Substation Design & Construction Specifications

Miller 230kV Substation
Rev 0
07/29/2025

Design & Construction Specifications– ISSUED FOR REVIEW

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Division 1 – GENERAL REQUIREMENTS

Section 011105 – Summary of Work

This Section summarizes the Work covered in detail in the complete Contract Documents.

1. CONTRACT INFORMATION:
    a. Owner(s): JEA (Jacksonville Electric Authority)
    b. Contractor: The provider of design and engineering drawings and documents [Burns & McDonnell Inc., 495 N Keller Rd, Maitland, FL 32751]
    c. Bidder/Supplier/Manufacturer/Vendor: Provider of equipment, structures and materials as specified here in.
    d. Subcontractor: Installer of equipment, materials, and structures. Provider of materials as indicated in the Bill of Materials and specified herein.
    e. Subsupplier: Manufacturer or supplier of equipment and materials not manufactured by Supplier.
    f. Contract Documents: Collection of specifications, drawings, and documents included with Contract.
    g. Project Location: 30°19’10.90” N 81°55’2.52” W

2. PROJECT DESCRIPTION:
    a. The Miller Substation project consists of installing a new 230kV, 3-element ring bus. A prefabricated control enclosure, which will contain preassembled relay panels, will be installed at site by a third-party vendor. The project scope of Work includes the installation of a substation fence (560’ x 360’) with barbed wire, gates and a paved drive path. Installation of foundations for 230kV equipment, structures and control enclosure. Erection of structures including bus supports, switch supports, dead-ends, SSVT supports, CCVT supports, CT/PT supports, security/light poles, and lightning masts. Installation of 230kV equipment including gas circuit breakers, instrument transformers, SSVTs, surge arresters and disconnect switches. Installation of a ground grid, ground risers (stingers), ground rods, switch operator ground mats, above grade grounding of cabinets/junction boxes and installation of welded ground stirrups. Installation of five (5) inches of gravel throughout the substation, extending three (3) feet outside substation fence. Installation of below grade (PVC) and above grade (PVC/flex/RGS) conduit to substation equipment, lights and security equipment. Installation of approximately 260’ of cable trench. Installation of fiber and security hand-holes. Installation of 230kV extra-high strength bus support insulators, AAC flex jumpers, 4” Schedule 80 aluminum tube bus, bus fittings and welded terminal/tee connectors. Installation of yard and security lights. Installation of low-voltage power cables to substation equipment, receptacles, lights and security equipment. Installation of auto-transfer switch (ATS), metering cabinet, yard AC distribution panels, SSVT fuse cabinets and bollards (PVC only).

3. WORK COVERED BY CONTRACT DOCUMENTS:
    a. The Work for this Project includes the acceptance of Owner and/or Contractor supplied material, procurement of material, erection, installation and documentation for the high voltage substation and transmission equipment required for this project, specified in this document and shown in associate engineering drawings package.
4. WORK BY OTHERS:
    a. Owner
        i. Procurement and delivery of some major equipment (as specified herein)
        ii. Outage Planning and coordination
        iii. Outage switching
        iv. Testing and Commissioning
    b. Contractor
        i. Design & Engineering
5. WORK SEQUENCE:
        i. Sequence of Work shall be determined by Subcontractor.
        ii. Construction ways and means shall be determined by Subcontractor.
6. GENERAL REFERENCE DOCUMENTS:
    a. JEA 'Substation Standards Reference Manual' 2023 Edition
    b. JEA 'Electric Master Material Catalog'
    c. JEA 'Underground Electric Distribution Construction Standards' 2025 Edition
    d. Geotechnical Engineering Report, Miller Substation, Terracon Project No. EQ255021, 6/6/2025
    e. Site Pad and Elevations 'JEA Substation Details and Sections' REV.0 12-16-2024 by SWCA.
    f. Specifications for prefabricated control enclosure at JEA Miller 230kV Substation, REV. 1 5/1/2025

End of Section 011105 – Summary of Work

Section 013300 – JEA Submittals

This section includes definitions, descriptions, transmittals, and review of Submittals.

GENERAL INFORMATION:

1. Definitions:
    a. Shop Drawings, product data, and Samples are technical Submittals prepared by Contractor, manufacturer or Supplier and submitted by Contractor to Purchaser as a basis for approval of the use of Equipment and Materials proposed for incorporation in the Work or needed to describe installation, operation, maintenance, or technical properties, as specified in each Division of the Specifications.
    b. Shop Drawings include custom-prepared data of all types including drawings, diagrams, performance curves, material schedules, templates, instructions, and similar information not in standard printed form applicable to other projects.
    c. Product data includes standard printed information on materials, products, and systems; not custom-prepared for this Project, other than the designation of selections from available choices.
    d. Samples include both fabricated and unfabricated physical examples of materials, products, and Work; both as complete units and as smaller portions of units of Work; either for limited visual inspection or (where indicated) for more detailed testing and analysis. Mock-ups are a special form of Samples which are too large to be handled in the specified manner for transmittal of Sample Submittals.
    e. Descriptions of submittal requirements (as applicable) are defined in Appendix B – Submittal Descriptions.
2. Informational Submittals are those technical reports, administrative Submittals, certificates, and guarantees not defined as Shop Drawings, product data, or Samples.
    a. Technical reports include laboratory reports, tests, technical procedures, technical records, and Contractor's design analysis.
    b. Administrative Submittals are those nontechnical Submittals required by the Contract Documents or deemed necessary for administrative records. These Submittals include maintenance agreements, Bonds, Project photographs, physical work records, statements of applicability, copies of industry standards, Project record data, schedules, security/protection/safety data, and similar type Submittals.
    c. Certificates and guarantees are those Submittals on Equipment and Materials where a written certificate or guarantee from the manufacturer or Supplier is called for in the Specifications.
3. Refer to Sections 013300A, 01300B, 013300C of this Part for detailed lists of Submittals and specific requirements.
4. Quality Requirements:
    a. Submittals such as Shop Drawings and product data shall be of suitable quality for legibility and reproduction purposes. Every line, character, and letter shall be clearly legible.
    b. Drawings such as reproducibles shall be useable for further reproduction to yield legible hard copy.
    c. Documents submitted to Purchaser that do not conform to specified requirements shall be subject to rejection by Purchaser, and upon request by Purchaser, Contractor shall resubmit

conforming documents. If conforming Submittals cannot be obtained, such documents shall be retraced, redrawn, or photographically restored as may be necessary to meet such requirements. Contractor's or its Subcontractor's failure to initially satisfy the legibility quality requirements will not relieve Contractor or its Subcontractors from meeting the required schedule for Submittals.

d. Submittals which are resubmitted by Contractor to address Purchaser comments shall have all changes from previous revision clearly clouded on the drawing or document. In addition, transmittal letters accompanying resubmitted transmittal shall clearly describe all changes made to each drawing or document.

5. Language and Dimensions:
    a. All words and dimensional units shall be in the English language.
    b. Metric dimensional unit equivalents may be stated in addition to the English units. However, English units of measurement shall prevail.
6. Submittal Completeness:
    a. Submittals shall be complete with respect to dimensions, design criteria, materials of construction, and other information specified to enable Purchaser to review the information effectively.
    b. Where standard drawings are furnished which cover a number of variations of the general class of Equipment, each drawing shall be annotated to indicate exactly which parts of the drawing apply to the Equipment being furnished. Use hatch marks to indicate variations that do not apply to the Submittal. The use of "highlighting markers" will not be an acceptable means of annotating Submittals. Annotation shall also include proper identification of the Submittal permanently attached to the drawing.
    c. Reproductions or copies of Contract Drawings or portions thereof will not be accepted as complete fabrication or erection drawings. Contractor may use a reproduction of Contract Drawings for erection drawings to indicate information on erection or to identify detail drawing references. Whenever the Drawings are revised to show this additional Contractor information, Purchaser’s title block shall be replaced with Contractor's title block, and Purchaser’s professional seal shall be removed from the drawing. Contractor shall revise these erection drawings for subsequent Purchaser revisions to the Contract Drawings.
7. Form of Submittals:
    a. Submittals and other Project documents shall be transmitted in electronic format as specified.
    b. Selected Submittals may be provided in paper ("hardcopy") copies only with advance approval of Purchaser, and using procedures specified herein.
    c. Equipment instruction books and operating manuals shall be provided in paper copies in addition to specified electronic format.
8. Electronic Format:
    a. Scanned Submittals and documents are not acceptable. Transmit Submittals and Project documents in:
        i. Nonproprietary, native electronic format incorporating any necessary reference files, or Adobe *PDF files created directly from native electronic format, or Purchaser-approved equal.
        ii. Electronic submittal PDF files are not to be combined files or collections of files/drawings. Each drawing document must stand alone.

iii. Each file will be right reading and orientation the same for all consecutive resubmissions.
iv. For any given Submittal, the filename and format shall be consistent for initial submission and subsequent revisions of the same. Use consistent naming convention throughout. Reference to revision or dates shall not be included in a filename.
v. Nonconforming Submittals are subject to rejection by Purchaser.

b. Provide "as-constructed" Submittals, record documents, Equipment instruction books and operating manuals, and other documents on CD-ROM in AutoCAD, and Adobe *PDF format as required and approved by Purchaser.
c. Equipment instruction books and operating and maintenance manuals shall be in Adobe *PDF format combined in one pdf file for the complete O&M manual, or divided into pdf files that represent entire volumes (corresponding to hardcopy volumes). The pdf files shall be completely bookmarked with links within the index sheet to the different sections within the manuals/volumes, corresponding to the defined tabs within the hardcopy version.
i. Digital delivery media shall be Purchaser's File Transfer Protocol (FTP) site(s).

TECHNICAL SUBMITTALS:

1. Schedule of Submittals:
a. Prepare for Purchaser's concurrence, a schedule for submission of all Submittals specified or necessary for Purchaser's approval of the use of Equipment and Materials proposed for incorporation in the Work or needed for proper installation, operation, or maintenance. Submit the schedule with the procurement schedule and construction progress schedule. Schedule submission of all Submittals to permit review, fabrication, and delivery in time so as to not cause a delay in the Work of Contractor or its Subcontractors or any other contractors as described in the Contract Documents.
b. In establishing schedule for Submittals, allow 20 days in Purchaser's office for reviewing original Submittals and 15 days in Purchaser's office for reviewing resubmittals.
c. Submittals requiring revision shall be resubmitted within 10 days after receipt of Purchaser's review notations.
d. The schedule shall indicate the anticipated dates of original submission for each item and Purchaser's approval thereof, and shall be based upon at least one resubmission of each item.
e. Schedule all Submittals (Shop Drawings, product data, and Samples) required prior to fabrication or manufacture for submission as needed to meet the required completion dates. Schedule Submittals pertaining to storage, installation, and operation at the Site for Purchaser's approval prior to delivery of the Equipment and Materials.
f. Resubmit Submittals the number of times required for Purchaser's "Submittal Approved." However, any need for resubmittals in excess of the number set forth in the accepted schedule, or any other delay in obtaining approval of Submittals, will not be grounds for extension of the Contract Times, provided Purchaser completes his reviews within the times specified.
g. Where a Submittal is required by the Contract Documents or the accepted schedule of Submittals, any related Work performed prior to Purchaser's review and approval of the pertaining Submittal will be at the sole expense and responsibility of Contractor.

2. Transmittal of Submittals:
    a. All Submittals (Shop Drawings, product data, and Samples) for Equipment and Materials furnished by Contractor, Subcontractors, manufacturers, and Suppliers shall be submitted to Purchaser by Contractor.
    b. After checking and verifying all field measurements, transmit all Submittals to Purchaser for approval as follows:
        i. Mark each Submittal by Project name and number, Contract title and number, and applicable Specification Section and Article number. Include in the letter of transmittal the Drawing number and title, sheet number (if applicable), revision number, and electronic filename (if applicable). Unidentifiable Submittals will be returned for proper identification.
        ii. Check and approve Submittals of Subcontractors, Suppliers, and manufacturers prior to transmitting them to Purchaser. Contractor's submission shall constitute a representation to Purchaser that Contractor approves Submittals and has determined and verified all design criteria, quantities, dimensions, field construction and installation criteria, materials, catalog numbers, compliance with Laws and Regulations, and similar data, and Contractor assumes full responsibility for doing so; and Contractor has coordinated each Submittal with the requirements of the Work and the Contract Documents.
        iii. At the time of each submission, call to the attention of Purchaser in the letter of transmittal any deviations from requirements of the Contract Documents.
        iv. Make all modifications noted or indicated by Purchaser and return the required number of revised Submittals until approved. Direct specific attention in writing, or on revised Submittals, to changes other than the modifications called for by Purchaser on previous Submittals. After paper copy Submittals have been approved, submit copies thereof for final distribution. Previously approved Submittals transmitted for final distribution will not be further reviewed and are not to be revised. If errors are discovered during manufacture or fabrication, correct the Submittal and resubmit for review.
        v. Following completion of the Work and prior to final payment, furnish record documents and approved Samples and Shop Drawings necessary to indicate "as constructed" conditions, including field modifications, in the number of copies specified. Furnish additional copies for insertion in Equipment instruction books and operating manuals as required. All such copies shall be clearly marked "PROJECT RECORD."
        vi. Submit a final record copy of the Master Field Drawing list which shall indicate the final revision status of each drawing on the list.
        vii. Keep a copy or sample of each Submittal in good order at the Site.
3. Quantity Requirements:
    a. Except as otherwise specified, transmit all Shop Drawings in the following quantities:
        i. Initial Submittal:
            1. Electronic – One (1) copy to Purchaser.
        ii. Resubmittals:
            1. Electronic - One (1) copy to Purchaser.
        iii. Submittal for final distribution:

1. Electronic - One (1) copy to Purchaser.

iv. As-constructed documents:

1. Paper – One (1) copy to Purchaser.
2. Electronic - One (1) copy to Purchaser.

b. Transmit Submittals of product data as follows:

i. Initial Submittal:

1. Electronic - One (1) copy to Purchaser.

ii. Resubmittals:

1. Electronic – One (1) copy to Purchaser.

iii. Submittal for final distribution:

1. Electronic - One (1) copy to Purchaser.

iv. Transmit Submittals of Material Samples, color charts, and similar items as follows:

1. Initial Submittal – Five (5) to Purchaser.
2. Resubmittal – Five (5) to Purchaser.

v. Transmit Submittals of Equipment instruction books and operating manuals as follows:

1. Initial Submittal:
    a. Electronic - One (1) copy to Purchaser.
2. Resubmittals:
    a. Paper – One (1) copies to Purchaser. Only Purchaser's comments will be returned to Contractor.
    b. Electronic – One (1) copy to Purchaser.
3. Submittal for Final Distribution – Five (5) paper copies to Purchaser.

c. When all Submittals have been updated to "as-constructed" conditions, transmit to Purchaser in electronic format.

d. Purchaser may copy and use for internal operations and staff training purposes any and all document Submittals required by this Contract and approved for final distribution, whether or not such documents are copyrighted, at no additional cost to Purchaser. If permission to copy any such Submittal for the purposes stated is unreasonably withheld from Purchaser by Contractor or any Subcontractor, manufacturer, or Supplier, Contractor shall provide to Purchaser 50 copies plus the number of copies required by Contractor at each final distribution issue.

e. Equipment erection drawings and other Submittals required for installation of Equipment furnished by others under separate contract for installation under this Contract will be transmitted to Contractor by Purchaser in the final distribution of such Submittals.

f. Information to Manufacturer's District Office: Contractor shall arrange for manufacturers and Suppliers of Equipment and Materials to furnish copies of all agreements, drawings, specifications, operating instructions, correspondence, and other matters associated with this Contract to the manufacturer's district office servicing Owner. Insofar as practicable, all business matters relative to Equipment and Materials included in this Contract shall be conducted through such local district offices.

4. Purchaser's Review:

a. Purchaser will review and take appropriate action on Submittals in accordance with the accepted schedule of Submittals. Purchaser's review and approval will be only to determine if the items of Equipment and Materials covered by the Submittals will, after installation or

incorporation in the Work, conform to information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

b. Purchaser's review and approval will not extend to design data reflected in Submittals which is peculiarly within the special expertise of Contractor or Contractor's Subcontractors or Suppliers. Review and approval of a component item as such will not indicate approval of the assembly in which the item functions.

c. Purchaser's review and approval of Shop Drawings, product data, or Samples will not relieve Contractor of responsibility for any deviation from requirements of the Contract Documents unless Contractor has in writing called Purchaser's attention to such deviation at the time of submission, and Purchaser has given written concurrence in and approval of the specific deviation. Approval by Purchaser shall not relieve Contractor from responsibility for errors or omissions in Submittals.

5. Submittal Action Stamp:

   a. Purchaser's review action stamp, appropriately completed, will appear on all Submittals of Contractor when returned by Purchaser. Review status designations listed on Purchaser's action stamp are defined as follows:

      i. A - SUBMITTAL APPROVED: Signifies Equipment or Material represented by the Submittal conforms with the design concept and complies with the intent of the Contract Documents and is approved for incorporation in the Work. Contractor is to proceed with fabrication or procurement of the items and with related Work. Copies of the Submittal are to be transmitted to Purchaser for final distribution.

      ii. B - SUBMITTAL APPROVED AS NOTED (RESUBMIT): Signifies Equipment and Material represented by the Submittal conforms with the design concept and complies with the intent of the Contract Documents and is approved for incorporation in the Work in accordance with Purchaser's notations. Contractor is to proceed with fabrication or procurement of the items and with related Work in accordance with Purchaser's notations and is to submit a revised Submittal responsive to notations marked on the returned Submittal or written in the letter of transmittal.

      iii. C - SUBMITTAL RETURNED FOR REVISION (RESUBMIT): Signifies Equipment and Material represented by the Submittal appears to conform with the design concept and comply with the intent of the Contract Documents but information is either insufficient in detail or contains discrepancies which prevent Purchaser from completing his review. Contractor is to resubmit revised information responsive to Purchaser's annotations on the returned Submittal or written in the letter of transmittal. Fabrication or procurement of items represented by the Submittal and related Work is not to proceed until the Submittal is approved.

      iv. F - FOR REFERENCE, NO APPROVAL REQUIRED: Signifies Submittals which are for supplementary information only; pamphlets, general information sheets, catalog cuts, standard sheets, bulletins and similar data, all of which are useful to Purchaser in design, operation, or maintenance, but which by their nature do not constitute a basis for determining that items represented thereby conform with the design concept or comply with the intent of the Contract Documents. Purchaser's reviews such Submittals for general content but not for basic details.

6. Instruction Books and Operating Manuals:

a. In addition to electronic Submittals specified above, Equipment instruction books and operating manuals prepared by the manufacturer shall include the following:
    i. Index and tabs.
    ii. Instructions for installation, start-up, operation, inspection, maintenance, parts lists and recommended spare parts, and data sheets showing model numbers.
    iii. Applicable drawings.
    iv. Warranties and guarantees.
    v. Address of nearest manufacturer-authorized service facility.
    vi. All additional data specified.
b. The information listed above shall be bound into hard-back binders of McBee Swing Hinge three-ring post Acco type. Sheet size shall be 8-1/2 x 11. Binder color shall be black. Capacity shall be a minimum of 1-1/2 inches, but sufficient to contain and use sheets with ease.
c. Provide the following accessories:
    i. Label holder.
    ii. Business card holder.
    iii. Sheet lifters.
    iv. Horizontal pockets.
d. The following information shall be imprinted, inserted, or affixed by label on the binder front cover:
    i. Owner's name.
    ii. Owner's facility or plant name.
    iii. Equipment item name.
    iv. Volume number (if applicable).
    v. Contract number.
    vi. Manufacturer's name and address.
e. The following information shall be imprinted, inserted, or affixed by label on the binder spine:
    i. Equipment item name.
    ii. Owner's name and Owner's facility or plant name.
    iii. Manufacturer's name.
    iv. Contract number.
    v. Volume number (if applicable).
f. Submit mockup of cover and spine for Purchaser’s review.

7. Samples:
    a. Office Samples shall be of sufficient size and quantity to clearly illustrate the following:
        i. Functional characteristics of the product, with integrally related parts and attachment devices.
        ii. Full range of color, texture, and pattern.
        iii. Material, manufacturer, pertinent catalog number, and intended use.

INFORMATIONAL SUBMITTALS:

1. Informational Submittals are comprised of technical reports, administrative Submittals, and guarantees which relate to the Work, but do not require Purchaser approval prior to proceeding with the Work. Informational Submittals include:
    a. Welder qualification tests.
    b. Welding procedure qualification tests.

c. Hydrostatic testing of pipes.
d. Certification on Materials:
    i. Steel mill tests.
e. Piping stress analysis.
f. Shipping or packing lists.
g. Job progress schedules.
h. Equipment and Material delivery schedules.
i. Progress photographs.
j. Warranties and guarantees.

2. Transmittal of Informational Submittals:
    a. All informational Submittals furnished by Subcontractors, manufacturers, and Suppliers shall be submitted to Purchaser by Contractor unless otherwise specified.
    b. Identify each informational Submittal by Project name and number, Contract title and number, and Specification Section and Article number marked thereon or in letter of transmittal. Unidentifiable Submittals will be returned for proper identification.
    c. At the time of each submission, call to the attention of Purchaser in the letter of transmittal any deviations from requirements of the Contract Documents.
3. Quantity Requirements:
    a. Technical reports and administrative Submittals except as otherwise specified:
        i. Electronic: One (1) to Purchaser.
    b. Written Certificates and Guarantees:
        i. Purchaser: Two (2) copies.
4. Test Reports:
    a. Responsibilities of Contractor and Purchaser regarding tests and inspections of Equipment and Materials and completed Work are set forth elsewhere in these Contract Documents.
    b. The party specified responsible for testing or inspection shall in each case, unless otherwise specified, arrange for the testing laboratory or reporting agency to distribute test reports as follows:
        i. Purchaser: Two (2) copies.
        ii. Engineer: One (1) copy.
        iii. Resident Project Representative: One (1) copy.
        iv. Contractor: Two (2) copies.
        v. Manufacturer or Supplier: One (1) copy.
5. Purchaser's Review:
    a. Purchaser will review informational Submittals for indications of Work or Material deficiencies.
    b. Purchaser will respond to Contractor on those informational Submittals which indicate Work or Material deficiency.

End of Section 01 33 00 - JEA Submittals

Section 013300A – Submittal Schedule

LEGEND: D = Digital Disk Media; E = Electronic; P(x) = Paper Copy (no. of copies); NTP = Notice to Proceed
Notice to Proceed = Effective Date of Contract

ID	Description	With Proposal (for bid evaluation and Notice to Proceed)	For Approval (required prior to fabrication)	For Information/ Certification/Construction
1	Certificate of Insurance			E - 10 days after NTP
2	Acknowledge Acceptance and Return of Contract.			E - 7 days after receipt of NTP
3	Notice of any Cancellation, Termination, or Material Changes of Insurance Policies			E, P(1) - 30 days before cancellation or change
4	Detailed Work Progress Schedule		E - 1 day after NTP, monthly thereafter	
5	Work Progress Reports			E - 1 day after NTP, monthly thereafter
6	Supplier Document List			E - cummulative with every submittal in addition to submittal coversheet.
7	Transportation / Shipping Plan			E - 1 week prior to shipment
8	Notice of Shipment			E - when shipped
9	Packing Lists			E - when shipped
10	Shipment Bills of Materials			E - when shipped
11	Unloading, Handling & Storage Requirements and Procedures			E - 1 week prior to shipment
12	Material Safety Data Sheets (if applicable)			E - 1 week prior to shipment
13	Approval Drawings / Design Data / Design Calculations	E - equipment outline	E - 6 weeks after NTP	E - Prior to Final Payment
14	Final As-Constructed Documentation			D(2), P(1) shipped with equipment, P(2) 1 week after shipment
15	Final Instruction Books			D(2), P(1) shipped with equipment, P(2) 1 week after shipment
16	Test Reports			D(2), P(1) shipped with equipment, P(2) 1 week after shipment
17	All Remaining Submittals Not Listed, but Specified in Contract Documents			

End of Section 013300A – Submittal Schedule

Section 013300B – Submittal Description

Submittal Descriptions

General Arrangement Drawings	• Dimension and location (plan and elevation) of all equipment and structures. • Identification of all access/maintenance requirements. • This section includes the expected guidelines for document submittals; however, any variation in content or quantities can be requested at any time by the engineers. • All words and dimensional units shall be in the English language. Metric dimensional unit equivalents may be stated in addition to the English units. Electronic format shall be Microsoft Word for Text documents and Microstation 2023 or later for CAD drawings. 3D shop or manufacture drawings are required.
Equipment Outline Drawings	• Outline dimensional drawing. • Location of all interface connections (plan and elevation). • Recommended/required mounting details clearly depicting bolting and anchor location, size, material, and projection requirements, or sufficient data such that the Purchaser can establish such requirements (for dynamic equipment or machinery data include operating speeds, rotating masses, centers-of-gravity, eccentricities, etc.). • Weight and center of gravity. • Type of interface connection (e.g., 150 lb. RF flange, welded, weld end preparation, wall thickness or schedule, etc.). • Allowable loads for all nozzles. • Removal space/maintenance requirements. • Special rigging requirements. • Thermal movements of all nozzles (if applicable).
Equipment Installation Details	• Drawings showing how to install all devices that require field installation. • Details including support/mounting devices. • Field welding requirements. • Field erection requirements; assembly drawings.
Mechanical Equipment Data	• Performance curves, showing operating points. • Calculations for sizing.
Equipment Lists	• Tabulation of all equipment provided (including mechanical, electrical, controls, etc.). • Identification of individual Tag Number used in Drawings and schedules. • Lists interface requirements for utility demands upon Purchaser. • Identification of sub-supplier for item.
Foundation Loadings and Details	• Foundation details/outlines depicting overall dimensions, pad and blockout requirements, anchor bolt locations and details, and any additional information necessary to establish the foundation arrangement. • Either actual or "not-to-exceed" foundation design loads, and their points of application, for all applicable load cases (i.e., dead, live, wind, seismic, thermal, pressure, dynamic, etc.) and combinations. • Identification of loading directions, magnitudes, and any other permanent data required for the foundation design.
Electrical Cable List	• Tabulation of all cables required between equipment furnished with this contract. • Provide cable number, from device tag, from device description, to device tag, to device description, schematic number, cable supplied by, type of cable required.

