surface adjacent to the protection device (breaker). The Contractor shall refer to the JEA Contract Administrator for approval of a labeling system for this purpose.

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### 8.5. LABELING OF SUBSTATION RECEPTACLES

The Contractor shall provide and install labels on all newly-installed substation receptacles at the job site. This will require that the Contractor perform the following tasks:

- 8.5.1. The Contractor shall apply labels on the substation receptacle structures as labeled on the Drawings.
- 8.5.2. The Contractor shall label the substation receptacle structures using a block stencil with three (3") high letters.
- 8.5.3. The Contractor shall prepare a reasonable portion of the surface of such structures and paint the characters onto the surface. Paint shall be Rust-oleum spray on #7776-830, flat black, or equal as approved by the JEA Contract Administrator.
- 8.5.4. The labeling shall be applied at a location to be field located by the JEA Contract Administrator.
- 8.5.5. Additionally, the Contractor shall label each receptacle on the inside of the receptacle faceplate or cover using a permanent fine-tip black marker. Sharpie Fine Point Series 30000 Black, or approved equal.

### 8.6. LABELING OF CONDUITS

The Contractor shall provide and install labels on all newly-installed conduits as a part of this work. This shall require that the Contractor perform each of the following:

- 8.6.1. Where conduits enter an electrical panel (AC/DC service panel, control panel, junction box, etc.), the Contractor shall label the conduit in two (2) places:
  - A. The Contractor shall label the conduit circumferentially, about two (2") inches outside of the box, using a permanent fine-tip black marker. The markings shall be positioned and sized so that a person working on the cabinet may readily see the markings.
  - B. The Contractor shall also apply the same labels, using a permanent fine-tip black marker, on the interior of the box, conspicuously near the conduit entry points.
- 8.6.2. Where conduits enter a cable trench, the Contractor shall label the conduit along the axis of the conduit, about two (2") inches below the conduit opening, using a permanent large-tip black marker. The markings shall be positioned and sized so that a person looking downward onto the conduit may readily see the markings.
- 8.6.3. Where a conduit terminates other than as mentioned above, the Contractor shall label the conduit along the axis of the conduit, about two (2") inches below the conduit termination, using a permanent large-tip black marker.
- 8.6.4. All conduit identifications shall be those taken from the Conduit Schedule which is attached to these Specifications.

### 8.7. LABELING OF CABLE

The Contractor shall provide and install labels on all newly-installed cables as a part of this work. This shall require that the Contractor perform each of the following:

- 8.7.1. All cables are to be labeled:
  - A. At both ends.
  - B. Where entering and leaving cable trenches or pullboxes.
  - C. Where exiting station electrical equipment, to include all AC/DC power panels, power circuit breakers, power transformers, junction boxes, fiber optic, video, and station control panels, etc.
- 8.7.2. Cable identification tags will be attached to the cable in a manner approved by the JEA Contract Administrator. The Contractor shall prevent galvanic corrosion and not intermix dissimilar metals (Aluminum-Copper, Stainless Steel-Aluminum) when attaching tags to cables. Plastic cable ties shall not be permitted for exterior applications. Examples of exterior connection methods are lockable beaded chain and metal wire.
- 8.7.3. Outdoor cable identification tags shall be 1/2" wide stainless steel, Dymo M1011 system, unless otherwise approved by the JEA Contract Administrator. Indoor cable identification tags shall be RhinoPRO 1/2" flexible

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nylon labels - black on white, Manufacturer part# 18488, unless otherwise approved by the JEA Contract Administrator. Indoor labels shall be secured with no less than two plastic cable ties.

- 8.7.4. All cable identification tags will have the appropriate cable number clearly stamped in no less than 1/4" high characters. Cable numbers are specified on the Cable Schedule attached to these Specifications. The Contractor shall install the following signage on the substation fence, wall, or partitions, and control building entry point(s) as a part of this Work. The signage shall consist of three (3) components, the signs which shall be used on the Perimeter Security Boundary (which shall normally be a fence or a wall), the Perimeter Entry Points (gates, doors, etc.), and the Control building Entry Points (typically doors).
- 8.7.6. Perimeter Signage: The perimeter signage shall consist of signs labeled "**HIGH VOLTAGE UNAUTHORIZED PERSONNEL KEEP OUT**" (JEA Item ID# SIGDA003), placed at approximately fifty (50') foot spacing around the entire perimeter boundary (fence, wall, etc.) and at a conspicuous height.
- 8.7.7. Perimeter Entry Points Signage: Each entryway shall have signage in addition to the requirements of the perimeter signage. Entryways include the fence gates and wall entryways. The entryways shall each have the following three (3) signs:
  - A. "HIGH VOLTAGE UNAUTHORIZED PERSONNEL KEEP OUT" (JEA Item ID# SIGDA003)
  - B. "**DANGER HARD HAT AREA**" (JEA Item ID# SIGDA004)
  - C. "CONTACT SYSTEM DISPATCH BEFORE ENTERING/AFTER SECURING" (JEA Item ID# SIGDA005)
- 8.7.8. Control building Entry Point Signage: Each control building Entry Point (door, roll up doors, or any other appurtenance for the admission of persons under reasonable conditions) shall have signage in addition to the requirements mentioned above. For this paragraph, the "Control building" shall be any and every humanly-accessible building within or adjoining to the substation property that contains any electrical apparatus that monitors, controls, or otherwise is essential to the operation of the substation, and is not otherwise designed for novice/public entry and occupancy.

Each Control building Entry Point shall each have the following two signs:

  - A. "High Voltage Unauthorized Personnel Keep Out" (JEA Item ID# sigda003)
  - B. "Contact System Dispatch Before Entering/After Securing" (JEA Item ID# sigda005)
- 8.7.9. Exact location of the signage may be reviewed and modified with the concurrence of the on-site JEA Contract Administrator.
- 8.7.10. All signs for this Work shall be provided by JEA. The Contractor shall request the signage, indicating type and quantity, in writing (by email or other typewritten instrument) from the JEA Contract Administrator approximately two (2) weeks in advance of need.
- 8.7.11. The Contractor may assume that all signs for this Work shall include corner holes riveted with a non-corroding grommet or eyelet. The Contractor shall fasten the signs to the perimeter fence or wall, or control building door, in a manner that is to be submitted in writing (by email or other typewritten instrument) to, and approved by, the JEA Contract Administrator.