Factory Acceptance Test Plan	• List and describe all procedures for factory testing of the control equipment prior to shipment. • Provide schedule of all tests under this contract.
O & M Manuals	• Index and tabs. • Description of equipment. • Operation instructions shall include precautions and critical points to be observed during equipment operation. Detailed procedures proving step-by-step instructions for start-up and shutdown of equipment for both normal and emergency conditions shall be included. • Troubleshooting. • Equipment drawings. • Installation instructions. • Maintenance instructions shall provide step-by-step disassembly and reassembly instructions for all equipment supplied. Recommendations for type of lubricants, frequency of lubrications, and any critical settings or tolerances required during the assembly shall be provided. • Sub-supplier component list. • Recommended spare parts. • Data sheets showing model numbers. • Nomenclature used to reference each item shall be consistent throughout the manuals. • Shop test reports and characteristic curves of all equipment that may prove to be helpful in operation shall be provided. Examples: horsepower or fuel consumption curves, head capacity curves, efficiency curves, etc. • Applicable drawings. • Warranties and guarantees. • Name and address of nearest manufacturer-authorized service facility. • All additional data specified.
Bill of Material	• Shall list all material items supplied. • Include item, tag, quantity, description, specification, drawings, manufacturer, purchase order number, model number, and delivery date. • Number and Description of equipment. • Theory of operation. • Troubleshooting. • Equipment drawings. • Installation instructions. • Maintenance instructions. • Supplier component list. •
Document List	• Shall list all Supplier documents and drawings individually. • Shall include document number, document description, document revision, and document date.

End of Section 013300B – Submittal Description

Section 013300C – Submittal Information Block

Submittal Information Block

Use this Submittal Information Block on all Submittals, whether prepared by Supplier, Subcontractor, or Subsupplier. On Shop Drawings, place as near as possible to the title block in the lower right corner.

Supplier fills in all blanks without preprinted information.

Project and Contract Identification	Date Purchaser Received
Supplier_____ Project Name _____ Project Number _____ Contract Title _____ Contract No. _____ Spec. Sect. No._____Art. No. _____ **Supplier's Approval:** Submission of this document shall represent Supplier's approval as specified in the Contract Documents. Supplier remains liable for accuracy of Submittals as provided in the Contract Documents.	**Purchaser's Action** (See Contract Documents) Initials & Date / Initials & Date A / E B / F C / G D

For use of the purchaser

End of Section 013300C – Submittal Information Block

Section 016005 – Equipment and Materials

This Section includes administrative and procedural requirements governing Subcontractor's selection of products for use in the Project.

1. DEFINITIONS:
    a. Definitions used in this Article are not intended to change the meaning of other terms used in these Contract Documents, such as "specialties," "systems," "structures," "finishes," "accessories," and similar terms. Such terms are self-explanatory and have well-recognized meanings in the construction industry.
    b. "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "Material," "Equipment," "system," and terms of similar intent.
        i. "Named Products" are items identified by the manufacturer's product name, including make or model number or other designation, shown or listed in the manufacturer's published product literature, that is current as of the date of the Contract Documents.
    c. "Materials" are products substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.
    d. "Equipment" is a product with operational or nonoperational parts, whether motorized, or manually operated, that may require service connections, such as wiring or piping.
2. QUALITY ASSURANCE:
    a. Source Limitations: To the fullest extent possible, provide products of the same kind from a single source.
    b. Compatibility of Options: When the Subcontractor is given the option of selecting between two or more products for use on the Project, the product selected shall be compatible with products previously selected, even if previously selected products were also options.
        i. Each Subcontractor is responsible for providing products and construction methods that are compatible with products and construction methods of other separate contractors.
        ii. If a dispute arises between Subcontractors over concurrently selectable, but incompatible products, Contractor will determine which products shall be retained and which are incompatible and must be replaced.
    c. Nameplates: Along with required labels and operating data, manufacturer or producer's nameplates, imprints, or trademarks may be placed on surfaces exposed to view.
        i. Labels: Locate required product labels and stamps on concealed surfaces or, where required for observation after installation, on accessible surfaces that are not conspicuous.
        ii. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated Equipment. Locate on an easily accessible surface that is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data:
            1. Name of product and manufacturer including address (and telephone number).
            2. Model and serial number.
            3. Capacity.

4. Speed.
5. Ratings.

d. Electronic Equipment:
   i. Subcontractor warrants that all equipment, devices, items, systems, software, hardware, and firmware provided shall be electronically compliant, meaning that they shall properly, appropriately, and consistently function and accurately process date and time data (including without limitation: calculating, comparing, and sequencing). This warranty supersedes anything in the Specifications or other Contract Documents which might be construed inconsistently. This warranty is applicable whether the equipment, device, item, system, software, hardware, or firmware is specified with or without reference to a manufacturer's name, make, or model number.

3. TRANSPORTATION AND SHIPMENT:
   a. Shipment Preparation: Subcontractor shall require manufacturers and Suppliers to prepare products for shipment in a manner to facilitate unloading and handling, and to protect against damage, deterioration, or unnecessary exposure to the elements in transit and storage. Provisions for protection shall include the following:
      i. Crates or other suitable packaging materials.
      ii. Covers and other means to prevent corrosion, moisture damage, mechanical injury, and accumulation of dirt in motors, electrical equipment, and machinery.
      iii. Suitable rust-preventive compound on exposed machined surfaces and unpainted iron and steel.
      iv. Grease packing or oil lubrication in all bearings and similar items.
   b. Marking: Each product item shall be tagged or marked as identified in the delivery schedule or on Submittals. Complete packing lists and bills of material shall be included with each shipment. Each piece of every item need not be marked separately, provided that all pieces of each item are packed or bundled together and the packages or bundles are properly tagged or marked.
4. PRODUCT DELIVERY, STORAGE, AND HANDLING:
   a. Deliver, store, and handle products as required by the SUBCONTRACT AGREEMENT and according to the manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and loss, including theft.
   b. Schedule delivery to minimize long-term storage at the Site and to prevent overcrowding of construction spaces. Allow ample time to avoid delay of the Work.
   c. Coordinate delivery with installation time to assure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
   d. Deliver products to the Site in an undamaged condition in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
   e. Inspect products upon delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected. Inspect shipment to assure:
      i. Product complies with requirements of Contract Documents and reviewed Submittals.
      ii. Quantities are correct.
      iii. Containers and packages are intact and labels are legible.

iv. Products are properly protected and undamaged.
v. Store products at the Site in a manner that will facilitate inspection and measurement of quantity or counting of units. Mark deliveries of component parts of Equipment to identify the Equipment, to permit easy accumulation of parts, and to facilitate inspection and measurement of quantity or counting of units.

f. Store heavy Materials away from the Project structure in a manner that will not endanger the supporting construction.
g. Store products subject to damage by the elements above ground, under cover in a weathertight enclosure, and with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.
h. Protect motors, electrical Equipment, plumbing fixtures, and machinery of all kinds against corrosion, moisture deteriorations, mechanical injury, and accumulation of dirt or other foreign matter.
i. Protect exposed machined surfaces and unpainted iron and steel as necessary with suitable rust-preventive compounds.
j. Protect bearings and similar items with grease packing or oil lubrication.
k. Handle and store steel plate, sheet metal, and similar items in a manner to prevent deformation.

5. Handling
   a. Provide equipment and personnel necessary, to unload and handle products, by methods to prevent damage or soiling to products, or packaging.
   b. Handle by methods to prevent bending or overstressing. Where lifting points are designated, lift components only at those points.
   c. Provide additional protection to surrounding surfaces as necessary to prevent damage.
6. Maintenance of Storage:
   a. Inspect stored products on a scheduled basis.
   b. Verify that storage facilities comply with manufacturer's product storage requirements, including environmental conditions continually maintained.
   c. Verify that surfaces of products exposed to elements are not adversely affected; that any weathering of finishes is acceptable under requirements of Contract Documents.
   d. For mechanical and electrical Equipment in long-term storage, provide manufacturer's service instructions to accompany each item, with notice of enclosed instructions on exterior of package. Service Equipment on a regularly scheduled basis.
7. Protection After Installation: Provide substantial coverings as necessary to protect installed products from damage from subsequent construction operations. Remove coverings when no longer needed or as specified.
   a. Subcontractor shall receive, check, unload, inventory, accept and store all Equipment and Materials delivered to the Site per proper notice and in accordance with manufacturer's instructions. Subcontractor shall report any damage to Contractor prior to or during unloading, and advise Contractor of any shortage at time of delivery. Contractor will verify such reports and so notify the Equipment Supplier. Subcontractor shall be responsible for proper location of trucks and railroad cars for unloading, any additional switching operations required, and all demurrage charges and substantiated claims for damage to trucks and railroad cars resulting from unloading operations.

End of Section 016005 – Equipment and Material

Division 3 – CONCRETE

Section 331000 – Concrete Framework

This Section includes Formwork for cast-in-place concrete.

PART 1

RELATED REQUIREMENTS:

1. Section 03 20 00 – "Concrete Reinforcement."
2. Section 03 30 00 – "Concrete."
3. Section 31 62 29 – "Drilled Shaft Foundations."
4. Section 31 66 10 – "Shallow Foundations."

DEFINITIONS

1. Form-facing material: Part of the formwork that is in direct contact with the concrete material.
2. Formwork: The total system that supplies support and provides shape to freshly placed concrete, which includes:
    a. Form-facing material
    b. Structural members
    c. Hardware
3. Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
4. Reference Standards:
    a. American Concrete Institute (ACI):
        i. ACI 117 - Specifications for Tolerances for Concrete Construction and Materials.
        ii. ACI 301 - Specifications for Structural Concrete.
        iii. ACI 318 - Building Code Requirements for Structural Concrete.
        iv. ACI 347R - Guide to Formwork for Concrete.
    b. American Society of Civil Engineers (ASCE)
        i. ASCE 37 – Design Loads on Structures during Construction
    c. Department of Commerce – National Institute of Standards and Technology (NIST)
        i. PS 20 – American Softwood Lumber Standard

SUBMITTALS

1. Product Data for the following:
    a. Form ties
    b. Form-release agent
    c. Form-facing materials
    d. Shall contain:
        i. Use/Application
        ii. Material
        iii. Applicable specification

QUALITY ASSURANCE

1. Inspection of all formwork per Shop Drawings and Contract Documents prior to placing concrete. Inspections shall include review of:

   a. Material dimensions
   b. In-place dimensions
   c. Material types
   d. Location
2. Inspection of all formed concrete surfaces after removal of formwork. Inspections shall include review of:
   a. Texture, panel-joints, color uniformity, and surface irregularities per ACI 347R.3 Table 3.1b.
   b. Surface void ratio per ACI 347R.3 Table 3.1d and Section 3.2 for concrete exposed to view.

DELIVERY, STORAGE, AND HANDLING

1. Deliver material to site:
   a. Include labels clearly identifying quantity, product name and manufacturer.
   b. Contractor shall coordinate delivery and provide means for offloading materials for storage in designated area.
2. Storage of material
   a. Store forms in accordance with manufacturer's instructions
   b. Forms susceptible to water damage shall be protected from rain and excess moisture.
3. Handling of material
   a. Protect forms during handling and erection to prevent damage.

PART 2

DESIGN CRITERIA

1. Design Loading
   a. Shall conform to the requirements of ASCE 37 and ACI 347R.
2. Deflection
   a. Maximum deflection of facing materials reflected on concrete surfaces shall be limited to 1/240 of the span between structural members of the formwork for concrete surfaces not exposed to view.
   b. 1/360 of the span between structural members of the formwork for concrete surfaces exposed to view.

MATERIALS

1. Form facing
   a. Concrete facing side of forms shall meet ACI 347R.3
      i. Category FC1 for concrete surfaces not exposed to view
      ii. Category FC2 for concrete surfaces exposed to view
   b. Stay-in-place metal forms
      i. Requires Engineer approval
2. Form framing
   a. Structural grade saw lumber complying with PS 20.
   b. Steel
3. Form release agent
   a. Shall be commercially available and will not bond with, stain, or adversely affect concrete surfaces.
   b. Agents shall not impair subsequent concrete surface treatments, including:

i. Concrete bonding
ii. Curing compounds (water and chemicals)

c. Agents shall be VOC compliant with a maximum VOC content of 3.8 lbs./gal. (450 g/L), or less where area restrictions are more stringent.

4. Form ties shall be:
   a. Factory fabricated designed to resist lateral pressure of fresh concrete on forms.
   b. Metal or glass-fiber-reinforced plastic.
   c. Water stops shall be provided when water tightness is required.
   d. The portion of the form tie remaining in place shall provide for a clearance of two times the minimum dimension of the tie, but not less than 3/4 inch, from the formed surface. See Figure 1 for details.

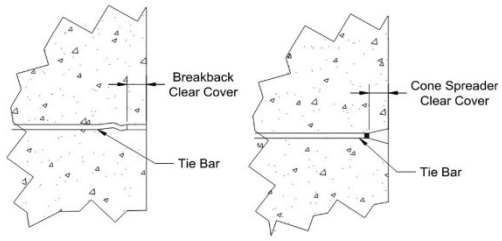


Figure 1 – Stay in Place Form Tie Clear Cover

5. Chamfer strips
   a. Shall be of wood, metal, PVC, or rubber
   b. 3/4-inch chamfer except where otherwise indicated.

PART 3

INSTALLATION OF FORMWORK

1. Conform to ACI 301, 318, and 347R
   a. Formwork shall be installed to meet the requirements of ACI 347.3R
   b. CSC1 for concrete surfaces not exposed to view, excluding color uniformity category
      i. Color uniformity shall meet category CU2
   c. CSC2 for surfaces exposed to view, excluding color uniformity and form-facing categories
      i. Color uniformity category shall be CU2
      ii. Form-facing category shall be FC2
2. Construct sufficiently tight to prevent concrete leakage.
3. Avoid offsets between adjacent forms and construct so that shores, braces, and stiffening members are in line with those below.
4. Form all necessary openings or chases for piping, ductwork, and similar items were indicated or as required for the Work.
5. Construct forms to be removable in sections without marring concrete surface.
6. Contractor shall be responsible for maintaining structural adequacy of the formwork during construction activities.

7. Before casting concrete
    a. Clean forms of sawdust, dust, dirt, rust, and other foreign materials.
    b. Treat forms with form release agent.
    c. Place chamfers in forms corners.
        i. For all exposed corners above grade.
        ii. For all corners that extend below finished grade to a depth of six (6) inches.
8. Construct and maintain forms to the tolerances given in ACI 117.

FORM REMOVAL

1. It is the responsibility of Contractor to consider all applicable factors and leave the formwork in place until it is safe to remove them.
2. All removal shall be performed in a manner which will prevent damage to the concrete and ensure the complete safety of the structure, with particular care for corners and edges.
3. Where forms support more than one element, the forms shall not be removed until the form removal criteria are met by all supported elements.
4. If formwork is removed prior to specified curing time, provide curing and protection as specified in Section 03 30 00.
5. Forms shall not be loosened or removed unless the minimum time or minimum compressive strength requirements below are met. Minimum time indicated is a period of cumulative number of hours, not necessarily consecutive, during which the temperature of the concrete surface is above 50°F.

Formwork Type	Elements	Time (hrs.)	Percent of Design Compressive Strength
Not Supporting weight of concrete	Walls Columns Sides of beams Slabs-on-ground	24	N/A
Supporting weight of concrete	Unshored slabs and beams which forms can be removed without disturbing shoring.	72	70
	Slab and beam shoring	72	85

End of Section 331000 – Concrete Framework

Section 032000 – Concrete Reinforcement

This section includes steel reinforcement and steel reinforcement accessories.

PART 1

RELATED REQUIREMENTS

1. Section 03 10 00 – "Concrete Formwork"
2. Section 03 30 00 – "Concrete"
3. Section 31 62 29 – "Drilled Shaft Foundations"
4. Section 31 66 10 – "Shallow Foundations"

REFERENCES

1. Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
2. Reference Standards:
    a. ASTM International (ASTM):
        i. ASTM A615/A615M – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
        ii. ASTM A700 – Standard Guide for Packaging, Marking, and Loading Methods for Steel Products for Shipment
    b. American Concrete Institute (ACI):
        i. ACI 117 – Specification for Tolerances for Concrete Construction and Materials
        ii. ACI 315R – Guide to Presenting Reinforcing Steel Design Details
        iii. ACI 318 – Building Code Requirements for Structural Concrete and Commentary
        iv. ACI MNL-66 – ACI Detailing Manual
    c. Concrete Reinforcing Steel Institute (CRSI):
        i. Manual of Standard Practice

SUBMITTALS

1. Product data
    a. Steel reinforcement
        i. For each lot of reinforcing steel delivered to the jobsite, furnish mill affidavits or test reports of compliance, or similar certification, certifying the grades and physical and chemical properties of the reinforcing steel and conformance with applicable ASTM Specifications.
    b. Accessories (bolsters, chairs, etc.)
        i. Shall contain:
            1. Use/Application
            2. Material
            3. Applicable specification
2. Shop Drawings:
    a. Shall conform to ACI MNL-66 or ACI 315R.
    b. Shall show like bars labeled with a mark number.
    c. Shall be clear, easily legible, and have a defined scale.
    d. Shall contain at a minimum:
        i. Fabrication information

ii. Bar details/diagrams
iii. Bar schedule
    1. Labels
    2. Size
    3. Lengths
    4. Material
    5. Grades
    6. Weights
iv. Placement information
    1. Bar arrangement
    2. Bar supports
    3. Spacers
    4. Splice location(s) and splice type(s)
    5. Construction joints
    6. Penetrations and inserts
    7. Lifting plan

3. Field Fabrication Plan
    a. If Contractor chooses to field fabricate reinforcement, provide a detailed fabrication plan including the following items in addition to those specified in paragraphs 1.04A and 1.04B, this Section:
        i. Surface cleaning
        ii. Cutting
        iii. Bending
        iv. Quality Control

QUALITY CONTROL

1. Inspect all reinforcing steel and accessories per Shop Drawings and Contract Documents prior to placing concrete. Inspections shall include review of:
    a. Size
    b. Shape
    c. Length
    d. Location

DELIVERY, STORAGE AND HANDLING

1. Store steel reinforcement off the ground in orderly stacks and protect from elements that would deteriorate material or impair bonding capability.
2. Store only bars with the same identifying label in the same stack.

PART 2

MATERIALS

1. Reinforcement bars and stirrups
    a. Conform to ASTM A615/A615M, Grade 60 except as otherwise specified.
    b. Shall be tagged with identifying mark identified in Shop Drawings corresponding to ASTM A700.
2. Tie wire

   a. Shall be uncoated 16-gauge wire or Engineer-approved alternative.
3. Accessories
   a. Bolsters, chairs, and other accessories
      i. Conform to ACI MNL-66 and the CRSI Manual of Standard Practice.
      ii. Metal accessories shall be galvanized or plastic-coated where legs will be exposed in finished concrete surfaces.
4. Precast concrete block bar supports
   a. May be used only for bar supports in slabs on ground.
   b. Blocks shall have a compressive strength equal to or greater than concrete mix being deposited around the supported reinforcement.

FABRICATION

1. Fabrication of bars
   a. Fabricate with cold bends conforming to the recommended dimensions shown in ACI 318, MNL-66, or CRSI Manual of Standard Practice.
   b. Field fabrication will be allowed only if Contractor has equipment to properly fabricate steel and must be approved by the Engineer/Owner.
   c. Do not straighten or re-bend cold worked bars or hot rolled high yield bars once having been bent. Where it is necessary to bend mild steel reinforcement already cast in the concrete, the internal radius of bend shall not be less than radius recommended in ACI 318, MNL-66, or CRSI Manual of Standard Practice.
   d. Welding of reinforcement is not permitted.
2. Fabrication tolerances
   a. Tolerances shall conform to ACI 117.

PART 3

PLACEMENT OF STEEL REINFORCEMENT

1. Place in accordance with ACI 318, the CRSI Manual of Standard Practice, and the Contract Documents.
2. Place reinforcement to maintain concrete cover as indicated on Contract Documents. If concrete cover is not provided on Contract Documents, Contractor shall place reinforcement to maintain concrete cover per ACI 318.
3. Provide all spacers and tie wire to secure steel reinforcement in place during the concrete placement so that spacing and clearances are maintained and concrete placement forces are resisted.
4. Welding of reinforcement is not permitted.
5. Splice steel to conform to ACI 318.
   a. Unless otherwise indicated in the Contract Documents, the minimum length of lap for tension lap splices shall be as required for Class B splices.

b. Splice locations shall be staggered using either of the following options shown in Figure 1:

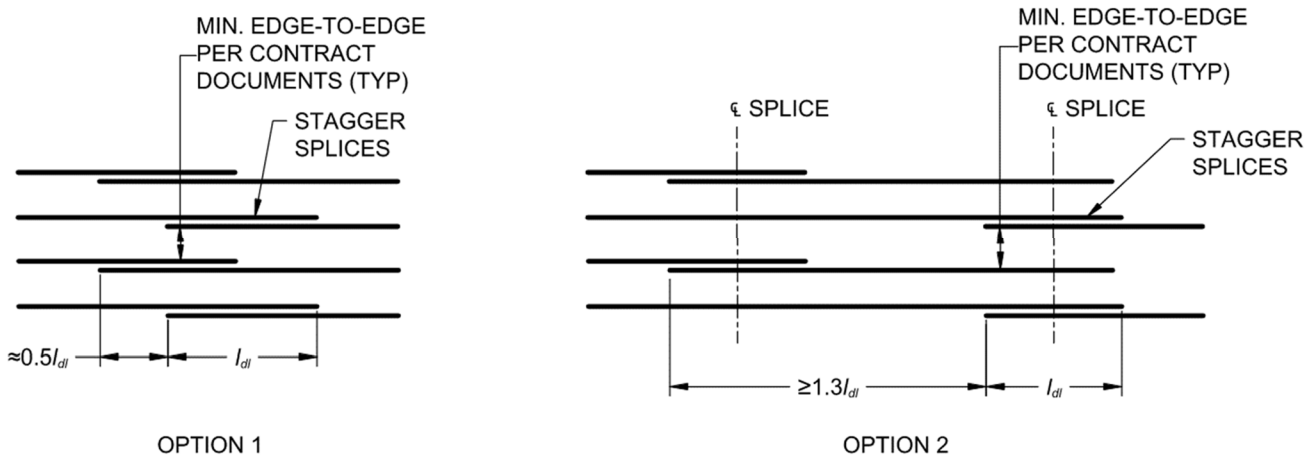


Figure 1 - Splice Staggering Options

6. Steel reinforcement shall be supported by an approved steel reinforcement accessory.
    a. Space as required by the condition of weight, bearing surface, and rigidity of the steel reinforcement and as to not interfere with the placement or pumping of concrete.
    b. Installation tolerances shall conform to ACI 117.

CLEANING OF REINFORCEMENT

1. Reinforcement at time of depositing concrete shall be free of corrosion, debris, or deleterious substances that may impair bond with concrete.
2. Contractor shall be careful to not employ cleaning techniques that are overly aggressive and polish the reinforcement.

End of Section 032000 – Concrete Reinforcement

Section 033000 – Concrete

This Section includes requirements for concrete material, placement, and testing.

PART 1

RELATED REQUIREMENTS

1. Section 03 10 00 – "Concrete Formwork"
2. Section 03 20 00 – "Concrete Reinforcement"
3. Section 31 62 29 – "Drilled Shaft Foundations"

REFERENCES

1. Definitions:
    a. Hot weather: as defined in ACI 305.1, as one or more of a combination of the following conditions that impairs the quality of freshly mixed or hardened concrete by accelerating the rate of moisture loss and rate of cement hydration, or otherwise causing detrimental results: high ambient temperature, high concrete temperature, low relative humidity, and high wind speed.
    b. Cold weather: as defined in ACI 306.1, as a period when for more than three successive days the average daily outdoor temperature drops below 40°F. The average daily temperature is the average of the highest and lowest temperature during the period midnight to midnight. When temperatures above 50°F occur during more than half of any 24-hour duration, the period shall no longer be regarded as cold weather.
    c. Final set: a degree of stiffening of a cementitious mixture greater than initial setting, generally stated as an empirical value indicating the time required for the cementitious mixture to stiffen sufficiently to resist, to an established degree, the penetration of a weighted test device.
    d. Fresh concrete: concrete that possesses enough of its original workability that it can be placed and consolidated by the intended methods.
    e. Initial set: a degree of stiffening of a cementitious mixture less than final set, generally stated as an empirical value indicating the time required for the cementitious mixture to stiffen sufficiently to resist, to an established degree, the penetration of a weighted test device.
    f. Plasticity: the property of freshly mixed cement paste and concrete that determines its workability, resistance to deformation, or ease of molding.
2. Comply with standards in effect as of the date of the Contract Documents unless otherwise indicated

REFERENCE STANDARDS

1. ASTM International (ASTM):
    a. ASTM A123 – Zinc (Hot-Galvanized) Coatings on Iron and Steel Products
    b. ASTM A153 – Zinc Coating (Hot-Dip) on Iron and Steel Hardware
    c. ASTM A36 – Standard Specification for Carbon Structural Steel
    d. ASTM C31/31M – Making and Curing Concrete Test Specimens in the Field
    e. ASTM C33 – Concrete Aggregates
    f. ASTM C39 – Compressive Strength of Cylindrical Concrete Specimens
    g. ASTM C40 – Organic Impurities in Fine Aggregates for Concrete
    h. ASTM C42 – Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
    i. ASTM C88 – Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

j. ASTM C94 – Ready-Mixed Concrete
k. ASTM C138 – Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
l. ASTM C143 – Slump of Hydraulic Cement Concrete
m. ASTM C144 – Standard Specification for Aggregate for Masonry Mortar
n. ASTM C150 – Portland Cement
o. ASTM C171 – Standard Specification for Sheet Materials for Curing Concrete
p. ASTM C172 – Sampling Freshly Mixed Concrete
q. ASTM C173 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
r. ASTM C192 – Making and Curing Concrete Test Specimens in the Laboratory
s. ASTM C219 – Standard Terminology Relating to Hydraulic and Other Inorganic Cements
t. ASTM C231 – Air Content of Freshly Mixed Concrete by the Pressure Method
u. ASTM C233 – Testing Air-Entraining Admixtures for Concrete
v. ASTM C260 – Air-Entraining Admixtures for Concrete
w. ASTM C309 – Liquid Membrane-Forming Compounds for Curing Concrete
x. ASTM C404 – Standard Specification for Aggregates for Masonry Grout
y. ASTM C494 – Chemical Admixtures for Concrete
z. ASTM C578 – Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
aa. ASTM C595 – Standard Specification for Blended Hydraulic Cements
bb. ASTM C618 – Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
cc. ASTM C685 – Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing
dd. ASTM C803 – Standard Test Method for Penetration Resistance of Hardened Concrete
ee. ASTM C805 – Standard Test Method for Rebound Number of Hardened Concrete
ff. ASTM C900 - Standard Test Method for Pullout Strength for Hardened Concrete
gg. ASTM C989 – Standard Specification for Slag Cement for Use in Concrete and Mortars
hh. ASTM C1064 – Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
ii. ASTM C1074 – Standard Practice for Estimating Concrete Strength by the Maturity Method
jj. ASTM C1077 – Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
kk. ASTM C1157 – Standard Performance Specification for Hydraulic Cement
ll. ASTM C1193 – Standard Guide for Use of Joint Sealants
mm. ASTM C1315 – Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete
nn. ASTM C1240 – Standard Specification for Silica Fume Used in Cementitious Mixtures
oo. ASTM C1260 – Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
pp. ASTM C1293 – Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction
qq. ASTM C1567 – Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
rr. ASTM C1582 – Standard Specification for Admixtures to Inhibit Chloride-Induced Corrosion of Reinforcing Steel in Concrete

ss. ASTM C1602 – Mixing Water Used in the Production of Hydraulic Cement
tt. ASTM C1778 - Reducing the Risk of Deleterious Alkali-Aggregate Reaction in Concrete
uu. ASTM C1797 – Standard Specification for Ground Calcium Carbonate and Aggregate Mineral Fillers for use in Hydraulic Cement Concrete
vv. ASTM C1866 – Standard Specification for Ground-Glass Pozzolan for Use in Concrete
ww. ASTM D994 – Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)
xx. ASTM D1751 – Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
yy. ASTM D1752 – Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
zz. ASTM E96 – Test Methods for Water Vapor Transmission of Materials
aaa. ASTM E329 – Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection

2. American Concrete Institute (ACI):
    a. ACI 301 – Specifications for Structural Concrete
    b. ACI 305.1 – Specification for Hot Weather Concreting
    c. ACI 306.1 – Specification for Cold Weather Concreting
    d. ACI 318 – Building Code Requirements for Reinforced Concrete and Commentary
    e. ACI 563 – Specifications for Concrete Repair
3. American National Standards Institute (ANSI):
    a. ANSI A10.9 – Safety Requirements for Concrete and Masonry Work
4. National Bureau of Standards (NBS) Specifications for Scales.
5. National Ready-Mix Concrete Association, “Truck Mixer, and Agitator Standards of the Truck Mixer Manufacturers’ Bureau.”
    a. TMMB 100-05 – Truck Mixer, Agitator and Front Discharge Concrete Carrier Standards.
6. Corps of Engineers:
    a. CRD-C 662-10 – Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials, Lithium Nitrate Admixture, and Aggregate (Accelerated Mortar-Bar Method).

ADMINISTRATIVE REQUIREMENTS

1. Submittals shall be provided to the ENGINEER in a timely manner to allow sufficient time for review and approval of all required submittals.

SUBMITTALS

1. Concrete Supply & Placement Plan to include:
    a. Batch plant location
    b. Maximum expected travel time to discharge location.
    c. Anticipated adjustments to the mix design allowed and the threshold for executing the adjustment to the concrete material.
    d. Placement time
    e. Contingency plan for interruptions in concrete supply
        i. Construction joint
2. Unique Concrete Mix Design to include:

a. Supplier & Source
b. Unique Mix Identification
c. Expected usage
d. Mix design proportions
e. Material supplier, source, certification & test reports for:
    i. Portland Cement
    ii. Fly Ash
    iii. Slag cement
    iv. Blended hydraulic cement
    v. Silica fume
    vi. Aggregates
    vii. Admixtures
f. Qualification Data
    i. Submit one of the following:
        1. Field Strength Test Records conforming to the Concrete Mixtures section of ACI 301.
        2. Laboratory Test Data conforming to ASTM C192

3. Product Data and/or Material Certificates for each:
    a. Curing compounds
    b. Bonding agents
    c. Adhesives
    d. Repair materials
4. Construction Test Data
    a. Submit concrete break test data for the required number of cylinders shown in Table 3 - Required Number of Cylinders.
5. Repair Procedure for defective surfaces or damage

QUALITY ASSURANCE

1. Concrete Supplier Qualifications:
    a. It is preferred that the proposed concrete batch plant maintain and provide a NRMCA Certificate of Conformance. A copy of the current Certificate of Conformance will be accepted as proof the batch plant is qualified and capable of producing the required material.
    b. Local Department of Transportation or AASHTO certifications will be accepted as alternative proof the batch plant is qualified and capable of producing the required material.
    c. If certifications are not available or current, the proposed batch plant shall be inspected by an independent testing and inspection company to verify that it meets the requirements of this Section, the NRMCA requirements, and ASTM C94, as applicable. A copy of this report shall be available for the ENGINEER to review at their request.
    d. Batch plants not meeting the requirements of this Section, ASTM C94, and/or ASTM C685 shall not be used to supply concrete for the project.
2. Testing Agency Qualifications:
    a. Testing Agency Qualifications: Independent testing agency complying with the requirements of ASTM C1077 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager. This includes certification requirements for their technicians and testing personnel.

i. Personnel performing field tests for acceptance shall be certified as ACI Concrete Field-Testing Technician Grade I, or equivalent.
ii. Personnel conducting laboratory tests for acceptance shall be certified as ACI Concrete Strength Testing Technician or ACI Concrete Laboratory Testing Technician – Level I, or equivalent.

b. If Testing Agency Qualifications are not per ASTM C1077, AASHTO, or Local Department of Transportation Certifications will be accepted as an alternative.

STORAGE

1. All materials shall be stored in a manner that complies with the manufacturer's recommendations.

FIELD CONDITIONS

1. Concrete supply plan, mix design, and placement techniques shall account for the conditions expected at the time of placement and finishing of concrete.

PART 2

PERFORMANCE/MIX DESIGN CRITERIA

1. Concrete mix design(s) shall adhere to the performance and mix design criteria outlined in Table 1 – Required Mix Design Properties. Information present in the table conforms to the exposure class and durability requirements in ACI 318.

		Mix Design Use			
		Above Grade Formed Structures	**Shallow Foundations**	**Drilled Shaft (Dry, Uncased)**	**Drilled Shaft (Casing/Slurry)**
Exposure Class (ACI 318 Exposure Class Table)	Freeze/Thaw Exposure [F0/F1/F2/F3]	F0	F0	F0	F0
	Sulfate Exposure: [S0/S1/S2/S3]	S3	S2	S0	S0
	Water Contact: [W0/W1]	W0	W0	W0	W0
	Corrosion Protection of Reinforcement: [C0/C1/C2]	C2	C0	C0	C0
Minimum Required Mix Design Characteristics	28-day Compressive Strength (f'_c) (psi)	5000	4500	2500	2500
	Nominal Aggregate Size	3/4	3/4	3/4	3/4
	Air Content (%)	N/A	N/A	N/A	N/A
	Max W/C Ratio	0.45	0.45	0	0
	Target Slump (in.)*	4 to 6	4 to 6	4 to 6	7 to 9
	Cement Type				
	ASTM C150	V plus pozzolan or slag cement	V	No type restriction	No type restriction
	ASTM C595	Type IP, IS, or IT with (HS) designation plus pozzolan	Type IP, IS, or IT with (HS) designation	No type restriction	No type restriction

		or slag cement			
	ASTM C1157	HS plus pozzolan or slag cement	HS	No type restriction	No type restriction
	Supplementary Cementitious Material	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	ASTM C33 Aggregate Class Designation	5S	Not Specified	2N	2N

Table 1- Required Mix Design Properties

* Target slump shall not exceed 9 in, and not without the use of water reducing, plasticizing, or similar admixtures. Changes to the mix on-site that deviate from the approved mix design shall not occur without prior approval from the ENGINEER.

2. Alternate mix design criteria and materials testing may be submitted if code compliant materials are unavailable for the project.
3. Alternate mix designs that deviate from this specification but conform to the local department of transportation (DOT) standards and have been reviewed, approved, and utilized on projects for the DOT may be submitted for review and approval.

CONCRETE

1. Concrete Materials
    a. Source Limitations:
        i. Concrete for a structural element shall come from the same ready mixed concrete supplier.
        ii. Use cementitious materials, aggregates, and admixtures of the same type or class and from the same sources as materials used in concrete represented by submitted concrete mixtures.
2. Cementitious Material
    a. Portland cement conforming to ASTM C150, as defined in Table 1.
    b. Blended hydraulic cement shall conform to ASTM C595.
    c. Hydraulic cement shall conform to ASTM C1157.
    d. Fly ash or natural pozzolan shall conform to ASTM C618.
    e. Slag Cement ASTM C989.
    f. Silica Fume shall conform to ASTM C1240.
    g. Ground Glass Pozzolan shall conform to ASTM C1866.
3. Coarse & fine aggregate:
    a. Conform to ASTM C33.
    b. Maintain coarse and fine aggregate free of ice, frozen lumps, and deleterious substances.
    c. Nominal aggregate size as selected in Tables 1 and 2 in ASTM C33.
    d. Alkali Silica Reactivity:
        i. In regions where aggregates are known to be reactive based on historical data, comply with one of the following:
            1. Aggregates are determined to be non-reactive:
                a. ASTM C1260 14-day expansion less than or equal to 0.10%,
                b. or ASTM C1293 1-year expansion less than or equal to 0.04%.

2. Aggregate and cementitious materials combination determined to be innocuous:
    a. ASTM C1567 14-day expansion less than or equal to 0.10%
3. Alkali content in concrete:
    a. for aggregate with C1260 expansion between 0.1 and 0.3 percent or C1293 expansion between 0.04 and 0.12 percent – concrete alkali content shall be less than 4 lb./yd3.
    b. for aggregate with C1260 expansion between 0.3 and 0.45 percent or C1293 expansion between 0.12 and 0.24 percent – concrete alkali content shall be less than 3 lb./yd3.

e. Soundness shall be determined according to ASTM C88.
    i. Fine aggregate subjected to five cycles of the soundness test shall have a weighted average loss not greater than 10% when sodium sulfate is used of 15% when magnesium sulfate is used as described in ASTM C33.
    ii. Coarse aggregate subjected to five cycles of the soundness test shall have a weighted average loss not greater than 12% when sodium sulfate is used of 18% when magnesium sulfate is used as described in ASTM C33.

f. Organic impurities in fine aggregate shall be determined and limited by ASTM C40.

4. Mineral Filler:
    a. Conform to ASTM C1797.
5. Water:
    a. Conform to ASTM C1602.
6. Admixtures:
    a. Admixtures shall conform to the following ASTM specifications according to the identified application:
        i. Air-Entraining Admixture: ASTM C260/C260M
        ii. Water-Reducing Admixture ASTM C494/C494M Type A
        iii. High-Range Water-Reducing Admixture: ASTM C494/C494M Type F or G
        iv. Accelerating Admixture: ASTM C494/C494M Type C or E
        v. Retarding Admixture: ASTM C494/C494M Type B or D
        vi. Extended Set-Retarding Admixture: ASTM C494/C494M Type B or D
        vii. Chloride-Induced Corrosion-Inhibiting Admixture: ASTM C1582/C1582M
        viii. Other admixtures that do not fall under ASTM C494 Types A through G, Used only with ENGINEER 's written approval:
            1. Workability-Retaining Admixture: ASTM C494/C494M Type S
            2. Shrinkage-Reducing Admixture: ASTM C494/C494M Type S
            3. Viscosity Modifying Admixtures: ASTM C494/C494M Type S
            4. Alkali-Silica Reaction Inhibiting Admixture: ASTM C494/C494M Type S
    b. Admixtures shall have no measurable chloride content.

CURING MATERIAL

1. Curing compounds shall conform to ASTM C309 or ASTM C1315.
2. Sheeting shall conform to ASTM C171.

PART 3

EXAMINATION

1. Prior to concrete placement, CONTRACTOR shall verify that placement conditions meet the requirements outlined in this Section and other referenced Specifications.

PREPARATION FOR CONCRETE PLACEMENT

1. All subgrade preparation shall be per SECTION 31 66 10.
2. All formwork preparation shall be per SECTION 03 10 00.
3. All rebar preparation shall be per SECTION 03 20 00.
4. All drilled shafts preparation shall be per SECTION 31 62 29.
5. Protect all elements from the intrusion of moisture and deleterious substances.
6. For concrete cast against earth, the excavation shall be prepared as follows:
    a. In accordance with the contract drawings.
    b. Dewatering shall be provided as applicable.
    c. Debris shall be removed from the bottom of the excavation.
7. For concrete cast against other structural and non-structural materials:
    a. Prepare surfaces as indicated in the Contract Documents. At a minimum, any surface that will bond to structural concrete shall:
        i. Be free of deleterious materials.
        ii. Shall be evaluated for imperfections or defects that may negatively impact longevity of either material. Contact ENGINEER prior to proceeding if defects or imperfections are discovered.
8. Cutting and Bonding to Existing Concrete:
    a. Cutting Existing Concrete:
        i. Use methods and equipment that will avoid damage to adjacent parts of the structure from heavy blows or vibration.
        ii. Cut existing concrete in a manner that prevents spalling and chipping and that forms a neat, straight edge.
        iii. Remove all loose or cracked concrete resulting from cutting existing concrete, leaving only sound, undamaged concrete, and clean reinforcing adjacent to new work.
        iv. Leave access opening edges with a neat, true grout surface to the opening size indicated.
    b. Bonding to Existing Concrete:
        i. Roughen concrete to ¼-inch amplitude.
        ii. Thoroughly clean the concrete surface and apply the bonding agent, as applicable. The bonding agent shall be applied in accordance with the manufacturer's written instructions.

PLACING OF CONCRETE

1. Concrete rejected on-site due to non-conformance with the specification shall not be re-worked in any manner and placed. Rejected concrete shall be returned and discarded. The following criteria as defined in this Section require that the concrete material be rejected and returned to the supplier to be discarded:
    a. Temperature
    b. Exceeding the approved time for delivery, discharge, and placement
    c. Poorly mixed concrete as identified by the presence of head packs or cement balls in the discharged concrete material.
2. Conventional Placing:
    a. General Requirements:

i. Conform to ASTM C94 for ready-mix concrete.
ii. Do not place concrete that has partially hardened or has been contaminated by foreign materials.
iii. Prevent mud or foreign materials from entering the concrete or forms during placement operations.

b. Conveying:
i. Convey concrete from the mixer and deposit in place by methods which will prevent the segregation or loss of materials.
ii. Equipment for chuting, pumping, and pneumatically conveying concrete shall be of such size and design as to provide a practically continuous flow of concrete at the delivery end.
iii. Aluminum conveying equipment shall not be used.

c. Depositing:
i. Drilled Shafts:
1. As specified in SECTION 31 63 29

d. Time Requirements:
i. Place concrete at a sufficient rate such that lifts below have not taken initial set before fresh concrete is deposited.
ii. Place concrete within 45 minutes after mixing. This period may be extended to 1 hour and 30 minutes provided that the combined air temperature, relative humidity, and wind velocity are such that the plasticity of the fresh concrete is satisfactory for placement and consolidation, and that the specified mixing water is not exceeded. Concrete which has partially set shall not be retempered but shall be discarded.
iii. Requests for extensions in placement times may be submitted to the ENGINEER by the CONTRACTOR as part of the Concrete Supply and Placement Plan. Extension request shall be submitted with a satisfactory slump loss test demonstrating that the concrete will retain adequate workability to not lose 3 inches of slump throughout the entire placement, or a drop to a total slump of 4 inches, whichever results in a higher slump. Efforts shall be made to simulate environmental conditions expected during placement for accurate slump loss predictions.
iv. Slump Loss Test Procedure
1. Mix concrete for the slump loss test at a temperature consistent with ambient and concrete temperatures expected during actual concrete placement.
a. Verify that the mix volume is at least 3 yd3 and is mixed in a manner similar to what will be used on the project.
b. Record the time water is introduced into the mix.
2. At the end of the mixing time, sample and perform and record the following:
a. slump;
b. concrete temperature;
c. concrete air content (if applicable);
d. ambient air temperature to the nearest 1°F; and
e. the current time
3. Remix the remaining concrete every 5 min. for 30 sec. at the mixing speed of the mixer, except for the 30-min. intervals discussed in (4).
4. Thirty min. after the last slump test, remix the concrete for 1 min. at the mixing speed of the mixer and then sample the concrete. Determine and record the slump,

concrete temperature, and time. Note —There will be five incidences of 30 sec. mixing followed by one incidence of 1 min. mixing.

5. Repeat steps (3) and (4) until the measured slump is less than or equal to 2 in. or as otherwise specified.

3. Underwater Placing of Concrete:
    a. As specified in SECTION 31 63 29.
4. Placement during Hot Weather
    a. Concrete placed during hot weather shall be placed in accordance with the practices outlined in ACI 305.1.
    b. The maximum temperature of fresh concrete at the time of discharge shall not exceed 95°F.
        i. A concrete mixture with a maximum temperature at time of discharge greater than 95°F shall be supported by past field strength test data or by preconstruction testing.
5. Placement during Cold Weather
    a. Concrete placed during cold weather shall be placed in accordance with the practices outlined in ACI 306.1.
    b. The minimum temperature of concrete as placed shall be defined as shown in the Table 2- Concrete Temperature.

Concrete Temperature		
Least dimension of section (in.)	Minimum temperature of concrete as placed and maintained during the protection period (°F)	Maximum gradual decrease in surface temperature during any 24h after end of protection (°F)
< 12	55	50
12 < 36	50	40
36 < 72	45	30
> 72	40	20

    c. Maintain contact surface temperature above 32°F when directly in contact with concrete or concrete accessories.
    d. All elements and concrete constituents shall not be frozen and be free of frozen moisture.
6. Finishes:
    a. Unformed Surfaces:
        i. Trowel finish—Float concrete surface, then trowel the surface. Unless otherwise specified, tolerance for concrete floors shall be for a flat surface in accordance with ACI 117. Addition of water to surface to facilitate finishing is prohibited. Do not apply hard-troweled finish to concrete with total air content greater than 3 percent.
        ii. Broom or belt finish—After concrete has received float finish, give concrete surface a coarse-scored texture by drawing a broom or burlap belt across the surface.
        iii. Nonslip finish—Unless otherwise specified, apply a broom or belt finish as indicated in Article 3.03F.1.d.
        iv. Unspecified unformed surface finishes—If finish is not specified, apply the following finishes to unformed concrete surface:
            1. Trowel finish—For interior floors
            2. Broom finish—For exterior surfaces, including slabs, ramps, walkways, and steps.
    b. Formed Surfaces:

i. Repair surface defects as specified in Article 3.05, this Section, except for surfaces against which fill material or concrete is to be placed.
ii. Rubbed finish—Rubbed finishes are required on exposed formed surfaces unless otherwise noted. Rubbed finishes are permitted at time of form removal or delayed until work areas are accessible.
    1. If finish is applied at form removal, wet the surface, and rub it with an abrasive stone to draw out mortar and fill surface voids.
    2. If rubbing is delayed or insufficient cement paste can be drawn from the concrete, mix grout as follows:
        a. 1 part by volume portland cement,
        b. 1-1/2 parts sand meeting the requirements of ASTM C144 or ASTM C404,
        c. Sufficient water to produce the consistency of thick paint.
    3. If accepted, packaged repair mortar or mortar additives are permitted.
    4. Scrub grout into voids and remove excess grout.
    5. Apply final finish using burlap, floating, or troweling.
    6. Cure as specified in Article 3.06, this Section.

FIELD QUALITY CONTROL

1. CONTRACTOR shall engage a qualified testing and inspection agency to perform the identified tests and inspection reports.
2. Testing and Reporting Requirements:
    a. Testing agency shall be responsible for obtaining, curing, and transporting specimens to the laboratory in accordance with ASTM C31/C31M.
    b. Testing agency shall report to CONTRACTOR and concrete manufacturer any failure of Work to comply with Contract Documents.
    c. Testing agency shall report results of tests and inspection to OWNER, CONTRACTOR, and concrete manufacturer.
    d. Test reports of concrete strength shall include reporting requirements of ASTM C31/C31M and ASTM C39/C39M including the following:
        i. Project Name
        ii. Name of testing agency
        iii. Names and certification numbers of field and laboratory technicians performing tests
        iv. Name of concrete manufacturer
        v. Date and time of sampling and field testing
        vi. Date and time of concrete placement
        vii. Location in Work of concrete represented by samples (Foundation Callout/Name)
        viii. Date and time sample was obtained
        ix. Truck and batch ticket numbers
        x. Specified compressive strength and test age
        xi. Concrete mixture designation
        xii. Results of tests of fresh concrete performed
        xiii. Information on storage and curing of test specimens, including curing method and maximum and minimum temperatures during initial curing period
        xiv. Compressive strength test results at required test ages and type of fracture of specimens tested

3. Concrete Delivery Tickets: For each load delivered to the project, collect, and submit a delivery ticket that conforms to the reporting requirements of ASTM C94. Jobsite additions of water or admixtures shall be recorded on the truck ticket and be signed by the individual requesting the adjustment.
    a. Name of ready-mix company and batch plant, or batch plant number
    b. Serial number of ticket
    c. Date
    d. Truck number
    e. Name of purchaser
    f. Project name and location
    g. Specific class or designation of the concrete in conformance with that identified in this Section.
    h. Amount of concrete in cubic yards.
    i. Time loaded or of first mixing of cement and aggregates.
    j. Amount of water allowed to be added at the discharge site.
    k. Amount of water added at the request of the purchaser or the purchaser's designated representative and their initials.
    l. Type and quantity of admixture or other adjustments made to the batch after batching.
4. Concrete Tests: Samples of concrete shall be obtained in accordance with ASTM C172, and the strength testing shall be performed as follows:
    a. Compressive Strength Test Specimens shall be defined per ASTM C31/C31M and as indicated below:
        i. For strength specimens to be standard cured for acceptance of concrete, cast a set of cylinders and cure specimens at the jobsite in accordance with ASTM C31/C31M.
        ii. For strength specimens to be field cured for form removal and structure or equipment placement, cast a set of cylinders and cure specimens at the jobsite in accordance with ASTM C31/C31M.
        iii. Cast the number of cylinders identified in Table 3 - Required Number of Cylinders for each age that strength will be tested.
        iv. Strength test results at the designated age shall be the average of two 6 × 12-in. or three 4 × 8-in. specimens.
        v. Breaking a single cylinder does not constitute a concrete break test.

Compressive Break Test	**6" dia. X 12" Cylinder**	**4" dia. X 8" Cylinder**
7-day*	4	6
28-day*	4	6
Spare	2	3
Total Cylinders	**10**	**15**

* Includes cylinders for standard and field cured

Table 3 - Required Number of Cylinders (standard and field cured)

        i. Transport specimens to the lab within 48 hours after casting and cure them in accordance with final curing requirements of ASTM C31/C31M until tested.
    b. Testing Frequency:
        i. Strength tests shall be performed at the following frequencies:
        ii. At least once a day per mix design.

iii. At least once per each 150 yd3 of concrete.
iv. At least once for each 5000 ft2 of surface area for slabs or walls.
v. The ENGINEER , OWNER , and CONTRACTOR reserve the right to require additional testing should the concrete quality prove poor due to a high coefficient of variation or standard deviation, either in testing or batching.

c. Slump: ASTM C143
d. Air Content: ASTM C231
e. Temperature: ASTM C1064
f. Density: ASTM C138
g. Compressive Strength Tests: ASTM C39/C39M
    i. Test specimens for compressive strength as shown in Table 3 - Required Number of Cylinders (standard and field cured)
    ii. Acceptance of concrete shall be based on strength test results of standard cured cylinders in accordance with ASTM C31 and tested at 28 days in accordance with ASTM C39.
    iii. Each time strength cylinders are made, tests of slump, air content, temperature and density shall be made and recorded with the strength test results.
    iv. Strength of each concrete class shall be deemed satisfactory when both of the following criteria are met:
        1. The average of three consecutive compressive-strength tests equals or exceeds specified compressive strength.
        2. Any individual compressive-strength test result does not fall below specified compressive strength, f'_c
            a. by more than 500 psi when $f'_c \leq 5000$ psi
            b. by more than $0.1f'_c$ when $f'_c > 5000$ psi
    v. When compressive strength tests fail to meet the provisions of Article 3.04D.7.d, follow procedure in ACI 301 for evaluation of concrete strength tests.
    vi. When it is deemed necessary to evaluate the adequacy of concrete strength, at least 3 cores shall be obtained from the portion of the structure represented by the low strength tests. Cores shall be removed and conditioned in accordance with ASTM C42. The strength of cores shall comply with the following:
        1. Average strength of 3 cores $\geq 0.85f'_c$
        2. Individual core strength $\geq 0.75f'_c$
h. Requirement for Structure Erection or Equipment Placemen
    i. Concrete shall attain, based on ASTM C39 standard test method of field-cured samples, either 75 percent of the intended minimum compressive design strength or sufficient strength to support the loads imposed during steel erection or equipment placement.
    ii. When structure erection is expected before the 28-day compressive strength test is available, the following options are available to determine the compressive strength of the in-place concrete:
        1. Field Cured Compressive Strength Test
            a. Collect test specimen cylinders as indicated in Table 3 - Required Number of Cylinders (standard and field cured)
            b. Test at X days according to ASTM C39

2. Nondestructive Testing (ENGINEER approval required)
    a. Penetration Test (Windsor Probe and Pin Test) ASTM C803
    b. Pull-out Test ASTM C900
    c. Maturity Method ASTM C1074

REPAIRS

1. Repair of Defective Surfaces:
    a. Concrete repairs shall be performed in accordance with ACI 301.CONTRACTOR shall submit a repair procedure in accordance with the methods and procedures outlined in ACI 301 for ENGINEER review and approval.

CURING

1. Curing activities shall conform to ACI 301.
2. CONTRACTOR shall take appropriate steps to cure all surfaces of the concrete construction, formed or unformed surfaces not in contact with the ground.
3. Cure all concrete by one of the following methods:
    a. For formed surfaces, leave in forms for a minimum of seven days. If formwork consists of wood or porous material, keep formwork wet to prevent drying of concrete surfaces.
    b. For formed and unformed surfaces, use saturated bats, soaker hoses, or sprinkler for a minimum of seven days after placement. Keep concrete continuously wet.
    c. For formed and unformed surfaces, using one coat of a liquid membrane forming compound conforming to ASTM C309. Apply immediately after removal of forms; or in case of a slab, after the concrete has been finished and is hardened sufficiently to walk on.
    d. For formed and unformed surfaces, use of polyethylene sheets, complying with ASTM C171, applied in full contact with surfaces.
    e. Alternate methods for moisture-preserving concrete curing can be submitted for ENGINEER's review and approval.
4. Curing of concrete during hot or cold weather shall conform to Article 3.03D and Article 3.03E, this Section.
5. Duration of Curing:
    a. Curing measures shall be performed for at least 7 days after placement.
    b. Curing measures may be terminated before the specified minimum duration in Article 3.06E.1, this Section, if one of the following conditions is satisfied:
        i. Tests of at least two 6 x 12 in. or at least three 4 x 8 in. cylinders that have been field cured in accordance with ASTM C31/C31M indicate compressive strength of at least 70 percent of ƒ´c when tested in accordance with ASTM C39/C39M.
        ii. The compressive strength of laboratory-cured cylinders, representative of the in-place concrete, exceeds 85 percent ƒ´c, provided the temperature of the in-place concrete has been maintained at 50°F or higher during curing.
        iii. Concrete strength reaches ƒ´c as determined by accepted in-place test methods meeting the requirements of 3.04, this Section.
    c. Unless otherwise specified, if one of the curing methods in Article 3.06C, this Section is used initially, the curing method may be replaced by one of the other methods after sufficient time and strength has elapsed per SECTION 03 10 00, PART 3, provided the surface of concrete does not become dry before replacement curing method is applied.

Division 26

Section 262416 – Panelboards

PART 1

RELATED DOCUMENTS

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

This Section includes furnishing and installing panelboards for low-voltage power applications. Furnish and install quantities and types as specified or as indicated. Equipment and materials shall be furnished as noted on the Bill of Materials.

REFERENCE STANDARDS

1. Applicable Standards (conform to all standards applicable to each item utilized) shall be latest revisions, supplements, and amendments to the following:
    a. Federal Specifications:
        i. W-C-375B/GEN - Circuit Breakers, Molded Case; Branch Circuit and Service.
        ii. W-P-115C - Panel, Power Distribution.
        iii. W-S-865C - Switch, Box, (Enclosed), Surface Mounted.
    b. National Electrical Manufacturers Association (NEMA):
        i. ICS 1 - Industrial Control and Systems.
        ii. ICS 2 - Industrial Control Devices, Controllers and Assemblies.
        iii. ICS 4 - Terminal Blocks for Industrial Use.
        iv. PB 1 - Panelboards.
        v. PB 2 - Deadfront Distribution Switchboards.
        vi. ST 20 - Dry-Type Transformers for General Applications.
        vii. 250 - Enclosures for Electrical Equipment (1,000V Maximum).
    c. National Fire Protection Association (NFPA):
        i. 70 - National Electrical Code.
    d. Underwriters Laboratory (UL):
        i. 50 - Cabinets and Boxes.
        ii. 67 - Panelboards.
        iii. 489 Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures
        iv. 508 - Industrial Control Equipment.
    e. JEA Substation Standards Reference Manual (2023 Edition)

SUBMITTALS

1. Submit as specified in Division 01.
2. Submittals shall be custom prepared by the panelboard manufacturer for this specific application.
3. Product Data: Submit for each type of product specified and included, with the following as a minimum:
    a. Data sheets for all components furnished as part of the system package.
4. Shop Drawings: Provide the following as a minimum:

a. Panelboard dimensions and weight. [Provide center-of-gravity information for each seismic rated panelboard.]
b. Complete data on circuit breakers. [Submit time - current characteristic curves of all devices.]
c. Panelboard short-circuit interrupting capacity, and information on buses: Phase, neutral, and ground.
d. Information on whether panelboard is fed from top or bottom.
e. Data on maximum and minimum incoming and outgoing feeder and branch circuit wire size.
f. Data on door, locks, and mounting: Surface or flush.
g. Data on total number of poles and number of unused poles that is available for future use.

5. Closeout Submittals: Final documentation shall include the following as minimum:
    a. Operation and Maintenance Manuals including the following:
        i. Operation and maintenance manuals for all components furnished.
        ii. Certified “As-Built” drawings of all equipment with information listed above.
        iii. Copies of all approved Product Data.
        iv. Copies of all approved Test Reports.
        v. Warranty Information.
    b. Maintenance Material Submittals:
6. Furnish extra materials and spare parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
    a. Keys: Two (2) spares for each type of panelboard cabinet lock.
    b. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Two (2) spares for each panelboard.

QUALITY ASSURANCE

1. Testing Agency Qualifications: Member company of NETA or a NRTL.
    a. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
2. Materials and Equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall be the manufacturer’s latest standard design that has been in satisfactory use for at least one year prior to Bid opening.
3. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
4. 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.
5. 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.
6. Panelboards shall comply with NEMA PB 1.
7. Comply with NFPA 70.
8. Mini-power centers shall conform to the applicable requirements of 10 CFR 429.47 – Distribution Transformers and 10 CFR 431.193 – Test procedures for measuring energy consumption of distribution transformers.

EXAMINATION

1. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

2. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
3. Verify Site conditions are suitable for installation of equipment.
4. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the work.
5. Proceed with installation only after unsatisfactory conditions have been corrected.

PART 2

ACCEPTABLE MANUFACTURERS (OR ENGINEER APPROVED EQUIVALENT)

1. Panelboards:
    a. General Electric Company.
    b. Square D Corporation.
    c. Eaton Corp.

PANELBOARDS

1. General Requirements:
    a. Except as otherwise indicated, provide panelboards, enclosure, and ancillary components of types, size and ratings indicated which comply with manufacturer's standard materials and with the design and construction in accordance with published product information.
    b. Heavy-duty type with voltage and ampere ratings as indicated.
    c. Enclosures of the following types:
    d. NEMA 3R - Raintight for outdoor locations.
    e. Panelboards in code gauge, hot-dipped galvanized sheet metal boxes with code gauge steel trim and finished with a rust inhibiting coating and ANSI Z55.1.61 No. 61 light gray paint.
    f. Hinged door with lock and catch combination in the front trim of all panelboards.
    g. Phenolic nameplate on front of panel engraved with the panelboard designation. Nameplate to be approximately 1 inch by 3 inches with 3/8-inch characters.
    h. Breakers with trip rating and number of poles as indicated.
    i. Future breaker space for the number of poles as indicated.
    j. Copper main buses of the capacity indicated.
    k. The short-circuit current rating of the assembled panelboard shall be equal to or greater than the interrupting capacity of the highest rated branch breaker.

PART 3

WARRANTY

1. All equipment furnished under this Section shall be warranted by the Contractor and the equipment manufacturer(s) for a minimum period of one year after substantial completion.
2. Warranty shall include all parts, labor, and expenses to perform necessary work.

DELIVERY, STORAGE, AND HANDLING

1. Panelboards shall be stored according to the manufacturer's instructions and in a conditioned space to avoid condensation, dust, and other environmental contaminants.
2. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (Approximately 250 watts per panelboard for average conditions) to prevent condensation.

3. Handle and prepare panelboards for installation according to NEMA PB 1 and manufacturer’s instructions.

EXAMINATION

1. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
2. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
3. Verify Site conditions are suitable for installation of equipment.
4. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the work.
5. Proceed with installation only after unsatisfactory conditions have been corrected.

PANELBOARDS INSTALLATION

1. Install panelboards, mini-power centers, and enclosures as indicated, providing NEC required working space, in accordance with manufacturer's written instructions, applicable requirements of NEC and in compliance with recognized industry practices to ensure that products fulfill requirements.
2. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A.
3. Fasten enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically anchored.
4. Provide properly wired electrical connections for panelboards within enclosures.
5. Install numbers on all circuit breakers and type the panelboard's circuit directory card upon completion of installation work. Clearly identify the load on each circuit and the circuit number according to the Contract Drawings.
6. Provide filler plates in all unused spaces.
7. Provision for future circuits at all flush mounted panelboards (unless indicated otherwise): Extend four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Extend four 1-inch conduits into raised floor space or below floor slab (not required for slabs on grade or basement floor slabs).
8. Install with top of panelboard approximately 6 feet above floor.

GROUNDING

1. Provide equipment grounding connections for panelboard enclosures as indicated and as required by NEC. Tighten connections to comply with tightening torques specified in UL 486A to assure permanent and effective grounds.

ADJUSTING AND CLEANING

1. Adjust moving parts and operable components to ensure normal function as recommended by manufacturer.
2. Upon completion of installation, clean interior and exterior of panelboards. Remove paint splatters, spots, dirt and debris.
3. Touch-up scratched or marred surfaces to match original finishes.

DEMONSTRATION

1. Subsequent to final wire and cable hook-ups, energize panelboards and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

End of Section 262416 - Panelboards

Section 262716 – Low Voltage Fuse & Terminal Cabinets

PART 1

1. This Division includes the individual specifications and requirements for all substation instrument transformer low voltage fuse and terminal cabinets to be furnished as noted on the Bill of Material. Quantities as indicated.
2. Installation required at the Job Site will be performed by this Contract.
3. Items furnished under this Section shall comply with the requirements of Division 01.

REFERENCE STANDARDS:

1. Test and assemble all equipment and materials in conformance with the latest revisions and supplements of all applicable IEEE, ASTM, OSHA and NESC standards including, but not limited to, the following:
    a. Institute of Electrical and Electronics Engineers (IEEE):
        i. IEEE C2 - National Electrical Safety Code.
        ii. IEEE C57.13.3 - Guide for Grounding of Instrument Transformer Secondary Circuits and Cases.
    b. ASTM International (ASTM):
        i. ASTM A6 - Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
        ii. ASTM A108 - Steel Bars, Carbon and Alloy, Cold Finished.
        iii. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
        iv. ASTM A143 - Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
        v. ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
        vi. ASTM A370 - Test Methods and Definitions for Mechanical Testing of Steel Products.
    c. Occupational Safety and Health Act (OSHA).
    d. JEA Substation Standards Reference Manual (2023 Edition)
2. Acceptable manufacturers are listed in PART 2. Other manufacturers than those listed may be employed with the approval of the Engineer and if the item to be furnished conforms to this Specification.
3. Experience:
    a. The manufacturer of each item of equipment or material furnished shall be regularly engaged in the fabrication of the item and it shall have an acceptable history of satisfactory, reliable service in outdoor substation use for a period of at least three years under comparable environmental conditions.
    b. Newly developed equipment with less than three years actual service will be considered from established manufacturers only if it has been adequately tested, meets the requirements of this Contract, and is approved by the Engineer.

PART 2

INSTRUMENT TRANSFORMER FUSE AND TERMINAL CABINETS:

1. Fuse and Terminal Cabinets:
    a. NEMA 3R enclosure: Dimensions as indicated.

b. Constructed from formed and welded code gage steel with full-length hinge and stainless-steel hinge pin, clamps, clamp screws and panel screws: Manufacturer and Model as indicated.
c. Furnish with steel or aluminum subpanel: Manufacturer and Model as indicated.
d. Furnish with drip shield kit: Manufacturer and Model as indicated.

PART 3

FIELD SERVICES:

1. Correction of errors, discrepancies, or omissions shall be made immediately upon notification from the Resident Engineer in order to prevent delay of construction. All corrections resulting from errors, discrepancies, shipping damage, etc., approved by the Resident Engineer to avoid delay in construction and required for the installation and proper use of equipment shall be paid for by the Supplier.

SHIPMENT

1. All cabinets shall be delivered to the Site with the Bill of Materials item numbers noted on the packaging material.

End of Section 262716 – Low Voltage Fuse & Terminal Cabinets

Division 31

Section 316329 – Drilled Shaft Foundations

PART 1 – GENERAL

SUMMARY

1. Work under this SECTION consists of furnishing all supervision, labor, equipment, materials, and quality control necessary to install all drilled shafts for the JEA-Miller Solar 69kV Substation.
2. Work under this SECTION shall conform to all requirements of ACI 336.1 published by the American Concrete Institute, Farmington Hills, Michigan, except as modified herein.
3. Drilled shafts shall be embedded to depths as indicated on the Drawings.
4. Contractor shall visit the Site prior to bidding to observe and review specific Site conditions and requirements for equipment, methods, and costs to install drilled shafts.
5. Contractor shall verify the location of all underground conduits, piping, duct banks and utilities prior to installing drilled shafts.
6. Owner will retain a Geotechnical Representative as defined herein.

RELATED REQUIREMENTS:

1. Section 03 10 00 – Concrete Formwork.
2. Section 03 20 00 – Concrete Reinforcement
3. Section 03 30 00 – Concrete.
4. Section 31 63 30 – Foundations for Direct Embedded Poles.

REFERENCE STANDARDS:

1. General:
    a. Standards listed by reference, including revisions by issuing authority, form a part of this SECTION to extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
    b. Where specifications and reference documents conflict, the specification shall govern.
    c. Unless otherwise noted, the latest revision of the following reference standards shall apply to this SECTION.
2. Applicable Standards:
    a. American Concrete Institute (ACI):
        i. 336.1 Specification for the Construction of Drilled Piers.
    b. American Petroleum Institute (API):
    c. 13A Specification for Drilling Fluid Materials.
    d. ASTM International (ASTM):
        i. D698 – Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3).
        ii. D2487 – Classification of Soils for Engineering Purposes (Unified Soil Classification System).
        iii. D4253 – Maximum Index Density of Soils Using a Vibratory Table.
        iv. D4254 – Minimum Index Density of Soils and Calculation of Relative Density.

DEFINITIONS:

1. Bearing Stratum The formation(s) or layer(s) of soil or rock that support the shaft and loads imposed on it.
2. Geotechnical Representative – The Geotechnical Representative is responsible for observation and recording of material verification, drilled shaft installation sequence and methods, and other quality control documentation as specified herein.
3. Pumping of Concrete Concrete placed under water or through slurry conveyed by pressure through a rigid pipe or flexible hose and discharged directly to bottom of shaft. Pressure is applied by piston pumps, pneumatic compressed air, or squeeze pressure pumps in accordance with ACI 336.1. NOTE: Placement of concrete under water or through slurry will not be permitted during construction of drilled shafts which bear upon or are socketed into rock.
4. Rock Excavation – Intact rock material encountered in excavating drilled shafts which cannot be removed with a conventional earth auger, and which requires a rock auger, core barrel, or hand labor using air powered tools and/or other special excavation procedures. Refusal of the earth auger shall be defined as a penetration rate equal to, or less than, 1 foot per 10 minute period with the full torque and crowd continuously applied. Earth, clay, coal seams, boulders, cobbles, rock fragments, soft fractured materials, or voids encountered between rock units will not be considered rock excavation.
5. Slurry Method of advancing drilled shaft hole where bentonite (sodium montmorillonite in accordance with API 13A) or anionic polymer is mixed with clean water or water within shaft to produce a slurry mixture capable of maintaining the stability of shaft walls and bottom in potentially caving and/or water bearing soils. Slurry is also used to increase density of fluid within shaft to offset exterior hydrostatic pressure and to facilitate removal of coarser grained soils by mixing and incorporation into the slurry mixture. NOTE: The use of slurry will not be permitted during construction of that portion of drilled shafts which bear upon or are socketed into rock.
6. Termination Criteria – All shafts shall be extended to the depths indicated.
7. Tremie Concrete placed under water or through slurry by means of gravity flow through a rigid pipe. NOTE: The use of the tremie method of placing concrete will not be permitted. Pumping will be required when placing concrete under water or through slurry.
8. Unclassified Excavation All materials encountered from the top of concrete or drilled shaft cutoff elevation to the tip bearing elevation, exclusive of rock excavation as described above.

EXPERIENCE QUALIFICATIONS:

1. Drilled Shaft Contractor
    a. A minimum of five (5) years of experience in drilled shaft construction, including experience with similar subsurface materials, water conditions, shaft dimensions, and special techniques as required.
    b. Submit a written description of equipment and techniques proposed for use on this Contract, and the name of three (3) similar projects successfully completed in the last five (5) years.
    c. The experience statement of past work and description of equipment and techniques proposed for use shall be submitted at time of Bid and will be considered in the evaluation of bids.

SUBMITTALS:

1. Submit as specified in DIVISION 01.
2. Bid Submittals:

a. Proposed drilled shaft rig name, model number, maximum continuous torque rating (ft lb), maximum downward force ("crowd"), proposed earth and rock auger attachments, and proposed special techniques and equipment. Submittals shall reflect any Contractor modifications that affect the torque and crowd ratings.
b. Proposed method(s) of construction – dry and uncased, temporary casing, slurry, or other procedure. If slurry methods are proposed, indicate whether mineral and/or polymer slurry will be utilized.
c. Experience Qualifications.

3. Pre-Construction Submittals: Submit the following items two (2) weeks prior to start of Work. Work shall not begin until all the submittals have been received and approved by the Owner. The Contractor shall allow the Owner two (2) weeks to review, comment, and return the submittal package after a complete set has been received. All costs associated with incomplete or unacceptable submittals shall be the responsibility of the Contractor.
    a. Detailed procedures for each anticipated method of construction dry and uncased, temporary casing, slurry, or other procedure including:
        i. Sequence of excavation, concrete placement, rebar cage placement, and placement of embedded items such as anchor bolts.
        ii. Method of concrete placement (i.e., free-fall, pump, or other).
        iii. Methods to prevent segregation of concrete during placement.
        iv. Methods to prevent caving, if necessary.
        v. Equipment and procedures for cleanout of bottom of drilled shaft.
        vi. Procedures for supporting rebar cage during concrete placement, including type, size and material construction of spacers to be used.
        vii. Procedures for supporting anchor bolts or other embedded items (as applicable).
        viii. Procedures for, and sequence of, installation and removal of temporary casing.
        ix. Procedures for emergency cold joint construction in the event concrete placement is unexpectedly interrupted.
        x. Procedures for placement and mix design for controlled low strength material (CLSM) mix, as applicable to backfill rejected drilled shaft foundations.
    b. Backfill material and procedures.
4. Construction and Closeout Submittals:
    a. Drilled Shafts: Submit at the completion of each day, drilled shaft construction logs similar to the form at the end of this SECTION and which contain the following information, where applicable.
        i. Identification number.
        ii. Shaft dimensions.
        iii. Ground surface elevation.
        iv. Bottom of concrete elevation.
        v. Top of concrete elevation.
        vi. Description of soils and/or rock encountered during drilling and the depths at which transitions occur.
        vii. A graph depicting the total volume of concrete and volume of concrete placed compared to theoretical concrete volume versus depth (only applicable to drilled shafts large enough to require multiple concrete trucks).
        viii. Bearing stratum description.

ix. Nature and location of obstructions.
x. Water conditions during drilling and concrete placement.
xi. Log of test probe holes, if required herein, including diameter, depth, and materials encountered.
xii. Amount of unclassified excavation.
xiii. Amount of rock excavation and length of socket, if required.
xiv. Method of construction - dry and uncased, temporary casing, slurry, or other.
xv. Details on deep foundation integrity testing, if applicable.

b. As-built shaft location and elevation data.
c. Detailed description of any remediation performed to resolve non-conforming work as described herein.
d. Geotechnical Representative shall provide a report at the end of drilled shaft installation activities including, but not limited to, the following:
    i. A general discussion of the activities observed.
    ii. Installation records as required by this SECTION.
    iii. Verification that drilled shafts were installed in general conformance with the specifications.
    iv. A list of drilled shafts not installed in accordance with the specifications and a discussion of what action was taken to resolve issues.

PART 2 - PRODUCTS

CONCRETE:

1. As specified in SECTION 03 30 00, except as follows:
    a. Minimum compressive strength of 4000 psi at 28 days.
    b. Slump requirements for concrete placed in drilled shafts shall be based on the construction method used, as follows:
        i. For dry uncased excavations: 4 to 6 inches.
        ii. For temporarily cased excavations: 6 to 8 inches.
        iii. For slurry excavations or placement of concrete under water: 7 to 9 inches.

CONCRETE REINFORCEMENT:

1. As specified in SECTION 03 20 00.

CONCRETE FORMS:

1. As specified in SECTION 03 10 00.

SLURRY:

1. Slurry shall consist of a mixture of bentonite (sodium montmorillonite conforming to API 13A) or anionic polymer and water to produce a slurry of sufficient density to maintain stability of the shaft walls and bottom and to facilitate removal of coarser grained soils from the excavation.
2. Slurry shall be transported, premixed, and processed using equipment made specifically for these purposes. Mixing slurry within the foundation excavation is not permitted.
3. Slurry properties such as density, sand content, pH, viscosity, etc., shall be tested and maintained per manufacturer's recommended ranges through the duration of excavation.

CASING:

1. Temporary and permanent casing shall be steel and of sufficient strength to prevent collapse or cave-in of the excavation and prevent soil and water from entering the excavation during drilling, field observation, and concrete placement.

DRILLING EQUIPMENT:

1. Excavate drilled shafts with an auger rig capable of drilling, as a minimum, the diameter and depth of foundations, including sockets, as shown on the Drawings in the subsurface materials present. Contractor is responsible for selecting appropriate drilling equipment and procedures as required to install the drilled shafts as indicated and in the subsurface conditions present. Rock excavation should be anticipated during drilling. Cobbles and/or boulders should not be anticipated during drilling. Other methods of excavation shall not be permitted.

PART 3 – EXECUTION

PREDRILLING

1. At Contractor's expense, drilled shaft foundations may be predrilled by an approved method to determine the depth to rock.

GENERAL EXCAVATION:

1. Unless otherwise approved in advance, construction of each drilled shaft shall be completed during one working day, including full excavation and placement of concrete.
2. Keep the ground surface for a minimum of 2 feet from the edge of the excavation clean and level.
3. Dispose of materials removed from the excavation at an off-site location unless otherwise directed.
4. Locate drilled shaft as indicated within the following tolerances. Deviations in excess of these tolerances shall be corrected at Contractor's expense, including additional costs for engineering, redesign, and inspection:
    a. Centerline: Within 2 inches or 4 percent of shaft diameter, whichever is less, of location indicated.
    b. Diameter: Plus +3 inches, minus -1 inch.
    c. Plumb: 1.0 percent of the length, 12.5 percent of shaft diameter, or 15 inches total, whichever is less.
    d. Cutoff Elevation: Plus +1 inch or minus -1 inch from cutoff elevation indicated.
5. Provide temporary casing with a minimum inside diameter equal to the nominal diameter of the drilled shaft and a sufficient strength to withstand the soil pressure. Provide casing on Site prior to start of excavation. At minimum, install temporary casing under the following conditions:
    a. To control seepage.
    b. To prevent collapse of the walls.
6. When casing is installed to control seepage or prevent collapse of the walls, casing shall be advanced in intimate contact with the surrounding soils and ahead of any excavation.
7. Except for deadend foundations, casing may be permanently left in place, provided that it is advanced in intimate contact with the surrounding soils and ahead of any excavation. Casings manufactured with fiber-based products shall not be permanently left in place. Casings shall not be permanently left in place for deadend foundations.

8. Remove all material regardless of classification within the shaft to meet the termination criteria as defined herein. Geotechnical Representative will field observe the excavation or drilling spoils and determine whether the excavation has achieved the required termination criteria. If termination criteria has not been met, Contractor shall extend the excavation until the criteria has been met or shall contact the Owner for direction.
9. Excavate shaft bottom to a level plane. Cleanout and remove all loose material and spoil from sides and bottom of the shaft to the degree determined by the Geotechnical Representative, and prior to placing concrete. In no case shall the average thickness of sediments on the shaft bottom exceed one-half inch, with a maximum thickness of one inch.
10. Drilled shafts which are overexcavated without Geotechnical Representative's approval shall have the overexcavation filled with unreinforced concrete, provided shafts do not require reinforcing steel for lateral or uplift loadings at depth, at Contractor's expense. If loads on shaft require reinforcing steel, provide steel with adequate lap splice at Contractor's expense.
11. Take all precautions necessary to prevent blowouts and disturbance of the sides or bottom of the excavation. If required, maintain water or slurry in the shaft at all times at a height sufficient to produce a positive head in the shaft.
12. If loose soil, a high water table, or other condition which causes the sides or bottom of the excavation to be unstable is encountered, advance the excavation through use of slurry, a temporary casing, or other approved method. The use of slurry shall be required for the construction of drilled shafts in cohesionless materials below the water table.
13. When slurry is used, maintain a positive head in the excavation at all times until placement of concrete. Circulate the slurry with sufficient consistency and velocity to remove the dislodged materials from the hole. Materials encountered which are too heavy to be removed by the slurry, may be removed by other approved means.
14. Mixing of slurry shall not be allowed in the drilled shaft excavation.
15. Selection of, use, and disposal of all slurry shall comply with contract documents and all applicable local, state, and federal requirements.

BACKFILLING:

1. Restore the ground surface to required grade in the lateral direction around the drilled shaft with on-site soils, to replace any soils that have collapsed or sloughed as a result of the Work.
2. Prior to any backfilling operations, submit proposed methods and materials for approval.
3. Placement and compaction of soils required to restore the ground surface to required grade shall be completed in accordance with the following:
    a. Cohesive Soils:
        i. Materials include silts and clays generally exclusive of topsoil, sands and gravel. Materials for which impact compaction will produce a well-defined moisture-density relationship curve.
        ii. Compaction shall achieve a minimum of 95 percent of maximum density with a moisture content plus or minus three (3) percent of optimum moisture per ASTM D698.
    b. Cohesionless Soils:
        i. Materials include gravels, gravel-sand mixtures, sands, and gravelly sands exclusive of topsoil, clayey and silty materials. Materials which are free-draining and for which impact compaction will not produce a well-defined moisture-density relationship

curve and for which the maximum density by impact methods will generally be less than by vibratory methods.

ii. Compaction shall achieve a minimum of 70 percent relative density as per ASTM D4253 and D4254.

CONCRETE FORMWORK:

1. As specified in SECTION 03 10 00.
2. Form the drilled shaft with round forms with an inside diameter equal to the drilled shaft's nominal diameter and of sufficient strength to restrain the concrete without deformation or settlement. Mushrooming at the top of the drilled shaft shall not be permitted.
3. Construct forms to be removable without marring concrete surface.
4. Surface of forms shall provide smooth, dense, plane surface to finished concrete where exposed to view.
5. Contractor shall be responsible for structural adequacy of formwork.
6. Do not remove forms and supports until at least 24 hours after completion of concrete placement (this period is a cumulative number of hours, not necessarily consecutive, during which the temperature of the concrete surface is above 50°F).

CONCRETE STEEL REINFORCEMENT:

1. As specified in SECTION 03 20 00.
2. Unless otherwise indicated or approved, welding on concrete steel reinforcement is not permissible.
3. Wet setting of anchor bolts shall not be permitted.
4. Splice concrete steel reinforcement only as indicated.
5. Support or tie off the rebar cage to prevent downward movement.
6. Shall be fabricated as indicated prior to completion of excavation.
7. Provide spacers of sufficient quantity, design and material construction to maintain appropriate clearance from the side walls or casing and shaft bottom. Spacers shall be located at the top, bottom, and at every 10 feet vertical interval between. A minimum of one spacer per foot of shaft diameter shall be spaced equally around the perimeter of the reinforcing cage at each vertical interval.

CONCRETE PLACEMENT:

1. Wet forms with clear, potable water prior to placing concrete.
2. Prior to placement of concrete, center reinforcing cages in the drilled shaft excavation and suspend or tie them off in an approved manner to cutoff elevation.
3. Place concrete immediately after final inspection and approval by Geotechnical Representative.
4. Concrete not placed within 90 minutes from batch time shall be rejected.
5. Fill entire volume of drilled shaft with concrete to the cutoff elevation in one continuous operation. Cold joints and construction joints are not permitted unless otherwise indicated on the Contract Drawings. Complete concreting within the same working day in which drilled shaft is excavated. If concrete is not placed within 4 hours of completion of excavation, the bottom of the excavation shall be re-augured to remove any softened bearing material and re-inspected by the Geotechnical Representative.
6. Where practical, and without compromising the stability of the excavation, dewater excavation before placing concrete. Hold the water level in the bottom of the excavation prior to concreting at a nominal depth not to exceed 2 inches.

7. In dry excavations, place concrete with an approved drop pipe or funneling device. Approval of the funneling device shall be dependent upon Contractor's demonstrated ability to direct concrete flow so as not to fall or strike against the sides of the temporary casing, the sides of the drilled shaft excavation, or steel reinforcement before reaching the bottom. Use an extension pipe to limit the maximum concrete free-fall distance to 15 times the cage diameter, but no more than 60 feet.
8. Place concrete in a manner that will not cause segregation of the particles or permit infiltration of water or any other occurrence which would tend to decrease the strength of the concrete or the capacity of the finished drilled shaft.
9. Where dewatering to a depth of 2 inches or less is impractical, or when using the slurry method, place concrete under water or through slurry as follows:
    a. Use a rigid pipe or flexible hose. Displace the slurry mud or water as the concrete is placed. Keep the end of the pipe or hose embedded in the concrete as the concrete is placed.
    b. Should the end of the pipe or hose be accidently pulled out of the concrete during the placement, discontinue the placing immediately and withdraw the pipe or hose to the surface. Reseal the pipe or hose at its bottom. Reinsert pipe in the shaft with the sealed end extending into the concrete to the level before the pullout. Placement may then be resumed.
    c. Over pour the cutoff point shown on the Drawings. Dip out the excess concrete. Geotechnical Representative will then visually observe the concrete at the top of the pour. If any contamination of the concrete is observed, reinsert the pipe or hose a sufficient distance into the concrete and continue placing fresh concrete until the contaminated concrete has been replaced by uncontaminated concrete.
    d. Draw off slurry displaced during concrete placement and remove from the Site.
    e. Use of a tremie pipe, in lieu of pumping, shall not be permitted.
10. Do not disturb the temporary casing, until a sufficient depth of concrete has been placed in the shaft excavation such that no voids will occur in the shaft due to intrusion of soil or water as the temporary casing is being withdrawn. If a known void is present along the sides of the drilled shaft, sufficient concrete shall be placed prior to disturbing the temporary casing such that sufficient concrete will remain above the bottom of casing after the void is passed.
11. Coordinate the withdrawal of temporary casing with concrete placement to maintain a minimum concrete head of five (5) feet above the casing bottom or until a sufficient depth of concrete has been placed to prevent intrusion of soil or water into the shaft concrete as the temporary casing is being withdrawn. Keep the temporary casing plumb and withdraw with a smooth, vertical motion, without jerks.
12. Should soil, rock, or water enter the excavation and contaminate the concrete, remove the contaminated concrete before completing pour.
13. Place concrete in accordance with applicable practices recommended by ACI.
14. Conveying:
    a. Convey concrete from the mixer and deposit in place by methods which will prevent the segregation or loss of materials.
    b. Equipment for chuting, pumping, and pneumatically conveying concrete shall be of such size and design as to provide a practically continuous flow of concrete at the delivery end.
    c. Do not use aluminum conveying equipment.
15. Consolidation of Concrete:

   a. Provide an adequate number of vibrators of sufficient capacity to keep up with the maximum rate of concrete placement. Keep on hand adequate standby equipment in good operating condition.
   b. Vibrate concrete within the top 5 feet, only after temporary casing has been pulled or when casing is permanent.
   c. Vibrate concrete until the concrete is thoroughly consolidated and the voids filled as evidenced by the level appearance of the concrete at the exposed surface and the embedment of the surface aggregate. Do not over vibrate to avoid segregation of concrete aggregate from the cement paste.
16. Additionally, as specified in SECTION 03 30 00.

NON-CONFORMING WORK:

1. Contractor shall be solely responsible for full compliance with the Contract Documents regardless of if and when discrepancies are brought to their attention. Contractor shall be responsible for all re-work necessary to achieve full compliance with the Contract Documents. Repairs or replacement shall be at the sole expense of the Contractor, including the costs to redesign, as required.
2. Owner may employ one or more of their representatives for observation and testing services.
3. Owner or Geotechnical Representative may reject any shafts which, in their opinion, do not conform to the Contract Documents or are shown to be deficient based on deep foundation integrity testing.
4. As directed by Owner, perform the following for rejected shafts at no additional cost to Owner:
   a. Leave shafts in place, cut off as directed, and install one or more replacement shafts in designated location(s).
   b. Withdraw the shaft and install a new shaft in the same location.
   c. Any holes which result from shaft withdrawal or excavation that results in unstable excavation shall be backfilled with controlled low strength material (CLSM) with strength characteristics equal to or greater than the material excavated. Contractor shall provide documentation of proposed CLSM mix planned for use.
   d. Pressure grouting to fill voids or restore sidewall or base soil conditions that have been disturbed due to the Work.
   e. Other remediation work, as directed.

End of Section 316329 – Drilled Shaft Foundations

Owner _____
Project Name _____
Project No. _____
Contract No. _____

Single Shaft

Record Report

Shaft No. _____

AS DESIGNED (Per Drawings)

Shaft Location/Area _____
Type/Diameter _____
Top Elevation (ft) _____
Length (ft) _____
Rebar Length (ft) _____

AS CONSTRUCTED

Started _____
Date/Time Completed _____
Diameter _____
Top Elevation (ft) _____
Bottom Elevation (ft) _____
Length (ft) _____
Tolerance _____
Plumbness _____
Concrete, Cy _____
Concrete Mix ID _____
Rebar Length _____
Socket Length (ft) _____

REMARKS

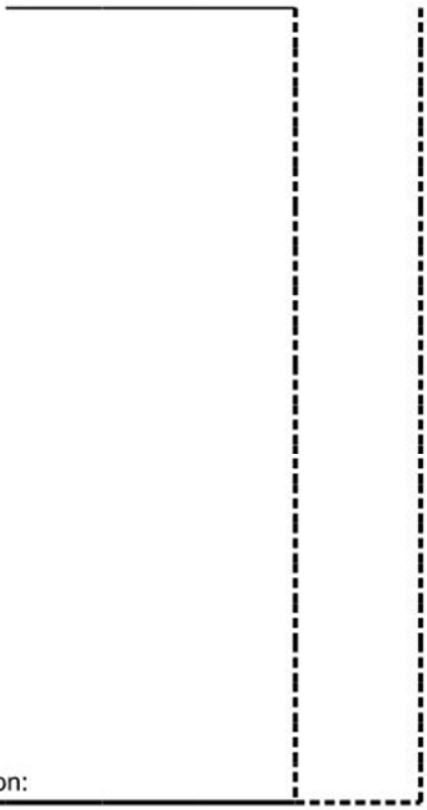
Bearing Material Description _____
_____
_____

Rebar - Size & Condition _____
_____
_____

Notes _____
_____
_____
_____
_____
_____
_____
_____

Shaft Log *(INCLUDE: Ground Elevations, Size, Shaft Casing, Water Conditions, Drilling & Concreting, Nature & Location of Obstructions, & All Other Pertinent Information.)*

Elevation: _____



Elevation: _____

Time of Concrete
Placement Start _____
Finish _____

_____
Drilled Shaft Subcontractor

_____
General Contractor

_____
Observer Name & Company

091399

Form TS-GT-1-8

Section 316330 – Foundations for Direct Embedded Poles

PART 1 - GENERAL

SUMMARY

1. Work under this Section consists of furnishing all supervision, labor, tools, equipment, materials, and quality control necessary to perform excavation and backfilling of foundations for direct embedded poles for JEA- Miller Solar 69kV Substation Project.
2. Work under this Section shall conform to all applicable requirements of ACI 336.1 published by the American Concrete Institute, Farmington Hills, Michigan, except as modified herein.
3. Excavations shall be completed, and poles embedded, to the dimensions indicated on the drawings, including socket length when applicable, and rely on end bearing for axial capacity.
4. Contractor and/or Subcontractor shall visit the Site prior to bidding to observe and review specific Site conditions and requirements for equipment, methods, and costs to perform excavation and backfilling for foundations.
5. Contractor shall verify the location of all underground conduits, piping, duct banks and utilities prior to performing excavations.
6. Owner will retain a Geotechnical Representative as defined herein.

RELATED REQUIREMENTS

1. SECTION 03 30 00 - Concrete.
2. SECTION 31 63 29 - Drilled Shaft Foundations.

REFERENCE STANDARDS

1. General:
    a. Standards listed by reference, including revisions by issuing authority, form a part of this Section to extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
    b. Where specifications and reference documents conflict, the specification shall govern.
    c. Unless otherwise noted, the latest revision of the following reference standards shall apply to this Section.
2. Applicable Standards:
    a. American Concrete Institute (ACI):
        i. 336.1 Specification for the Construction of Drilled Piers.
    b. American Petroleum Institute (API):
        i. 13A – Specification for Drilling Fluid Materials.
    c. ASTM International (ASTM):
        i. C33 – Concrete Aggregates
        ii. D698 - Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3).
        iii. D1241 – Materials for Soil-Aggregate Subbase, Base and Surface Courses.
        iv. D2487 – Classification of Soils for Engineering Purposes.
        v. D4253 – Maximum Index Density of Soils Using a Vibratory Table.
        vi. D4254 – Minimum Index Density of Soils and Calculation of Relative Density.

DEFINITIONS:

1. Bearing Stratum – The formation(s) or layer(s) of soil or rock that support the embedded pole and loads imposed on it.
2. Geotechnical Representative – The Geotechnical Representative is responsible for observation and recording of material verification, embedded pole excavation and installation sequence and methods, and other quality control documentation.
    a. The Geotechnical Representative will be provided by the Owner.
3. Corrugated Metal Pipe (CMP) – cylindrical, corrugated steel casing used to create a stabilized excavation for subsequent placement of the direct-embedded pole.
4. Pumping of Concrete Concrete placed under water or through slurry conveyed by pressure through a rigid pipe or flexible hose and discharged directly to the bottom of the excavation. Pressure is applied by piston pumps, pneumatic compressed air, or squeeze pressure pumps in accordance with ACI 336.1. NOTE: Placement of concrete under water or through slurry will not be permitted during construction of embedded poles which bear upon or are socketed into rock.
5. Rock Excavation – Where applicable for measurement and payment purposes, rock excavation is defined as intact rock material encountered in the excavation which cannot be removed with a conventional earth auger and/or underreaming tool, and which requires a rock auger, core barrel, or hand labor using air powered tools and/or other special excavation procedures. Refusal of the earth auger shall be defined as a penetration rate equal to, or less than, 1 foot per 10 minute period with the full torque and crowd continuously applied. Earth, clay, coal seams, boulders, cobbles, rock fragments, soft fractured materials, or voids encountered between rock units will not be considered rock excavation.
6. Slurry Method of advancing excavation where bentonite (sodium montmorillonite in accordance with API 13A) or anionic polymer is mixed with clean water or water within the excavation to produce a slurry mixture capable of maintaining the stability of excavation walls and bottom in potentially caving and/or water bearing soils. Slurry is also used to increase density of fluid within the excavation to offset exterior hydrostatic pressure and to facilitate removal of coarser grained soils by mixing and incorporation into the slurry mixture. NOTE: The use of slurry will not be permitted during construction of that portion of the excavation which bears upon or is socketed into rock.
7. Tremie Concrete placed under water or through slurry by means of gravity flow through a rigid pipe. NOTE: The use of the tremie method of placing concrete will not be permitted. Pumping will be required when placing concrete under water or through slurry.
8. Unclassified Excavation Where applicable for measurement and payment purposes, all materials encountered from the ground surface to the tip bearing elevation, exclusive of rock excavation as described above.

EXPERIENCE QUALIFICATIONS:

1. Foundation Contractor
    a. A minimum of 5 years' experience in foundations for direct embed pole construction, including experience with similar subsurface materials, water conditions, excavation dimensions, and special techniques as required.
    b. Submit a written description of equipment and techniques proposed for use on this Contract, and the name of three similar projects successfully completed in the last 5 years.

c. The experience statement of past work and description of equipment and techniques proposed for use shall be submitted at time of Bid and will be considered in the evaluation of bids.

SUBMITTALS:

1. Submit as specified in DIVISION 1.
2. Bid Submittals:
    a. Proposed excavation rig name, model number, maximum continuous torque rating (ft lb), maximum downward force ("crowd"), proposed earth and rock auger attachments, and proposed special techniques and equipment. Submittals shall reflect any Contractor modifications that affect the torque and crowd ratings.
    b. Proposed gradation and source of crushed rock backfill material, if used.
    c. Proposed method(s) of construction – dry and uncased, temporary casing, slurry, or other procedure. If slurry methods are proposed, indicate whether mineral and/or polymer slurry will be utilized.
3. Pre-Construction Submittals: Submit the following items two (2) weeks prior to start of Work. Work shall not begin until all the submittals have been received and approved by the Owner. The Contractor shall allow the Owner two (2) weeks to review, comment, and return the submittal package after a complete set has been received. All costs associated with incomplete or unacceptable submittals shall be the responsibility of the Contractor.
    a. Detailed procedures for each anticipated method of construction dry and uncased, temporary casing, slurry, or other procedure including:
        i. Sequence of excavation, pole and bearing plate installation, and placement of crushed rock or concrete.
        ii. Methods to prevent segregation of concrete during placement, if used.
        iii. Methods to prevent caving, if necessary.
        iv. Procedures for, and sequence of, installation and removal of temporary casing.
        v. Procedures for supporting direct embedded pole during placement of crushed rock or concrete backfill, and throughout curing of concrete, if used.
        vi. Equipment and procedures for placement and compaction of crushed rock.
        vii. Equipment and procedures for placement of concrete.
    b. Procedures to mitigate the potential for buoyancy due to the following conditions:
        i. Backfill placement is unexpectedly interrupted and cannot be completed the same working day as pole setting.
        ii. Multi-section poles are not fully assembled within 7-days of the setting the base section.
    c. Gradation and source of crushed rock backfill material.
    d. Concrete mix design.
4. Construction and Closeout Submittals:
    a. Submit at the completion of each day, foundation construction logs similar to the form at the end of this Section and which contain the following information, where applicable:
        i. Identification number.
        ii. Excavation dimensions (depth, diameter).
        iii. Pole embedment depth.
        iv. Bearing plate dimensions (where applicable).

v. Ground surface elevation.
vi. Description of soils encountered during drilling and the depths at which transitions occur.
vii. Bearing stratum description.
viii. Nature and location of obstructions.
ix. Water conditions during drilling and backfill placement.
x. Amount of unclassified excavation.
xi. Amount of rock excavation
xii. Length of socket, if required.
xiii. Method of construction - dry and uncased, temporary casing, slurry, or other.
xiv. Type of backfill used.
xv. For crushed rock backfill, identify placement and compaction methods.
xvi. For concrete backfill, identify placement method.

b. As-built foundation location and elevation data.

PART 2 – PRODUCTS

GENERAL

1. The Owner will furnish poles for direct embedment.

CONCRETE:

1. If applicable, as specified in SECTION 03 30 00, except as follows.
    a. Minimum 28-day compressive strength of 2,000 psi.
    b. Slump requirements for concrete placed in foundations shall be based on the construction method used, as follows:
        i. For dry uncased excavations: 4 to 6 inches.
        ii. For temporarily cased excavations: 6 to 8 inches.
        iii. For slurry excavations or placement of concrete under water: 7 to 9 inches.

SLURRY:

1. Slurry shall consist of a mixture of bentonite (sodium montmorillonite conforming to API 13A) or anionic polymer and water to produce a slurry of sufficient density to maintain stability of the excavation walls and bottom and to facilitate removal of coarser grained soils from the excavation.

CASING:

1. Temporary and permanent casing shall be steel and of sufficient strength to prevent collapse or cave-in of the excavation and prevent soil and water from entering the excavation during drilling, field observation, and backfill placement.
2. Corrugated Metal Pipe (CMP) shall not be utilized as permanent casing for excavations unless it is used in conjunction with temporary steel casing and the annulus between the CMP and temporary steel casing is backfilled with concrete before removal of temporary steel casing to ensure stability of the excavation. The minimum annulus between the temporary casing and CMP shall be 6-inches to allow for backfilling with concrete.

DRILLING EQUIPMENT:

1. Perform excavations with an auger rig capable of drilling, as a minimum, the diameter and depth of foundations, including sockets, as shown on the Drawings in the subsurface materials present. Contractor is responsible for selecting appropriate drilling equipment and procedures as required to complete the excavations and install the foundations as indicated and in the subsurface conditions present. Rock excavation should be anticipated during drilling. Cobbles and/or boulders should not be anticipated during drilling.

PART 3 – EXECUTION

PREDRILLING:

1. At Contractor's expense, foundation excavations may be predrilled by an approved method to determine the depth to rock.

GENERAL EXCAVATION:

1. Unless otherwise approved in advance, construction of each direct embedded pole foundation shall be completed during one working day, including full excavation, setting of pole, and placement of backfill.
2. Grade the area around the excavation, or construct a temporary berm, to prevent flow of surface water into the excavation.
3. Keep the ground surface for a minimum of 2 feet from the edge of the excavation clean and level.
4. Dispose of materials removed from the excavation at an off-site location unless otherwise directed.
5. Locate excavations as indicated within the following tolerances. Deviations in excess of these tolerances shall be corrected at Contractor's expense, including additional costs for engineering, redesign, and inspection:
    a. Centerline: Within 2 inches or 4 percent of excavation diameter, whichever is less, of location indicated.
    b. Diameter: Plus 3 inches, minus 1 inch.
    c. Excavation Plumbness: 1.0 percent of the excavation depth, 12.5 percent of excavation diameter, or 15 inches total, whichever is less.
    d. Depth: Plus 3 inches, minus 0 inch. Measurement shall be along the side of least dimension where penetration occurs along a sloping grade.
6. Take all precautions necessary to prevent blowouts and disturbance of the sides or bottom of the excavation. If required, maintain water or slurry in the excavation at all times at a height sufficient to produce a positive head in the excavation.
7. If loose soil, a high water table, or other condition which causes the sides or bottom of the excavation to be unstable is encountered, advance the excavation through use of slurry, a temporary casing, or other approved method. The use of slurry shall be required for the construction of excavation in cohesionless materials below the water table.
8. Provide casing with a minimum inside diameter equal to the nominal diameter of the excavation and a sufficient strength to withstand the soil pressure. Provide casing on Site prior to start of excavation. Install:
    a. To control seepage.
    b. To prevent collapse of the walls.
9. When casing is installed to control seepage or prevent collapse of the walls, casing shall be advanced in intimate contact with the surrounding soils and ahead of any excavation.
10. When casing is used in combination with concrete backfill, casing may be permanent or temporary.

11. For permanent casing, pressure grout with lean grout as directed by Geotechnical Representative to fill voids between permanent casing and the hole wall due to caving or collapsed-wall conditions during construction which result in voids between the permanent casing and excavation wall.
12. If corrugated metal pipe (CMP) is to be utilized as a permanent casing, it shall be used in conjunction with temporary casing. The temporary casing shall be utilized to prevent collapse of walls during excavation. The CMP can then be lowered into the excavation, the annulus between the CMP and temporary casing backfilled with concrete per 3.05.D of this Section and the temporary casing removed. The minimum annulus between the temporary casing and the CMP shall be 6 inches.
13. Casings manufactured with fiber-based products shall not be permanently left in place.
14. Pressure grout with lean grout as directed by Geotechnical Representative to fill voids between permanent casing and the excavation wall due to caving or collapsed-wall conditions during construction which result in voids between the permanent casing and excavation wall.
15. When slurry is used, maintain a positive head in the excavation at all times. Circulate the slurry with sufficient consistency and velocity to remove the dislodged materials from the hole. Materials encountered which are too heavy to be removed by the slurry, may be removed by other approved means.
16. Remove all material regardless of classification within the excavation to the depths indicated in the Contract Documents at which time Geotechnical Representative will field observe the excavation or drilling spoils and determine whether the excavation satisfies termination criteria. If termination criteria has not been met, Contractor shall extend the excavation until the criteria has been met or shall contact the Owner for a revised design. Excavation bottom shall be excavated to a level plane.
17. Cleanout and remove all loose material and spoil from sides and bottom of the excavation to the degree determined by the Geotechnical Representative, and prior to placing pole and backfill material. In no case shall the average thickness of sediments on the excavation bottom exceed one-half inch, with a maximum thickness of one inch.
18. Foundations which are overexcavated without Geotechnical Representative's approval shall have the overexcavation backfilled with crushed rock or concrete, as specified, at Contractor's expense.

POLE EMBEDMENT AND INSTALLATION TOLERANCES:

1. Prior to embedding pole, Contractor shall confirm that the indicated over-excavation depth and bearing plate requirements, as well as suitable bearing conditions, are present at the base of the excavation.
2. Center of the pole base shall not deviate from the center of the base of the excavation by more than one (1) inch.
3. Pole bottom shall be set to within plus or minus three (3) inches of the embedment depth indicated.
4. Pole plumbness criteria shall be as indicated.
5. Deviations in excess of the indicated pole location and installation tolerances shall be corrected at Contractor's expense.

BACKFILLING:

1. Backfill type shall be concrete material as indicated and specified herein.
2. Complete all backfilling within the same working day in which excavation is performed.
3. Place backfill immediately after final inspection and approval by the Geotechnical Representative.
4. Concrete Backfill:

a. Prior to placement of concrete, restore the ground surface to required grade in the lateral direction around the excavation with on-site soils, to replace any soils that have collapsed or sloughed as a result of the Work. Mushrooming of concrete at the top of the foundation shall not be permitted.
b. Concrete not placed within 90 minutes from batch time shall be rejected.
c. Place concrete in accordance with applicable practices recommended by ACI.
d. Fill entire volume of excavation with concrete to the ground surface in one continuous operation.
e. Where practical, and without compromising the stability of the excavation, dewater excavation before placing concrete. Hold the water level in the bottom of the excavation prior to concreting at a nominal depth not to exceed 2 inches.
f. In dry excavations, place concrete with an approved drop pipe or funneling device. Approval of the funneling device shall be dependent upon Contractor's demonstrated ability to direct concrete flow so as not to fall or strike against the sides of the casing or the sides of the excavation. Use an extension pipe to limit the free-fall distance to 15 times the minimum annulus thickness, but no more than 20 feet.
g. Place concrete in a manner that will not cause segregation of the particles or permit infiltration of water or any other occurrence which would tend to decrease the strength of the concrete.
h. Where dewatering is impractical, or when using the slurry method, place concrete under water or through slurry as follows:
    i. Use a rigid pipe or flexible hose. Displace the slurry mud or water as the concrete is placed. Keep the end of the pipe or hose embedded in the concrete as the concrete is placed.
    ii. Should the end of the pipe or hose be accidently pulled out of the concrete during the placement, discontinue the placing immediately and withdraw the pipe or hose to the surface. Reseal the pipe or hose at its bottom. Reinsert pipe in the excavation with the sealed end extending into the concrete to the level before the pullout. Placement may then be resumed.
    iii. Overpour the cutoff point shown on the Drawings. Dip out the excess concrete. Geotechnical Representative will then visually observe the concrete at the top of the pour. If any contamination of the concrete is observed, reinsert the pipe or hose a sufficient distance into the concrete and continue placing fresh concrete until the contaminated concrete has been replaced by uncontaminated concrete.
    iv. Draw off slurry displaced during concrete placement and remove from the Site.
    v. Use of a tremie pipe, in lieu of pumping, shall not be permitted.
i. Do not disturb the temporary casing, until a sufficient depth of concrete has been placed in the excavation to ensure that no voids will occur in the excavation due to intrusion of soil or water as the temporary casing is being withdrawn. If a known void is present along the sides of the excavation, sufficient concrete shall be placed prior to disturbing the temporary casing to ensure sufficient concrete will remain above the bottom of casing after the void is passed.
j. Keep the temporary casing plumb and pull with a smooth, vertical motion, without jerks, to ensure, in Geotechnical Representative's opinion, that no voids will occur in the backfill due to intrusion of soil or water as the casing is being withdrawn. Coordinate the withdrawal of temporary casing, with concrete placement to maintain a load of concrete approximately 5 feet above the casing bottom.

k. Should soil, rock, or water enter the excavation and contaminate the concrete, remove the contaminated concrete before completing pour.
l. Conveying:
    i. Convey concrete from the mixer and deposit in place by methods which will prevent the segregation or loss of materials.
    ii. Equipment for chuting, pumping, and pneumatically conveying concrete shall be of such size and design as to provide a practically continuous flow of concrete at the delivery end.
    iii. Do not use aluminum conveying equipment.
m. Consolidation of Concrete:
    i. Provide an adequate number of vibrators of sufficient capacity to keep up with the maximum rate of concrete placement. Keep on hand adequate standby equipment in good operating condition.
    ii. Vibrate concrete within the top 5 feet, only after temporary casing has been pulled or when casing is permanent.
    iii. Vibrate concrete until the concrete is thoroughly consolidated and the voids filled as evidenced by the level appearance of the concrete at the exposed surface and the embedment of the surface aggregate. Do not over-vibrate to avoid segregation of concrete aggregate from the cement paste.
n. Additionally, as specified in SECTION 03 30 00.

5. Soil Backfill
    a. Backfill the upper one (1) foot and restore the ground surface to required grade above the concrete backfill as indicated on the Drawings. Fill in the lateral direction around the foundation with on-site soils, to replace any soils that have collapsed or sloughed as a result of the Work. Place the soil in 6-inch lifts and compact as specified below. Sufficiently compact all material replaced, with the exception of topsoil, as follows:
        i. Cohesive Soils: Compaction shall achieve a minimum of 95 percent of maximum density with a moisture content plus or minus 3 percent at optimum moisture per ASTM D698.
        ii. Cohesionless Soils: Compaction shall achieve a minimum of 70 percent relative density as per ASTM D4253 and D4254.

PROTECTION

1. Protect installed poles from the potential for buoyancy due to the following conditions:
    a. Backfill placement unexpectedly interrupted and cannot be completed the same working day as pole setting.
    b. Multi-section poles are not fully assembled within 7-days of setting the base section

NON-CONFORMING WORK:

1. Contractor shall be solely responsible for full compliance with the Contract Documents regardless of if and when discrepancies are brought to their attention. Contractor shall be responsible for all re-work necessary to achieve full compliance with the Contract Documents. Repairs or replacement shall be at the sole expense of the Contractor, including the costs to redesign, as required.
2. Owner may employ one or more of their representatives to provide observation and testing services.

3. Owner or Geotechnical Representative may reject any foundations which, in their opinion, do not conform to the Contract Documents.
4. As directed by Owner, perform remediation work for rejected foundations at no additional cost to Owner.

End of Section 316630- Foundations for Direct Embedded Poles

Owner _____
Project Name _____
Project No. _____
Contract No. _____

Single Shaft

Record Report

Shaft No. _____

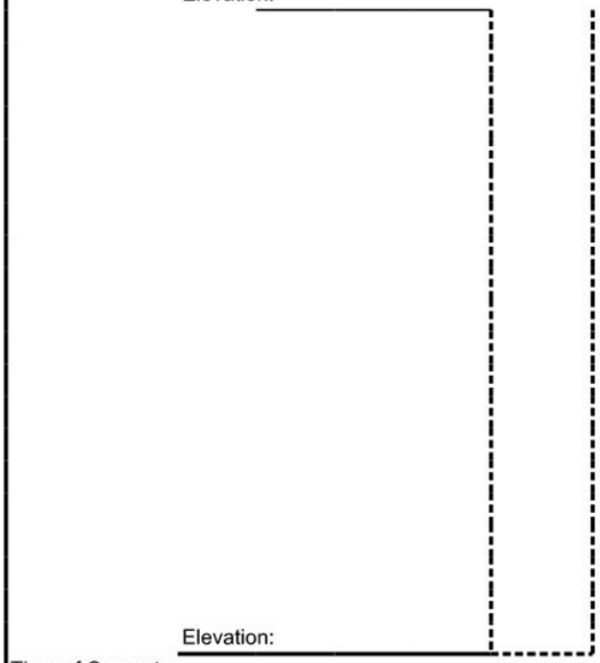
AS DESIGNED (Per Drawings)
Shaft Location/Area _____
Type/Diameter _____
Top Elevation (ft) _____
Length (ft) _____
Rebar Length (ft) _____

AS CONSTRUCTED
Started _____
Date/Time Completed _____
Diameter _____
Top Elevation (ft) _____
Bottom Elevation (ft) _____
Length (ft) _____
Tolerance _____
Plumbness _____
Concrete, Cy _____
Concrete Mix ID _____
Rebar Length _____
Socket Length (ft) _____

REMARKS
Bearing Material Description _____
_____
_____
Rebar - Size & Condition _____
_____
_____
Notes _____
_____
_____
_____
_____
_____
_____
_____

Shaft Log *(INCLUDE: Ground Elevations, Size, Shaft Casing, Water Conditions, Drilling & Concreting, Nature & Location of Obstructions, & All Other Pertinent Information.)*

Elevation: _____



Elevation: _____

Time of Concrete
Placement Start _____
Finish _____

_____
Drilled Shaft Subcontractor

_____
General Contractor

_____
Observer Name & Company

091399 Form TS-GT-1-8

Section 316620 – Shallow Foundations

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

1. This Section covers the furnishing of materials and the installation of shallow foundations.

RELATED REQUIREMENTS

1. Section 03 20 00 – "Concrete Reinforcement"

PART 2 - PRODUCTS

CONCRETE

1. As specified in Section 03 20 00, PART 2.02.

REINFORCEMENT

1. As specified in Section 03 20 00, PART 2.01.

PART 3 - EXECUTION

INSTALLATION

1. Spread footing shall be located as indicated with the following tolerances:
    a. Centerline: Within 2 inches of that indicated.

REINFORCING STEEL

1. As specified in Section 03 20 00, PART 3.01.

FORMWORK

1. As specified in Section 03 20 00, PART 3.02.

PLACING CONCRETE

1. As specified in Section 03 20 00, PART 3.03.

CONCRETE FINISH AND CURING

1. As specified in Section 03 20 00, PARTS 3.05 and 3.06.

STUB ANGLES AND ANCHOR BOLTS

1. Shall be installed as specified in Section 31 66 30.

End of Section 316620 – Shallow Foundations

Division 33

PART 1

Section 330570 – Installation of Major Substation Equipment

1. This Section includes the unloading (except where indicated otherwise) moving, storage, installation, and necessary field assembly of equipment and materials furnished by the Owner and as indicated on the Bill of Material including, but not limited to, the following:
    a. Three (3) 230-kV SF6 gas circuit breaker(s).
    b. Substation structures, equipment and materials.
    c. Three (3) 230 kV CT / PT Combo Units.
    d. Nine (9) 230 kV Coupling Capacitor Voltage Transformer.
    e. Twelve (12) 230 kV Disconnect Switches.
    f. One (1) 230 kV single bay Dead-end Structures including:
        i. Three (3) 230 kV Insulators.
        ii. Three (3) 230 kV Surge Arrestors.
    g. Two (2) 230 kV double bay Dead-end Structures including:
        i. Six (6) 230 kV Insulators.
        ii. Six (6) 230 kV Surge Arrestors.
    h. Two (2) 50 kVA Station Service Transformers.
    i. Six (6) 85’-0” Steel Probe Poles.
2. Related Work Specified Elsewhere:
    a. Grounding: DIVISION 33.
    b. Field Testing: DIVISION 33.
    c. Cable & Accessories: 33 72 43
    d. Cable Tray & Wireway: 33 72 33 36
    e. Panelboards: 26 24 16
    f. Relay Switchboards: 33 72 33
    g. Batteries & Accessories: 33 72 22 43
    h. Surge Arresters: 33 75 39

REFERENCE STANDARDS

1. American Institute of Steel Construction (AISC):
    a. M015L - Manual of Steel Construction Load & Resistance Factor Design.
    b. M016 - Manual of Steel Construction Allowable Stress Design.
    c. S323 - Quality Criteria and Inspection Standards.
2. American Society for Testing and Materials (ASTM):
    a. D877 - Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes.
    b. D1816 - Test Method for Dielectric Breakdown Voltage of Insulating Oils of Petroleum Origin Using VDE Electrodes.
3. American National Standards Institute/American Welding Society (ANSI/AWS)
    a. D1.2 – Structural Welding Code – Aluminum.
4. Institute of Electrical and Electronics Engineers (IEEE):
    a. C2 - National Electrical Safety Code.
5. National Fire Protection Association (NFPA):

a. 70 - National Electrical Code.

6. Steel Structures Painting Council (SSPC)
    a. SP 3 - Surface Preparation Specification No. 3 Power Tool Cleaning.
7. JEA Substation Standards Reference Manual (2023 Edition)

PART 2

EQUIPMENT AND MATERIALS

1. Provide all equipment as required for the installation of equipment and materials including, but not limited to, the following:
    a. Vacuum Equipment and Insulating Oil-Handling Equipment:
        i. Vacuum pump - approximately 150 cfm capable of 10 microns Hg vacuum in the blanked-off condition.
        ii. Vacuum gauge - McLeod (with a mercury trap to prevent transformer contamination) electronic device with a 0-2000-micron range. A minimum of three sensing units must be available for the electric device.
        iii. Vacuum pipes or flexible hoses - 3-inch minimum diameter, length as required, capable of holding a 50-micron vacuum.
        iv. Vacuum valve - 3-inch minimum diameter, to be no smaller than vacuum hose diameter, with a snap action.
        v. Degasification and dehydration unit.
        vi. Clear plastic sight hose, capable of withstanding a 50-micron vacuum.
        vii. Additional equipment as may be required by the manufacturer.
        viii. Welding equipment if required for shipping split including portable electrical power generators if required.
        ix. Miscellaneous fittings, couplings, and valves as may be required to make proper oil filling, vacuum, and dew point monitoring connections.
        x. Ambient temperature thermometer.
    b. Aluminum heliarc welding equipment and wire.
    c. Cranes and fork lifts.
    d. Jacking equipment.
    e. Miscellaneous hand and power tools.
    f. Heavy hauling equipment and materials:
        i. Multiwheeled lowboys (size as required).
        ii. Hauling tractor (size as required).
        iii. Tractor, capable of pushing, backing, or anchoring on grades, 5 percent or greater.
        iv. Heavy cribbing, blocks, planks, or rails.
        v. Chains, equipment tie down and safety.
        vi. Winch or cranes.
        vii. Hydraulic lifting jacks with a common control for simultaneous lifting and lowering.
        viii. Other miscellaneous materials as required.
    g. In-line dryer/filter for SF6 gas.

RECEIVING AND STORAGE OF MATERIALS:

General:

1. Receipt of Materials:
    a. Unload all equipment promptly when delivered and pay all demurrage charges and claims from damage to cars or vehicles resulting from Contractor's unloading operations. The Contractor shall be responsible for the proper location of railroad cars for unloading. Any additional switching operations required will be the Contractor's responsibility.
    b. Inspect all equipment and material for damage and check against shipping receipts for any missing parts. Inform the Engineer of any shortages or damaged materials at the time of delivery. Report obvious shipping damage immediately to the Engineer. Note the damage on the shipping company's forms before accepting shipment.
    c. Prepare "Material Receipts" in triplicate for each shipment received, on standard forms furnished by the Engineer. Receipts shall be distributed to the Engineer's as well as the Contractor's file and shall list in detail all items received noting any items damaged or missing as listed on manufacturer's shipping list. "Material Receipts" shall have attached to Engineer's copy the shipping list taken from the equipment received. Material receiving reports shall be filled out, signed, dated, and delivered to the Engineer within 24 hours of receiving the materials.
    d. The Contractor shall be responsible for any damage or missing items of stored equipment and material while in his custody.
    e. The Contractor shall pay all deposits for shipping containers such as gas bottles, cable reels, etc.; be responsible for the containers while on site; and arrange for their pickup when the contents of the containers have been expended.
2. Inventory of Crates and Boxes:
    a. All accessory parts received in cartons shall be inventoried item by item with any damage or shortages noted.
    b. All materials received in crates shall be uncrated to the extent that a complete and thorough inventory may be made. Upon the completion of the inventory, the equipment shall be recrated, packaged, and stored to the satisfaction of the Engineer.
3. Heavy Equipment Hauling:
    a. Provide the services of a heavy hauling contractor experienced in moving and handling equipment of this size, weight, and type (unless evidence can be shown that the contractor possesses the proper equipment and skilled personnel equal to that of such a contractor).
    b. The Contractor shall be licensed, if required by the local regulatory agency, for the area in which the work is to be done.
    c. The Contractor shall own his equipment or have a bona fide lease for the use of such equipment.
    d. The Contractor shall issue a surety bond with the local regulatory agency adequate to cover all possible damage to roads, highways, bridges, etc., as determined by said agency. This bond shall be in addition to the bond required for equipment protection on this contract.
    e. The Contractor shall have insurance in minimum amounts as required by the local regulatory agency for Personnel Injury Liability and for Property Damage Liability.
4. Work must be done under the supervision of an experienced rigger approved by the Engineer.
5. Extreme care must be used in moving this equipment to assure personnel safety and prevent damage to the equipment. The proposed methods, materials, and operations must be approved before work is started.

6. Roadways, bridges, and other areas over which equipment is to be moved shall be planked and braced, if necessary, for their protection.
7. Contractor shall secure all permits and make all other necessary arrangements with local street and highway authorities and police as required to obtain use of right-of-way, crossing rights, and traffic control for moving equipment from the points of unloading to points of installation. All stipulations for the issuance of permits shall be strictly followed. Copies of these permits shall be provided to the Engineer.
8. Contractor shall be responsible for raising or having raised all power cables, telephone cables, service drops, etc., to provide sufficient overhead clearances for equipment. Replace or restore to original condition all items damaged because of heavy equipment hauling.
9. The Contractor shall familiarize himself with the design loading of all equipment and structures and shall not overload. Use all lifting lugs provided.
10. Replace or restore to original condition any equipment or material missing or damaged while under the responsibility of this contract.
11. Equipment shall be moved to its permanent location as soon as possible. If temporarily stored, the equipment shall be blocked on the ground as low as possible with the approval of the Engineer. Cover all spaces and voids in the blocking to limit access under the equipment if stored in an area accessible by the public.
12. Medium-Weight Equipment Receiving:
    a. Use cranes or fork lifts of sufficient size to prevent overloading of lifting equipment. Do not load rigging in excess of its recommended safe working load. When fork lifts are used, line the forks so that equipment finishes will not be marred.
    b. Rigging equipment shall be inspected prior to use and during its use to assure safety. If found defective, the rigging equipment shall be replaced.
    c. Use lifting hooks, eyes, etc., if provided on the equipment for lifting.
    d. Use rope or synthetic webbing for slinging steel structures.
13. Material Storage:
    a. Equipment and materials shall be placed in storage areas as designated.
    b. Storage areas shall be divided into lots for the storage of each particular substation's materials.
    c. Substation lots shall be divided into areas for the storage of particular materials, such as follows:
        i. Bus, cable, weldments, etc.
        ii. Switches.
        iii. Insulators.
        iv. Steel.
        v. Grounding.
        vi. Conduit.
    d. Materials shall be stored such that materials being used first will not have to be lifted over materials which will be used later.
    e. As much as possible, all parts for a particular piece of equipment shall be stored in one location.
    f. The Contractor shall be responsible for any damaged or missing items of stored equipment and material while in his custody.

g. Deliver all spare or extra parts to the Owner's warehouse and store as directed at the end of the job.

14. Material Inventory Control:
    a. Material inventory shall be started in conjunction with "Material Receipts" prepared for receiving materials.
    b. Materials shall be listed in accordance with the manner of storage.
    c. Materials which are a portion of some other item shall be listed as such.
    d. Material inventory control reports shall be made weekly or as directed by the Engineer. This report may be compiled by numerical addition or subtraction of items received or used and include, but not be limited to, the following:
        i. New materials received.
        ii. Materials incorporated into the project.
        iii. Materials missing.
        iv. General comments concerning the condition of materials.
    e. An inventory, item-by-item count, shall be made of all materials on hand monthly or as directed by the Engineer.
15. Material Protection: All equipment while under the responsibility of this Contract whether furnished and installed, or furnished by the Owner and installed under this Contract, shall be adequately protected. Provide protection as specified in DIVISION 1 and the following:
    a. Equipment shall be stored outdoors unless designed for permanent indoor installation and must be stored indoors.
    b. Where stored out of doors, equipment shall be properly blocked up 6 inches off the ground on timbers.
    c. Equipment requiring indoor storage must be stored in the control house or warehouse space provided by the Contractor which shall be heated by this contract when required by weather conditions to prevent condensation and shall be locked or supervised to prevent the entrance of unauthorized persons. Temporary buildings and trailers shall be in locations acceptable to the Engineer and will be removed when the work is complete.
    d. Provide adequate protection during storage, installation, and up to the time of final acceptance, from the following:
        i. Rain and all other weather conditions.
        ii. Dust, dirt, sand, and concrete splatter.
        iii. Excessive heat, freezing, and condensation.
        iv. Welding operations, falling objects, and construction work in general.
    e. Provide protection in a manner meeting the approval of the Engineer and manufacturer's representatives by the application of the following:
        i. Tarpaulins.
        ii. Properly controlled electric heaters, heating lamps and fans.
        iii. Temporary guards, protective awnings, barricades, etc.
    f. Particular care shall be exercised in protecting equipment from moisture and damage to the finish. Equipment with damaged finish shall be touched up or completely repainted to equal the original finish as directed by the Engineer.
    g. All work, material, and equipment furnished or installed by the Contractor shall be kept in a clean condition during the construction period of the project as required by the Engineer.

h. Store equipment and materials in accordance with instructions of the manufacturer's representatives when storage at the site is required.
i. The Engineer shall be informed of any arrangements made for storage of materials or equipment in a place other than the Owner's site. Evidence of insurance coverage shall be furnished.
j. Contractor shall assume responsibility for and protect all equipment and materials during the storage period in accordance with the manufacturer's or supplier's recommendations including the following:
    i. Protection of equipment and machinery of all kinds against corrosion, moisture deteriorations, mechanical injury, and accumulation of dirt or other foreign matter.
    ii. Protection of exposed machined surfaces and unpainted iron and steel as necessary with suitable rust-preventive compounds.
    iii. Blocking equipment and material stored outdoors at least 6 inches above the ground and arranging for natural drainage with equipment drain connections open but protected.
k. Materials and equipment shall not show any pitting, rust, decay or other deleterious effects of storage prior to final acceptance of the work.
l. Upon the receipt of breaker, a pressure gauge, capable of reading both positive and negative pressure shall be installed on the unit and monitored daily.

PART 3

GENERAL

1. Install equipment and materials complete as specified and as required for operation and continuous service at the locations shown on the drawings.
2. Include assembly of all shipping sections and miscellaneous items of equipment shipped unassembled as received from the manufacturer.
3. Install at times as required to meet the specified construction schedule and as necessary to move equipment into place without delaying erection of structures. Do not place equipment onto concrete foundations until minimum concrete compressive strength requirements are met as follows:
    a. Structure foundations shall be cured at least 7 days and shall have a concrete compressive greater than 70 percent of the specified minimum 28-day strength prior to the installation of structures.
    b. Equipment foundations shall be cured at least 14 days and shall have a concrete compressive strength greater than 85 percent of the specified minimum 28-day strength prior to the installation of equipment.
    c. Structure foundations shall be cured at least 28 days and shall have a concrete compressive strength greater than or equal to 100 percent of the specified minimum 28-day strength prior to attaching wires or bus to structures on these foundations.
4. Include any disassembly and reassembly of any parts or sections of equipment made necessary by obstructions or other limitations encountered in moving equipment to the final location indicated.
5. Conform exactly to the manufacturer's recommendation in all respects. Any conflict between the contract drawings and specifications and the manufacturer's written or verbal recommendations shall be referred to the Engineer for final decision.

6. Provide all openings in floors, walls, roofs, and other structures necessary for complete equipment installation and connection unless such openings are specifically noted on the drawings or reference drawings as being provided by others.
7. Paint all nongalvanized steel supporting material with one coat of red lead chromate primer and two finish coats of fast drying enamel of color selected by the Engineer.
8. Include leveling, shimming, anchoring to floor or foundations with bolts or cinch anchors, and any necessary grouting.
9. Include receiving, caring for, and finally delivering to Owner's storage, all tools, maintenance devices, and other accessories furnished with the equipment.
10. Include removing and replacing any covers, bus and wiring connections, etc., whenever and for whatever number of times it is directed by the Engineer for inspection or testing.
11. Restore all equipment to a "factory clean" condition before final acceptance is made.
12. All oil drums furnished by a manufacturer, if any, shall become the property of the Owner. Store oil drums on the site horizontally with bungs down as directed by the Engineer.
13. All deposits for cable reels or any other shipping containers shall be paid by this contract.

POWER CIRCUIT BREAKERS:

1. General:
    a. This Contract will perform delivery inspection as directed by the manufacturer's field representative, apply all dry air or nitrogen required, unload and haul the tank assembly and all auxiliary equipment (bushings, CTs, crates, etc.), dress out, fill with oil or SF6 gas, test as specified, and energize the power circuit breakers as directed by the manufacturer's field representative and the Engineer.
    b. Power circuit breakers shall be moved from the trucks directly to their foundations.
    c. Temporary power supply connections shall be installed to the control mechanism housing for space heaters until permanent power is available.
    d. Furnish and install temporary light bulb heaters in each tank and remove just before the tanks are finally processed.
    e. Do not perform any installation work without the presence and consent of the manufacturer's field representative.
2. Unit Description:
    a. Three (3) 230-kV power circuit breaker(s) furnished as noted on the Bill of Material.
        i. 230-kV, 3000-A, three-tank, SF6 breakers.
        ii. Shipping weight of largest component (3-pole breaker less bushings) – 7,218 pounds.
        iii. Weight of gas - 189 pounds.
        iv. Total net weight – 9,147 pounds.
3. On-Car Inspection:
    a. Inspect the tape from the impact recorder in the presence of the railroad freight agent, the Engineer, and the manufacturer's field representative.
    b. Remove all manhole covers as required and directed by the manufacturer's field representative or the Engineer for an internal inspection. For units shipped pressurized with dry air install a positive/ negative gas pressure gauge on each tank assembly, read and record the pressure of each tank assembly.
    c. After the internal inspection of tank assemblies shipped pressurized with dry air, the tank assemblies shall be pressurized to 2 psi minimum dry air.

4. Assembly:
    a. Anchor to foundations with galvanized anchor bolts and shim as required for level installation of the breaker.
    b. Three (3) 230-kV breakers will be shipped with the high-voltage bushings removed.
    c. Remove all blocking materials within each breaker pole.
    d. Install high-voltage bushings, CTs, shields, grading resistors, shunt capacitors, etc., as directed by the manufacturer's field representative.
    e. Assist manufacturer's field representative with operating mechanism and contacts adjustments.
    f. Make all other adjustments and open and close manholes required by the manufacturer's field representative.
    g. Check all internal and external connections for tightness.
    h. Check and lubricate all moving parts.
    i. Adjust compressed air and gas operating mechanisms.
    j. Connect frame grounds as specified in DIVISION 8.
    k. Paint all PCB manual trip levers red.
    l. Connect conduit risers to control cabinet and make all external control, CT, and auxiliary power connections.
    m. The circuit breakers are shipped without SF6 gas. Upon receipt, the Contractor shall monitor the gas pressure and maintain the gas pressure per the manufacturer's recommendations until the breakers are accepted by the Owner.
    n. If the storage of breakers is required, fill with oil or gas as specified before storage.
    o. Deliver spare parts to the Owner's warehouse and store as directed.
5. SF6 Gas Filling:
    a. Contractor shall fill SF6 gas-filled PCBs completely with SF6 gas after high-voltage bushings and other equipment have been installed. All vacuum and gashandling equipment shall be subject to approval by the manufacturer's field representative and the Engineer.
    b. Install all fittings, valves, couplings, etc., required for connecting vacuum hoses, SF6 gas supply lines, and gauges. All gauges shall be connected through a shutoff valve so that either the gauge or sensing unit may be replaced if necessary. Use sealing tape at all connections.
    c. Remove all tools and extraneous materials from the PCB tanks. Wipe all dust and dirt from internal mechanisms using solvents as approved by the manufacturer's field representative.
    d. Install desiccant bags, close the manholes, and start pulling vacuum as soon as possible after the desiccant bags have been installed.
    e. Vacuum shall be maintained at the level and for the time period as specified by the manufacturer's instructions and/or field representative.
    f. The following records shall be kept to include, but not be limited to, the following, every 30 minutes:
        i. Vacuum level of the PCB assembly in millimeters or microns of mercury.
        ii. Ambient temperature.
    g. SF6 gas shall be installed in the PCBs at rates and to levels as specified by the manufacturer or his field representative.
    h. Moisture measurements shall be made on the SF6 gas before the gas is installed into the PCB and then after the gas has stabilized in the PCB.
6. Electrical SF6 Service Trailer:

a. Equipment includes, but is not limited to, the following items to be used in reclaiming SF6 gas:
    i. Vacuum pump.
    ii. Gas compressor.
    iii. Vacuum gauge.
    iv. Storage tank.
    v. Refrigeration unit.
b. Contractor shall check all electrical, vacuum, oil, SF6 systems, pipes, valves, etc., to verify serviceability.
c. Contractor may use this facility to service the SF6 gas PCBs, however, all desiccant, pump oil, etc., shall be replaced after use. The vacuum pump is of insufficient capacity to pull the initial vacuum on the PCBs.

SUBSTATION STEEL STRUCTURES:

1. General:
    a. This Contract will perform all receiving, storing, assembling and installation of all steel structures as indicated by the manufacturer's drawings and as directed by the Engineer in order to place the equipment in complete working order.
    b. Steel structures shall not be erected on the foundations until foundation concrete tests indicate acceptability for use and approval for erection is received from the Engineer.
    c. Furnished as noted on Bill of Material.
2. Description:
    a. 230-kV Substation:
        i. One (1) 230-kV A-Frame single bay dead-end structure.
        ii. One (1) 230-kV A-Frame two bay dead-end structure.
        iii. Six (6) 230-kV high switch stand support structures.
        iv. Six (6) 230-kV low switch stand support structures.
        v. Six (6) 230-kV 3-phase low diagonal bus support structures.
        vi. Three (3) 230-kV 3-phase low bus support structures.
        vii. Nine (9) 230-kV 3 phase high bus support structures.
        viii. Two (2) 230-kv 1-phase low bus support structures.
        ix. Seven (7) 230-kV 1-phase low bus support structures.
        x. Nine (9) 230-kV coupling capacitor voltage transformer support structures.
        xi. Three (3) 230-kV current transformer/potential transformer combo support structures.
        xii. Two (2) 50 kVA station service transformer support structures.
        xiii. Six (6) 230-kV 85’ static mast structures.
        xiv. Six (6) insulator adaptors
    b. All substation structures and equipment stands: (All are unit weights below)
        i. Single Bay A-Frame deadend structure – 34,839 pounds.
        ii. Two Bay A-Frame deadend structure – 56,656 pounds.
        iii. High switch stand structure – 5,482 pounds.
        iv. Low switch stand structure – 3,702 pounds.
        v. Diagonal bus support structure – 3,253 pounds.
        vi. 3 phase low bus support structure – 2,040 pounds.
        vii. 3 phase high bus support structure – 2,910 pounds.

viii. 1 phase low bus support structure – 1,137 pounds.
ix. Coupling capacitor voltage transformer support structure – 380 pounds.
x. Current transformer / potential transformer metering support structure – 433 pounds.
xi. Station service transformer support structure – 951 pounds.
xii. Static Mast structure - 5,530 pounds. Insulator Adaptors – 272 pounds.

c. No additional payment will be made to the Contractor for weights in excess of the above listed weights nor will a credit be requested from him for weights less than those listed.

3. Assembly:
   a. Erect structures in strict compliance with the manufacturer's drawings, code markings, and instructions after foundations have cured a minimum of 28 days unless otherwise approved in writing by the Engineer.
   b. Erect structures in energized yard in strict compliance with OSHA standards.
   c. Assemble sections, square, and approximately align trusses and columns in the ground.
   d. Correction of misfits by the moderate use of drift pins and a moderate amount of reaming, punching, chipping, or cutting are considered a part of erection. Any errors which prevent the proper assembly of parts by these measures or which require correction or adjustment must be immediately reported to the substation materials supplier and Engineer before assembly. All correction of errors by this contract, other than those considered a normal part of erection, as directed by the substation materials supplier must be approved by the Engineer before such corrections are made. All corrections shall be performed at no increase in the contract price.
   e. Assemble the structures, accurately aligning each portion and finally tightening. Installation of fasteners shall be as outlined in the American Institute of Steel Construction, Inc. Manual of Steel Construction.
   f. Clean all cuts, welds, and damaged areas in galvanized steel structures according to SSPC SP3 and 1-3 mils profile depth and apply organic zinc rich primer at 3 mils dry.
      i. Carboline - SP676.
      ii. Koppers - Organic Zinc.
      iii. Tnemec - 90-93.
   g. Level all structures, columns, and legs on finished foundations prior to erection of equipment and materials.
   h. Ground all steel structures as indicated.

OTHER MAJOR EQUIPMENT AND MATERIALS:

1. General:
   a. This Contract will perform all receiving, storing, assembling, and installation of all bus supports, bus materials connectors, equipment, etc., as indicated by the manufacturer's drawings and directed by the Engineer in order to place the equipment in complete working order.
   b. Transmission line dead-end spans shall not be attached to substation dead-end structures until after these structures have been completely assembled.
   c. Furnished as noted on Bill of Material.
2. Description:
   a. 230-kV Substation Equipment and Materials:
      i. Three (3) 230 kV, 900 kV BIL SF6 circuit breakers.

ii. Twelve (12) 245-kV, 900-kV BIL, manually-operated, 3000-ampere, group-operated, vertical break disconnect switches.
iii. Nine (9) 230-kV, 900-kV BIL, coupling capacitor voltage transformers.
iv. Three (3) 230-kV, 650-kV BIL current transformer / potential transformer combo unit.
v. Two (2) 50 kVA station service voltage transformers.
vi. Three (3) 230 kV CT/PT combo Units.
vii. Nine (9) 230-kV surge arresters, 144-kV MCOV.
viii. One lot of conductors, damping cable, connectors and attachments, conductor spacers, fittings, and hardware.
ix. One lot of bus insulators and switch insulators.
x. One lot of welded connectors, identification tags, nameplates, clamps, power circuit breaker and transformer stud to NEMA 4-hole-pad connectors, fuse and terminal cabinets.
xi. One lot of conduit, grounding shots, grounding welds, and grounding connectors.
xii. One lot of miscellaneous nuts, bolts, screws and mounting hardware.

3. Assembly:
    a. Install conduit risers complete to equipment enclosures.
    b. Switches:
        i. Assemble, install, lubricate, and adjust all switches and operating mechanisms in accordance with the manufacturer's instructions.
        ii. Install switch operator's grounding plates at operator's normal standing position when operating switch or circuit switcher. Connect switch operator handles to column ground with flexible strap provided, and connect ground plate with a separate copper conductor direct to the point where flexible strap connects to the column ground.
        iii. Do not set the set screws of any switch or circuit switcher without the approval of the manufacturer's field representative or the Engineer.
    c. CVTs, CT/PT Combo Units and Surge Arresters:
        i. Install capacitor voltage transformers, current/potential transformer combination units , and surge arresters on stands or on the structures as indicated.
        ii. Connect grounds to the equipment above ground with ground grid risers as indicated. Routing of the above grade grounding not specifically indicated shall be approved by the Engineer.
        iii. Mount secondary terminal and fuse cabinets on respective supporting structures or columns as indicated.
    d. Buses and Conductors:
        i. Erect and install all tube buses, conductors, and interconnections as required by manufacturer's drawings.
        ii. Welded aluminum bus erection shall include and conform to the following:
            1. Fabricate all buses and interconnections to correct length and shape.
            2. Bends shall be made with a hydraulic bender without kinks or surface damage.
            3. Field weld all pipe-to-pipe and pipe-to-fitting connections using inert gas arc welding.

4. Furnish the services of a welder who is experienced and certified in inert gas aluminum welding. Welding personnel shall have qualified for the certification within the past 12 months for pipe-groove and fillet welds as required in ANSI/AWS D1.2. Provide portable power generators if required for the welding operation.
5. All welding is to be performed, where possible, close to the ground within an enclosure to prevent air currents from disturbing the inert gas screen. Where welds must be made in final overhead position a tent or other approved temporary wind screen must be used.
6. Follow exactly the welding procedure, including the use of proper filler wire or rod, as prescribed by the aluminum bus and connector manufacturer. Furnish all 4043 or 5356 aluminum-alloy welding wire required to complete the welding.
7. Clean all areas to be welded by degreasing with naphtha, acetone, or alcohol; wire brushing with a stainless steel brush; or buffing with 60X grit flapper wheel as required to produce a bright, clean surface.
8. Submit to the Engineer complete details of the proposed welding procedure, experience record, and certification data on the person proposed to do the welding, as well as samples of welds made at the jobsite in all four standard positions.

iii. Maintain proper phasing of buses and connections as indicated. Install phase identification plates as specified.
iv. Install high-voltage connections complete to equipment including connections to terminals of switches, circuit breakers, surge arresters, voltage transformers, CVTs, and bus.
v. Use electrical joint compound for all aluminum connections. Sufficient quantities have been provided by the manufacturer for use by the Contractor. Additional quantities, if required, shall be furnished by the Contractor.
vi. Install bus tubing and interconnections without splices unless otherwise permitted by the Engineer. Necessary splices in aluminum tubing shall be made with welded tubular aluminum splicing sleeves. Only one splice between any two rigid bus supports will be permitted.
vii. Drill two weepholes, 1/8-inch diameter, 6 inches apart, in the bottom of each horizontal span of bus tubing at the point of lowest sag and remove all burrs caused by the drilling.
viii. Install complete termination of incoming transmission lines at the substation structures and power plant.
ix. Install structure shielding and grounding materials, clamps, etc., including switch operator ground pads, flexible braid, conductor, etc., for all grounding connections. All grounding conductor including lengths to connect to structure grounds shall be furnished by this contract.
x. Install connectors for high-voltage connections to terminal pads or studs.
xi. Megger all buses, switches, and equipment, with a 1000-V megger for one minute after the installation of each major section of bus. Meggering shall be phase-to-phase and phase-to-ground.

End of Section 330570 – Installation of Major Substation Equipment

Section 337119.23 – Cable Trench

PART 1

This Section includes all precast or polymer cable trench and accessories.

1. REFERENCE STANDARDS:
    a. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
    b. Applicable Standards (conform to all standards applicable to each item utilized) shall be latest revisions, supplements, and amendments to the following:
        i. National Fire Protection Association (NFPA):
            1. 70 - National Electrical Code.
        ii. JEA Substation Standards Reference Manual (2023 Edition)
2. SUBMITTALS
    a. Submit the following as indicated in Section 013300 “JEA Submittals”:
        i. Cable trench layout drawings
        ii. Cable trench details and Bill of Material

PART 2

ACCEPTABLE MANUFACTURERS:

1. Trenwa Products, Inc.

GENERAL:

1. A precast or polymer cable trench system, installed in earth trenches, with covers extending above the surrounding crushed rock surfacing shall be constructed at the locations indicated in Contract Documents.
2. The trench system shall consist of precast or polymer concrete framing members and side sections or precast or polymer sections and removable cover sections assembled to form a completely enclosed trench, except with open (earth) bottom. A geotextile fabric liner shall be installed prior to the cable trench, which will completely cover the bottom width of the trench. Once the liner and cable trench has been installed, a 4 inch bedding of sand shall be installed within the cable trench and over fabric liner.
3. Construct to elevations as indicated in Contract Documents including all excavation and backfill.

MATERIAL:

1. Furnish a precast or polymer concrete cable trench system, manufactured by Trenwa Products, Inc. or approved equivalent.
2. The trench shall be approximately 30-inches wide by 16-inches deep overall (including covers).
3. The precast or polymer sides of the trench system shall be furnished in 10ft lengths, however, special lengths and configurations shall be furnished where required by the layout plans on the Drawings. Trench design may be such that sides of the trench are held in place by pressure of the external earth backfill.

4. The precast or polymer trench covers shall be furnished in sections sized to permit easy removal by one person and each shall have lifting tool slots or other lifting provisions.
5. Trench systems furnished shall be designed to support at least 200 pounds per square foot live load.
6. Precast or polymer members shall be cast in steel forms using 3,000 pounds or greater, high early strength concrete. Members shall be cured for a period of at least fourteen days.
7. Furnish all necessary special fittings, offsets, terminations and other fittings as indicated in Contract Documents or required to provide a complete installation.
8. Cable trench shall be designed for H-20 loading for road crossings where indicated on the Contract Drawings.
9. Geotextile Fabric:
    a. PennDOT Construction Class 4 Type A Geotextile Fabric.
    b. Geotextile shall be manufactured of new, first quality products designed and manufactured specifically for the purpose of filtering out soil fines while maintaining good drainage characteristics.
    c. Geotextile shall be so produced as to be free of tears, punctures, or any sign of contamination by foreign matter. Any such defect shall be repaired in accordance with the manufacturer's recommendations. Geotextile must be uniform in thickness with a maximum 10% deviation from the nominal thickness. Edges shall be straight and free of nicks and cuts.

PART 3

1. Excavate trenches to a minimum width consistent with stability of the sides. Remove all material required to provide proper alignment and elevation of Work.
2. Remove all excess excavated material from the Site or place in stockpile.
3. Excavate completely to below the bottom elevation of the framing members and fill over excavation by returning to grade with mechanically compacted fine crushed rock backfill to form a smooth trench bottom.
4. Install geotextile on prepared surface or within trench using careful procedures with minimum handling. Unroll panels as close to their final position as possible.
    a. Seaming of Geotextile:
        i. Geotextile panels shall be overlapped a minimum of 3 inches before sewing.
        ii. Geotextile panels shall be joined by sewing geotextile panels together with a thread made of the same material as the geotextile.
        iii. Geotextile may be heat seamed (with no open flame). Engineer approval required prior to use of heat seaming.
5. Framing members and sections shall be set only on firm, compacted earth at an elevation such that top of cable trench will be at the elevations indicated.
6. After setting frames and sides or sections in place, place backfill along sides and place a minimum four-inch bedding of sand in trench to form a level bottom just covering the framing members.
7. Mechanically tamp the backfill along outside walls of trench.
8. Install ground cables in the trench system over its entire length of the same size as the station ground grid. Ground cable clips shall be used to support cable from the support members. Bond new ground cable to existing trench ground at intersection.
9. Conduits entering the trench system shall be laid out just beneath the sides of the trench as indicated.
    a. Contractor to cut geotextile fabric as required for conduit entries into cable trench.
10. Contractor shall be required to correct settlement of installation before acceptance by Owner.

11. Place covers on trenches immediately after installation. After cable installation has been completed, once again place covers on trenches.
12. Protect trenches against entrance of construction debris, mud, rock, or earth during construction and after placing of sand bedding. Clean out trenches of any such foreign materials immediately prior to each of the following:
    a. Placing of geotextile fiber liner
    b. Placing of sand bedding
    c. Initial placing of trench covers
    d. Placing of cables
    e. Final placing of trench covers
13. Provide the Owner with all cover removal tools used during installation plus two spares.
14. Cable trench entry shall be sealed to prevent water intrusion into the control enclosure.

End of Section 337119.23 – Cable Trench

Section 337116.24 – Tubular Streel Structure (Install)

PART 1 - GENERAL

RELATED DOCUMENTS:

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

SUMMARY:

1. This Section includes all work necessary to receive, assemble and erect tubular steel structures as indicated and specified.

RELATED REQUIREMENTS:

1. Section 31 63 29 – Drilled Shaft Foundations.
2. Section 31 63 30 – Foundations for Direct Embed Monopoles.

REFERENCE STANDARDS:

1. Applicable Standards:
    a. ASTM International (ASTM):
        i. A780 - Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
    b. American Welding Society (AWS):
        i. AWS D1.1/D1.1M - Structural Welding Code - Steel.
    c. Other applicable standards suggested by the Contractor and approved by theOwner.
2. In cases where the above standards are in conflict, unless specifically noted elsewhere in the Contract Documents, the Contractor shall request clarification from the Owner.

PART 2 – PRODUCTS

1. GENERAL:
    a. The Owner will furnish all structure components for assembly and erection of the tubular steel structures.
    b. Contractor shall replace any materials that are damaged or lost while in Contractor's possession as needed to complete the project. Replacement material shall be equal to the material supplied by the Owner.

PART 3 - EXECUTION

RECEIVING AND STORAGE OF MATERIALS:

1. Care shall be taken not to damage the steel structures or members during unloading and handling.
2. Structures and members shall be sorted and supported on wooden blocks prior to erection. At no time shall the structures or members be laid directly on the ground. Parts bent, twisted or damaged shall not be installed, but shall be reported immediately to the Owner.

METHODS OF ERECTION:

1. The proposed structure design will permit the use of the following erection methods:
    a. Crane Erection.

b. Section Method.
c. Tilt up Method.

ASSEMBLY AND ERECTION:

1. Structures shall be erected at the locations indicated on the Contract Drawings.
2. Structures shall not be erected on drilled shaft foundations until they have cured at least seven days and have a concrete compressive strength greater than 70% of the specified minimum 28-day strength.
3. Structures shall be assembled and erected in compliance with the manufacturer's instructions.
4. Slip joints shall be assembled as follows:
    a. Thoroughly clean members at the joint.
    b. Align match marks.
    c. Jack sections together maintaining proper alignment.
    d. The Contractor shall use jacking methods and equipment per structure manufacturer's recommendations.
    e. Sections shall not be forced into place.
    f. Tie the slip jointed sections together so that the sections will not separate during erection. Remove ties after erection.
    g. No welding shall be allowed in the assembly.
    h. The Contractor shall inspect the joint to verify there are no major gaps between the pole sections.
    i. The Contractor shall record the section overlap and jacking force used for all slip joints. This information shall be provided to the Owner at the Engineer’s request.
5. The structure shall be erected using only the lifting points specified by the structure manufacturer.
6. Structures shall be installed such that the arms or insulators are aligned with the left or right reference stakes with a maximum variation of 1.5 degrees.
7. The installed and unloaded structures shall be plumb to within 1 inch of vertical for noncambered and nonraked poles measured when there is no temperature gradient in the pole. Cambered or raked poles shall be plumb to within 1 inch of the amount of camber or rake indicated by the manufacturer's Drawings. At the[Owner's discretion, the Contractor shall use a transit to verify a structure is plumb.
8. All bolts and nuts shall be torqued to manufacturer's recommendations.
9. Arms shall be secured after erection until stringing in accordance with the manufacturer's recommendations. The Contractor shall follow the manufacturer's recommendations for preventing wind-induced vibration of unloaded structures and structural components.
10. Once all anchor bolt nuts are tightened on top of the baseplate, Contractor shall verify nuts below the baseplate are securely tightened.
11. The structures will be furnished with [two sets of] climbing devices. Upon completion of the Work, the Contractor shall remove the climbing devices and deliver them to the Owner.

DAMAGE AND MISFABRICATED MEMBERS

1. The Contractor shall notify the Owner of any missing, misfabricated, or damaged members or components.
2. Any members or components lost or damaged while in possession of the Contractor shall be repaired or replaced by the Contractor at no additional cost to the Owner. Costs incurred due to delays or additional labor caused by these lost or damages pieces shall be borne by the Contractor.

COATING REPAIR

1. Galvanized Structures:
    a. All galvanizing repairs shall conform to ASTM A780.
    b. All rust shall be removed from damaged areas by wire brushing, chipping, or sand blasting.
    c. Damaged areas shall be coated with a cold process galvanized coating as manufactured by ZRC Products Company (ZRC Cold Galvanizing Compound) or approved equal in accordance with the manufacturer's recommendations.
2. Embedded Structures:
    a. Repair damage to the embedded section per manufacturer's recommendations.

End of Section 337116.24 – Tubular Streel Structure (Install)

Section 337124 - Ceramic Insulators

PART 1

SUMMARY

1. This Section includes the specifications and requirements for all substation post insulators to be furnished by this Contract, except for disconnect switch insulators (as covered in Section 33 71 26.30). Quantities to be installed by Contractor as indicated below:
    a. Nine (9) 230kV High-strength (TR No. 308) insulators (horizontal dead-end mounted)
    b. Ninety (90) 230kV High-strength (TR No. 308) insulators (for switch assemblies)
    c. Fifty-eight (58) 230kV Extra-high strength (cantilever strength of 2,750 lb.) insulators (rigid tub bus supports)
2. Erection and assembly required at the Job Site will be performed by Contractor
3. Items furnished under this Section shall comply with the requirements of Division 01

REFERENCE STANDARDS:

1. Applicable Standards:
    a. American National Standards Institute (ANSI):
        i. C29.1 - Test Method for Electrical Power Insulators
        ii. C29.2 - Insulators Wet-Process Porcelain and Toughened Glass Suspension Type
        iii. C29.7 - Wet-Process Porcelain Insulators High-Voltage Line-Post Type
    b. American Society for Testing and Materials (ASTM):
        i. A153 - Zinc Coating [Hot-Dip] on Iron and Steel Hardware
    c. Federal Standards:
        i. FED-STD-595B - Colors Used in Government Procurement
    d. JEA Substation Standards Reference Manual (2023 Edition)
    e. Hardware – Insulators Committee. *CIGRE TB 184 Composite Insulator Handling Guide.pdf*. CIGRE. Paris: CIGRE, 2020-12.21.TB.

DEFINITIONS:

1. The word "ceramic" when used shall mean porcelain.

SUBMITTALS:

1. Submit as specified in Division 01.
2. Compliance submittals include, but are not limited to, the following:
    a. Test reports of design tests per ANSI C29.2.
    b. Test reports of quality conformance tests per ANSI C29.2.

FABRICATION AND QUALITY ASSURANCE:

1. Post Insulators shall be manufactured under an established quality assurance program.
2. Supplier shall submit for approval any and/or all quality plans, forms, and procedures applicable to manufacture of insulators, if requested.
3. The manufacturer of each item of equipment or material furnished shall be regularly engaged in the fabrication of the item and it shall have an acceptable history of satisfactory, reliable service in outdoor substation use for a period of at least three years under comparable environmental conditions.

4. Newly-developed equipment with less than three years' actual service will be considered from established manufacturers only if it has been adequately tested to industry standards, meets the requirements of this Contract, and is reviewed and approved by the Engineer.
5. Supplier shall be engaged in producing such products for at least five (5) years and able to supply proof, if requested, of manufacturing such products for at least twenty (20) separate utility clients in that same time frame.
6. Materials shall be as specified, of recent manufacture, unused and free of defects or irregularities. All components of the same design and designation shall be identical and interchangeable.

ACCEPTABLE MANUFACTURERS:

1. LAPP Insulators.
2. PPC Insulators.
3. Hubbell Power Systems, Inc.
4. NGK-Locke, Inc.
5. Victor Insulators, Inc.
6. Newell-PSN, LLC.

PART 2

EXAMINATION

1. The Contractor shall read insulator and hardware Manufacturer’s instructions prior to start of work.
2. The Contractor shall inspect the structures and verify that all structure assembly and setting/erection work is complete to the point where the insulator and hardware installation may be safely and correctly performed.
3. The Contractor shall inspect all insulator and hardware assemblies for missing parts, defects, and proper fit before installation, and shall immediately notify the Company’s Representative of any issues. Defective components or assemblies with missing pieces shall not be installed and shall be replaced.
    a. All insulator assemblies and hardware shall be clean, bright, and free from dirt, nicks, chips, or other mars at time of installation.
    b. Polymer insulators shall be inspected for damage to the sheaths and sheds. Any exposed fiberglass rod or other damage shall immediately be brought to the attention of the Company’s Representative. Damaged insulators shall not be installed. Damaged insulators shall be replaced with sound units prior to final acceptance of the line.
4. Existing Structures
    a. Prior to installing new insulators on existing structures, the Contractor shall verify that the condition of the existing structures is adequate for climbing before allowing workers to climb the structures for insulator installation.

INSTALLATION:

1. Insulators and hardware assemblies shall be fully assembled and installed in accordance with the Drawings and Manufacturer’s specifications.
    a. Overall dimensions shown on the construction drawings for insulator and hardware assemblies are approximate only. Assemblies shall be measured for accurate determination of jumper lengths and conductor cut-offs when installing dead-end accessories.
    b. All hardware associated with the insulator assemblies shall be installed in a manner to best facilitate future maintenance and operation.

DAMAGE:

1. Insulators which are scratched, cracked, chipped, or damaged in any other manner shall not be installed. During construction, if any insulators become scratched, cracked, chipped, or damaged in any other manner, remove from the assembly and replace with a non defective insulator at the Contractor's expense.
2. Cigre 184 and manufacturer's handling and installation instructions shall be followed.
3. All shipping containers, insulators, and hardware shall be transported, assembled, and installed in a manner that avoids damage of any kind.
4. Insulators and hardware shall be stored in their shipping containers until installation. The containers shall be properly supported and stacked so as not to damage the containers or individual items within. The containers must be blocked up off the ground so that they do not come in contact with the ground or standing water.
    a. Polymer insulators shall be stored in rodent proof containers. The Service Provider should be aware that there have been problems in the past with rodents damaging polymer insulators. The Service Provider shall mitigate potential of damage and assure that there is no damage to the polymer insulators during storage whether at the staging yard or on the right-of-way.
    b. Containers shall be supported in a manner to provide positive drainage to prevent collection of water in or on the container.
    c. Insulators and hardware shall be properly supported off the ground and protected after the material has been removed from the original packaging during the framing process.
        i. Do not place insulators directly on the ground. Insulators shall be set on flat supporting surface that evenly contacts all of the sheds/skirts. Do not overhang insulators.
        ii. Do not stack many insulators on top of each other to prevent deformation of sheds/skirts.
        iii. Do not place sharp objects, materials, tools, or corona rings above or below the insulators to prevent cutting or nicking the sheath or sheds.
    d. Workers shall not climb or stand on insulators or corona rings.
    e. Do not bend or twist insulators.
    f. Avoid bumping insulators with personnel bucket, crane cable or other lifted materials.
    g. Do not drag insulators on the ground. For 4 foot and longer insulators, carry them by having one person at each end to carry insulators so that the insulator does not bend more than 30 degrees. Very long insulators shall be supported in the middle by a third person.
    h. Do not lift the insulators by the weather sheds/skirts.
    i. Do not step on insulators.
    j. Lift insulators by metal end fittings. Do not attach rope or sling to sheath/rod or sheds/skirts.

CLEANING:

1. Clean the insulators and hardware just prior to and during installation to ensure that they are free of dirt, mud, or other foreign and deleterious matter.

ALIGNMENT:

1. Post Insulators:
    a. Orient all insulators to shed water from the skirts for vertical mounted insulators. Sheds shall face downward as to not collect rainwater.

b. Where mounting surfaces are uneven, metal shims shall be used to adjust insulator mounting to comply with above.

CORONA RINGS:

1. Corona rings, when required, shall be free of dents, nicks, scars, projections, or roughness. Replace damaged corona rings. Sharp projections or roughness may be repaired by sanding with abrasive cloth. Install corona rings as indicated.

STORAGE

1. Insulators shall be stored according to the requirements listed in Section 330570 Part 2.

End of Section 337124 - Ceramic Insulators

Section 337233.33 – Raceway and Boxes for Utility Substations

PART 1

1. This Section includes furnishing and installing of all conduit, fittings, boxes, and accessories as specified or indicated.
2. The Contract Drawings define the size and type of each conduit. This does not apply to lighting and convenience power systems conduit. The specifications define the type of all conduit.

REFERENCE STANDARDS:

1. Applicable Standards (conform to all standards applicable to each item utilized) shall be latest revisions, supplements, and amendments to the following:
    a. American Society for Testing and Materials (ASTM):
        i. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
        ii. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
        iii. A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
        iv. A668 - Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use.
        v. A1008 - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable .
        vi. B241 - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
        vii. F512 - Standard Specification for Smooth-Wall Poly(Vinyl Chloride) (PVC) Conduit and Fittings for Underground Installation.
    b. Federal Specifications:
        i. WW-C-540A - Conduit, Metal, Rigid, (Electrical, Aluminum).
        ii. WW-C-566C - Conduit, Metal, Flexible.
    c. National Electrical Manufacturers Association (NEMA):
    a. C80.1 - Electrical Rigid Steel Conduit (ERSC)
    b. C80.3 - Steel Electrical Metallic Tubing (EMT).
    c. C80.5 - Electrical Rigid Aluminum Conduit (ERAC)
    d. FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit Electrical Metallic Tubing, and Cable .
    e. RN 1 - Polyvinyl-Chloride(PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
    f. TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit .
    g. TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
    h. TC 6 – Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installation.
    i. TC 9 - Fittings for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installation.
14. National Fire Protection Association (NFPA):
15. 70 - National Electrical Code (NEC).
16. Underwriters Laboratory (UL):
    a. 1- Standard Flexible Metal Conduit.

b. 6 – Electrical Rigid Metal Conduit - .
c. 360 - Standard for Liquid-Tight Flexible Metal Conduit.
d. 467 - Grounding and Bonding Equipment.
e. 514A - Metallic Outlet Boxes.
f. 514B – Conduit, Tubing, and Cable Fittings.
g. 514C – Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.
h. 651 - Standard for Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.
i. 651A - Schedule 40 and 80 High Density Polyethylene (HDPE) Conduit.
j. 797 - Electrical Metallic Tubing - Steel.

17. JEA Substation Standards Reference Manual (2023 Edition)

SUBMITTALS:

1. Submittals shall follow requirements listed in Division 1 and include, but are not limited to, the following:
    a. Product Data:
        i. Submit manufacturer's catalog cuts, technical product data, including specifications and installation instructions, for each type of product required. Include data substantiating that materials comply with requirements.

PART 2

ACCEPTABLE MANUFACTURERS:

1. Subject to compliance with requirements, provide each type of conduit, fittings, boxes, supports, paints and coatings from one of the following. Any deviations from manufacturers below will need to be approved by project Engineer.
    a. Rigid Steel Conduit (Type RSC):
        i. Allied Tube and Conduit Corporation.
        ii. Triangle Wire & Cable Inc.
        iii. Wheatland Tube Company.
    b. Rigid Steel Conduit with Bonded Polyvinyl Chloride (PVC) Jacket (Type PSC):
        i. Occidental Coating Company.
        ii. Perma-Cote Industries.
        iii. Plasti Bond
    c. Electrical Metallic Tubing (Type EMT)
        i. Allied Tube and Conduit Corporation.
        ii. Triangle Wire and Cable, Inc.
        iii. Wheatland Tube Company
    d. Rigid Nonmetallic Conduit (Type RNC):
        i. Carlon Division, Lamson & Session Company.
        ii. CertainTeed Corp.
        iii. Condux International, Inc.
    e. Flexible Steel Conduit (Type FSC):
        i. Alflex Corp (Southwire).
        ii. Anamet, Inc., Anaconda Metal Hose.
        iii. Electri-flex Company.
    f. Conduit Fittings for Rigid Metallic Conduit:

i. Heavy-Duty Fittings:
    1. Appleton Electric Company (Emerson Industrial Automation).
    2. Crouse-Hinds Company (Cooper).
    3. O-Z/Gedney Company (Emerson Industrial Automation).
ii. Conduit Expansion Fittings:
    1. O-Z/Gedney Company (Emerson Industrial Automation).

g. Conduit Boxes for Rigid Metallic Conduit:
    i. Hoffman Engineering Company.
h. Supports:
    i. B-Line Systems, Inc.
    ii. GS Metals Corporation.
    iii. Power-Strut Division, Allied Tube and Conduit Corporation.
    iv. Unistrut Corporation.
i. Conduit Identification Tags: KC Plastic Laminating Company, Kansas City, Missouri.
j. Fireproof Coatings:
    i. Carboline Company - Intumastic 285.
    ii. Flamemaster Corporation - Flamaster 77.
k. Penetration Sealers:
    i. 3M Corporation - Fire Stop Foam 2001.
    ii. Fireproof coatings listed above when applied as specified.
l. Damming Materials:
    i. Boards: Thermal Ceramics - Firemaster Board.
    ii. Fiber: Thermal Ceramics - Firemaster Blanket or Fiber.
m. Paint and Coatings:
n. Supports:
    i. Rust-Oleum.
o. Rigid Steel Conduit:
    i. Kop-Coat, Carboline Company.

DESIGN REQUIREMENTS (TYPICAL FOR ALL TYPES):

1. Each length of conduit furnished with coupling on one end and metal or plastic thread protector on other end.
2. UL listed and labeled on each conduit length, fitting, and accessory.
3. Sizes of conduit, fittings, and accessories as indicated by construction documents or required by applicable standards.
4. The CONTRACTOR shall furnish equipment and materials meeting the specified ratings and performance at the altitude and ambient temperatures specified.

RIGID STEEL CONDUIT (TYPE RSC):

1. Mild ductile steel, circular in cross section with uniform wall thickness sufficiently accurate to cut clean threads.
2. Each length threaded on both ends.
3. All scale, grease, dirt, burrs, and other foreign matter removed from inside and outside prior to application of coating materials.
4. Galvanized using the hot-dip process.

RIGID STEEL CONDUIT WITH BONDED POLYVINYL CHLORIDE (PVC) JACKET (TYPE PSC):

1. Hot-dipped galvanized rigid steel conduit as specified in RIGID STEEL CONDUIT, this Section.
2. Prior to application of PVC coating, clean interior and exterior surfaces to remove contaminates and treat with chromic acid to provide a suitable surface for bonding.
3. Adhesive:
    a. Heat-polymerized, epoxy-acrylic.
    b. Approximately 0.5-mil thickness.
    c. To cure, heat the conduit.
4. Coated externally except for pre-threaded ends with PVC to a nominal 40 mils, 0.035-inch to 0.045-inch.
5. Uniformly coat around outside diameter and full length of the conduit.
6. Coating bonded to surface of conduit with adhesion greater than the cohesive strength of the coating.
7. Each coupling and fitting to include a sleeve that overlaps the conduit.
8. Length of the overlapping sleeve equals diameter of the conduit or 2 inches, whichever is less.

ELECTRICAL METALLIC TUBING (TYPE EMT):

1. High-grade steel manufactured to standards which assure maximum ductility.
2. Exterior protected by electro-galvanizing process.
3. Interior surface uniformly coated with aluminum lacquer or enamel.
4. Final treatment of chromic acid to form a corrosion resistant coating of zinc chromate on galvanized surfaces.
5. Watertight compression-type fittings throughout.

RIGID NONMETALLIC CONDUIT (TYPE RNC):

1. Fabricated from self-extinguishing high-impact polyvinyl chloride designed for aboveground and underground installations.
2. Fittings and accessories fabricated from same material as conduit.
3. Solvent-cement-type joints as recommended by manufacturer.
4. Inside diameter no less than that of rigid steel conduit.
5. Dielectric strength a minimum of 400 volts per mil.
6. Rated and labeled for use with 90-degree C rated conductors.
7. Schedule 40 PVC conduit required for direct burial applications.
8. Type A PVC thin wall conduit may be used in concrete encased applications only. Type EB conduit will not be acceptable.

FLEXIBLE STEEL CONDUIT (TYPE FSC):

1. Liquid-tight conduit with flexible galvanized-steel core and a polyvinyl chloride covering.
2. Spiral encased copper bonding conductors for conduit in sizes 1-1/4 inches and smaller.
3. Special grade polyvinyl chloride (PVC) jacket, suitable for use in -50 degrees F through 220 degrees F areas.
4. Special grade polyvinyl chloride (PVC) jacket, suitable for oil-resistant applications.

CONDUIT FITTINGS FOR RIGID METALLIC CONDUIT:

1. Heavy-duty cast malleable iron or aluminum for All types of fittings.

2. Mogul type for conduit sizes 1-1/2 inches and larger.
3. LBD or roller action type LB for right angle fittings for conduit sizes 2 inches and larger.
4. Full-threaded hubs and rubber-gasketed covers.
5. Zinc, cadmium-plated, or bronze hardware, bolts, screws, and bushings for assembly.
6. Iron fittings to be cadmium plated or galvanized.
7. Standard and junction fittings.
8. Couplings and elbows fabricated from the same material as conduit and each treated as required for the conduit.

CONDUIT BOXES FOR RIGID METALLIC CONDUIT:

1. Steel Boxes:
    a. Electro-galvanized steel boxes.
    b. Galvanized steel covers.
    c. Cadmium-plated or bronze screws and bolts.
    d. Minimum gauge requirements:

No Surface Area Exceeds	No Single Dimension Exceeds	Steel (MSG)
360 sq in	24 in	16
1,000 sq in	40 in	14
1,500 sq in	60 in	12
Over 1,500 sq in	Over 60 in	10

    e. Threaded conduit entrances or waterproof hubs outdoors and in other areas subject to moisture.
    f. Include provisions for mounting cable supports where indicated in contract documents or as required by NEC.

SUPPORT SYSTEM:

2. Use galvanized steel conduit clamps to support all exposed metallic conduit.
3. Use nonmagnetic clamps to support nonmetallic conduits.
4. Fabricated from structural steel or manufactured framing members equal to "Unistrut" P-3000 series as manufactured by Unistrut Corporation unless otherwise indicated.
5. Provide all necessary rods, anchors, inserts, clamps, spacers, shims, bolts and miscellaneous steel.
6. Galvanized or cadmium-plated members.
7. Where exposed to weather or high humidity, use noncorrodible, galvanized or cadmium-plated metal for nuts, bolts, washers, shims, and other small accessories.

CONDUIT IDENTIFICATION TAGS:

1. Gothic, 3/4-inch, black characters on white background.
2. Made of white flame-retardant PVC, with "Perma-stik" adhesive and peel-off backing.

PART 3

GENERAL REQUIREMENTS:

Location:

1. Install conduit as near as possible to the routing indicated on contract drawings. Owner's Representative shall be notified of any deviations from indicated routing.
2. Shift locations as required to avoid interference with other equipment. Coordinate relocation with other work in area.
3. Where routing of conduit is not indicated, such as for lighting, home run circuits and other systems requiring small conduit runs, route conduit as specified subject to approval by Owner's Representative.
4. Furnish conduit in sizes indicated on contract drawings. Where sizes are not indicated, minimum conduit size shall be 3/4-inch.
5. Size conduit in accordance with NEC requirements. Where larger sizes are indicated in contract documents, the contract documents shall prevail.
6. No conduits shall be routed through cable tray or cable trench openings located in walls, floors, etc.
7. Seal around wire and cable and empty conduits in all equipment terminal cabinets and all conduits routed through floors, walls and ceilings of control buildings with duct and conduit sealer.
8. Holes and Sleeves:
    a. Unless indicated as being provided by others, provide through floors, walls, ceilings, and roofs as necessary for conduit runs, including weatherproofing at outside walls and on roofs.
    b. Furnish sleeves for all holes and forms for all openings in new work.
    c. Core drill all holes in existing work using a dustless method. All core drilling locations shall be approved by the Owner's Representative before Work commences.
    d. Seal all holes and slots in walls, floors and ceilings with penetration sealer:
        i. Silicone Foam: Dam penetration with specified fiber and/or board and fill to a depth of six inches.
        ii. Coatings (Holes or Slots):
            1. Fill hole with specified fiber.
            2. Cut a 1/2-inch-thick piece of the specified board large enough to cover the opening and overlap the wall three to six inches.
            3. Attach board in at least two places.
            4. Apply coating 1/4-inch thick (wet) to board and the wall or floor three inches all around the board.
        iii. Make connections including any required punching to boxes, panels and other equipment as follows:
            1. Indoors: Double locknuts, one inside and one outside.
            2. Outdoors: Use threaded conduit fittings or waterproof hubs.
        iv. Drill and tap motor main and auxiliary terminal boxes as required, and make connections as follows:
            1. Indoors: Double locknuts, one inside and one outside.
            2. Outdoors: Use threaded conduit fittings or waterproof hubs.
        v. Make connections to cable trays as follows:
            1. Attach to tray with cable tray conduit clamps specifically designed for this application.
            2. Attach to top of tray where tray covers are not required and to bottom of tray where covers are required.
            3. Do not cut or punch tray side rails to install conduit.
        vi. Terminate all conduit runs with insulated bushings.

vii. Running threads will not be permitted.
viii. Coat all field cut threads, scars, or wrench abrasions in galvanized conduit with one coat of zinc- rich coating at 3 mils dry:
    1. Carboline Carbozinc 658.
    2. Keeler & Long KL4400
    3. Tnemec 90-97.
ix. Do not exceed the following number of bends between cable pulling points:

Max. Length of Run (Feet)	Max. No. of 90-degree Bonds
0-49	4
50-99	3
100-149	2
150-199	1

x. Place drainage fittings or weep holes (for boxes only) at low points where moisture can collect, except in hazardous areas.
xi. Metallic conduit systems shall be electrically continuous in their entirety, with bonding jumpers provided as required by NEC.
xii. Provide suitable protection for conduit risers against damage during construction.
xiii. Test conduits (witnessed by the Owner's representative) required to be installed but left empty with ball mandrel. Clear any conduit which rejects ball mandrel. Pay costs involved for restoration of conduit and surrounding surfaces to original condition. Provide 200-pound tensile strength nylon conduit fish line throughout the entire length of all empty conduits. Leave 12 inches of slack at each end.
xiv. Carefully ream ends of all conduit lengths after cutting to eliminate sharp burrs.
xv. Clean inside of all conduit before pulling wire.
xvi. In finished rooms, install conduit concealed in walls, floors and above suspended ceilings (or in ceiling slab where suspended ceiling is not specified).

EXPOSED INSTALLATION:

1. Install in building interior spaces where specified or indicated in contract documents.
2. Install above grade outdoors.
3. Install horizontal runs as high above floor as possible, and in no case lower than seven feet above floor, walkway, or platform in passage area.
4. Run conduit parallel or perpendicular to walls, ceilings, beams and columns unless indicated otherwise.
5. Route to clear all doors, windows, access wells and openings.
6. Group parallel runs in neatly aligned banks where possible with minimum of one-inch clearance between conduits.
7. Maintain six-inch clearance between conduit and coverings on all hot lines; steam, hot water, etc.
8. Do not exceed a distance of eight feet between supports on horizontal or vertical runs.

CAST-IN-CONCRETE INSTALLATION:

1. Install where specified or indicated in contract documents.
2. Do not install conduit in concrete when conduit diameter exceeds one-third of concrete thickness.
3. Install parallel runs with a minimum spacing of three conduit diameters between conduits.
4. Install in floor slabs maintaining a route as straight as possible.

5. Use long radius elbows except on risers where curved portion of elbow would extend above the finished floor or foundation.
6. Make all joints watertight after installation by coating all finished joints with Kop-Coat Bitumastic No. 50 or equivalent waterproof paint.
7. Tie securely in place to prevent movement when concrete is poured
8. Cap ends of all conduit before concrete is poured.
9. Slope finished floor away from conduit risers.
10. Clean out all conduits immediately after concrete work is finished.

BURIED INSTALLATION:

1. Install as indicated in contract documents.
2. Bury conduits a minimum of 18 inches below finish grade unless otherwise indicated.
3. Before burying or trenching check with Resident Project Representative as to existing grade conditions and the possibility of future coordination problems.
4. Slope conduits away from conduit risers where possible.
5. Use long radius bends at all risers unless otherwise indicated.
6. Provide wall entrance seals where conduit enters the building or subgrade walls/floors from exterior underground.
7. Maintain 2-foot separation from underground piping.
8. Make all joints watertight after installation by coating all finished joints with Kop-Coat Bitumastic No. 50 or equivalent waterproofing paint on galvanized conduit.
9. Cap ends of all conduit before backfilling.
10. After conduits have been installed in trench, carefully backfill trench in layers of four to eight inches of friable sandy or silty clay containing fine material sufficient to provide a dense mass free of voids and capable of satisfactory compaction and tamp each layer with a power tamp. Backfill material shall be free of roots or other organic matter, refuse, ashes, cinder, frozen earth, or other unsuitable material.

RIGID STEEL CONDUIT (TYPE RSC):

1. Install as specified or indicated in contract documents.
2. Permitted for exposed, concealed, and cast-in-concrete applications.
3. Permitted for buried applications if encased with a minimum of 3 inches of concrete.
4. Use anti-seize compound on conduit threads.
5. Use bender per manufacturer's instructions.

RIGID STEEL CONDUIT (ELBOWS) WITH BONDED POLYVINYL CHLORIDE (PVC) JACKET (TYPE PSC):

1. Install as indicated in contract documents.
2. Permitted for buried application.
3. Tighten conduit with strap wrench and repair any damaged coating with a liquid patching compound as recommended by manufacturer.

ELECTRICAL METALLIC TUBING (TYPE EMT):

1. Install as specified or indicated in contract documents.
2. Permitted for exposed, concealed, and cast-in-concrete applications with the following restrictions:
    a. Use only for lighting and convenience power circuits.

b. For exposed applications use indoors only and only where protected by flanges of columns, beams, or other protective structures.
c. Install concealed in walls, floors, and above suspended ceilings where possible.
d. Do not use where conduit passes through floors or to support light fixtures.
e. Do not install in hazardous locations.

RIGID NONMETALLIC CONDUIT (TYPE RNC):

1. Permitted for cast-in-concrete and buried applications. Bury conduits at least 18 inches below finish grade unless indicated otherwise.
2. Make all joints watertight with cement compound furnished by conduit manufacturer.
3. Slope conduits away from conduit risers where possible.
4. Maintain six-inch separation from underground piping.
5. After trench bottom has been finished to grade, lay conduit, then carefully backfill trench in layers of four to eight inches of dry unfrozen material, and tamp each layer with a power tamp.

FLEXIBLE STEEL CONDUIT (TYPE FSC):

1. Install as specified or indicated.
2. Permitted for exposed and concealed applications.
3. Do not install underground or cast-in-concrete.
4. Install at all points of connection to equipment mounted on supports to allow for expansion and contraction.
5. Install at locations where rigid conduit connections are impractical.
6. Maximum length shall be six feet.
7. Install an external bonding jumper to conform to NEC on conduit sized 1-1/2 inches and larger.
8. Use for conduit expansion joints where practical.

CONDUIT FITTINGS:

1. Install as specified, indicated, or necessary.

BOXES:

1. Install boxes as specified, indicated, or as required by NEC.
2. Provide with 1/4-inch drain holes where installed at indoor termination of duct banks or outdoor conduit run.
3. Indoors, conform to NEMA Type 1 enclosure in all nonhazardous locations.
4. Outdoors, conform to NEMA Type 3R except in manholes and handholes NEMA Type 4.
5. Furnish 4-inch octagon or square boxes with raised simplex receptacle covers for fluorescent light fixture outlets specified in DIVISION 26.
6. Metallic Barriers:
    a. Designed not to separate phases of a power circuit.
    b. Provide as necessary for the isolation of power circuits from other type circuits. Refer to SECTION 33 71 19.

SUPPORTS:

1. Construct with sufficient rigidity to hold all mounted equipment and material in permanent and neat alignment.

2. Design to provide 1/4-inch space between equipment housings and walls or columns upon which they are mounted.
3. Do not exceed load requirements in NEC and NEMA standards.
4. Paint all field cuts or welding of supports with one coat of zinc-rich coating at 3 mils dry:
    a. Carboline 658.
    b. Keeler & Long KL4400.
    c. Tnemec 90-97.
5. Use electrogalvanized steel conduit clamps and nonmagnetic conduit clamps to support electrogalvanized steel conduit and nonmagnetic conduit respectively.

CONDUIT IDENTIFICATION TAGS:

1. All conduits runs shall be labeled at both ends and at all entrance and exit points to the cable trench.
2. Install on all scheduled conduit at time of installation.
3. Clean the conduit surface and install a tag at each conduit termination in such a manner that the tag is readable from the floor, platform, or other vantage point.
4. Provide temporary conduit identification until the permanent conduit identification can be installed. An acceptable method is the use of a broad-tipped permanent ink marker.

End of Section 337233.33 – Raceway and Boxes for Utility Substations

Section 337243 – Substation wire, Cable and Accessories

PART 1

1. This Section includes all electrical wire, cable and accessories (including terminations).
2. Definition: Burns & McDonnell type designations such as "PRN1," "CEN1," and "SRN2," indicated or specified are for identification only and are not intended to correspond to any trade designation.
3. Equipment and materials shall be furnished as noted on the Bill of Materials.

RELATED REQUIREMENTS:

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
2. Section 26 24 16 - Panelboards

REFERENCE STANDARDS:

1. Applicable Standards (conform to all standards applicable to each item utilized) shall be latest revisions, supplements, and amendments to the following:
    a. ASTM International (ASTM):
        i. ASTM B3 - Soft or Annealed Copper Wire.
        ii. ASTM B8 - Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
        iii. ASTM B33 – Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes.
        iv. ASTM B172 - Rope-Lay-Stranded Copper Conductors Having Bunch-Stranded Members, for Electrical Conductors.
        v. ASTM B189 - Lead-Coated and Lead-Alloy-Coated Soft Copper Wire for Electrical Purposes.
    b. Association of Edison Illuminating Companies (AEIC):
        i. AEIC CS5 - Specifications for Cross-Linked Polyethylene Insulated Shielded Power Cables Rated 5 Through 46 kV.
        ii. AEIC CS6 - Specifications for Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 5 Through 69 kV.
        iii. AEIC G5 - Underground Extruded Power Cable Pulling Guide.
    c. Institute of Electrical and Electronics Engineers (IEEE):
        i. IEEE 48 - Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV.
        ii. IEEE 404 - Extruded and Laminated Dielectric Shielded Cable Joints Rated 2.5 kV to 500 kV.
        iii. IEEE 1210 – Standard Tests for Determining Compatibility of Cable-Pulling Lubricants with Wire and Cable.
    d. National Electrical Manufacturers Association (NEMA) and Insulated Cable Engineers Association (ICEA):
        i. NEMA WC 57 / ICEA S-73-532 – Control, Thermocouple Extension, and Instrumentation Cables.
        ii. NEMA WC 70 / ICEA S-95-658 – Power Cables Rated 2,000 Volts or Less for the Distribution of Electrical Energy.

iii. NEMA WC 71 / ICEA S-96-659 – Nonshielded Cables Rated 2,001-5,000 Volts in the Distribution of Electrical Energy.
iv. NEMA WC 74 / ICEA S-93-639 – 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.
v. ICEA S-97-682 – Standard for Utility Shielded Power Cables Rated 5 through 46kV.

e. National Fire Protection Association (NFPA):
   i. NFPA 70 - National Electrical Code (NEC).
f. Underwriters Laboratory (UL):
   i. UL 13 - Power-Limited Circuit Cables.
   ii. UL 44 - Thermoset-Insulated Wires and Cables.
   iii. UL 83 - Thermoplastic-Insulated Wires and Cables.
   iv. UL 854 - Service-Entrance Cables.
   v. UL 1072 - Medium-Voltage Power Cables.
   vi. UL 1277 - Electric Power and Control Tray Cables with Optional Optical-Fiber Members.
   vii. UL 1581 – Reference Standard for Electrical Wires, Cables, and Flexible Cords.
g. JEA Substation Standards Reference Manual (2023 Edition)

SUBMITTALS:

1. Submit as specified in Division 01.
2. Include, but are not limited to, the following:
   a. Data sheets for each wire and cable type specified.
   b. Data sheets for wire and cable accessories.
   c. Cable manufacturer's approved splicing and terminating materials.
   d. Cable manufacturer's approved pulling compounds.
   e. Cable manufacturer's installation requirements such as maximum pulling tensions, sidewall pressures, minimum bending radii, etc.
   f. Other equipment and materials to be used.
   g. Unpriced Wire and cable purchase orders.
   h. Documentation of loss measurements shall be provided in hard copy format attached to the reel.

QUALITY ASSURANCE:

1. Wire and Cable shall be manufactured under an established quality assurance program.
2. Supplier shall be engaged in the production of such wire and cable for a minimum of five (5) years.
3. Factory Tests:
   a. Factory tests shall be conducted on wire and cable as specified on each individual Wire and Cable Specification Sheet contained in this Section.
   b. Wire and cable certification sheets shall be submitted to the Engineer as specified on each individual Wire and Cable Specification Sheet and in accordance with requirements in Division 01.

PART 2

ACCEPTABLE MANUFACTURERS:

Engineer approval required for any deviations from the below listed manufacturers.

1. Wire and Cable:
    a. Shielded Control Cable:
        i. Lake Cable
        ii. Nexans
        iii. Okonite
        iv. Prysmian
        v. Southwire
    b. Instrument Cable:
        i. Nexans
        ii. Okonite
2. Wire and Cable Accessories:
    a. Control, Instrument, and Specialty Cable Connectors:
        i. AMP Special Industries.
        ii. Burndy.
        iii. Panduit Corporation.
        iv. Thomas and Betts Company, Inc.
        v. Minnesota Mining and Manufacturing (3M).
    b. Cable Connectors for Power Cable:
        i. AMP Special Industries.
        ii. Burndy.
        iii. Panduit Corporation.
        iv. Thomas and Betts Company, Inc.
        v. Minnesota Mining and Manufacturing (3M).
    c. Termination and Splice Kits (Shielded Medium-Voltage Power Cable):
        i. Minnesota Mining and Manufacturing (3M).
        ii. Raychem.
        iii. Tape and Insulation Putty: Minnesota Mining and Manufacturing (3M).
    d. Cable Ties:
        i. AMP Special Industries.
        ii. Dennison Manufacturing Company.
        iii. Panduit Corporation.
        iv. Thomas and Betts Company, Inc.
        v. Minnesota Mining and Manufacturing (3M).
    e. Cable Supports:
        i. Hubbell, Kellems Grips.
        ii. O. Z. Gedney Company.
    f. Modular Blocks:
        i. Entrelec.
        ii. Phoenix Contact.
        iii. Weidmuller.
    g. Terminal Blocks:
        i. General Electric.
        ii. Stanwick Electrical Products Company.
        iii. States Company.
    h. Cable Identification Tags:

i. Allen Marking Products, Kansas City, Missouri.
ii. Floy Tag and Manufacturing, Seattle, Washington.
iii. Panduit Corporation.
iv. Specialty Products Company, Rock Hill, South Carolina.

WIRE AND CABLE:

1. The Cable Schedule defines the type, size, end points, and routing of each wire or cable (excluding grounding cables).
2. Cable Packaging:
    a. Each cable reel will hold only one continuous cable.
    b. Reel Identification Numbers:
        i. Each cable reel shall have a unique identification number.
        ii. Reel identification shall be placed on one of the end flanges and using one of the following methods:
            1. Permanently stenciled 1/2-inch letters.
            2. Corrosion-resistant metal tag, minimum size shall be 3 inches by 5 inches with 1/4-inch stamped letters.
        iii. Reel identification shall include the following:
            1. Project name.
            2. Contract name.
            3. Contract number.
            4. Engineer's type designation such as "PRL1," "CEL1," etc., and wire size and number of conductors such as "250/1/C," or 14-7/C.
            5. Starting and ending cable footage marker number.
            6. Reel identification number (unique for each reel).
    c. Cable End Preparations:
        i. Each cable end, except for medium voltage cables, shall be sealed with a rubber cap or other approved method to prevent moisture entry.
    d. Corresponding lighting, intercom, convenience power, and grounding cable requirements are indicated in associated portions of the Contract Documents.
    e. Wire and cable shall be furnished in accordance with the Specification Sheets at the end of this Section.
    f. Multi-conductor power cables shall include a grounding conductor as part of the assembly.
    g. Wire or cables indicated with insufficient information for determining length shall be included in Bid at 250-foot length of type of wire or cable indicated. The Contract price will be adjusted up or down using unit prices after actual wire or cable length is determined.
    h. Medium voltage cable shall have copper tape shield. Wire type longitudinal shielding will not be acceptable.

CONNECTORS:

1. General Requirements:
    a. Designed and sized for specific cable being connected.
    b. Solder-less, pressure-type connectors constructed of non-corrodible tin-plated copper.
    c. Rated current-carrying capacity equal to or greater than the cable being connected.

d. Application tooling for connectors shall contain die or piston stops to prevent over- crimping and cycling or pressure relief to prevent under-crimping. Dies of all application tooling shall provide dot or wire size coding for quality control verification. All tooling shall be manufactured by the connector manufacturer.

2. Power Connectors (Sizes 12 to 4 AWG):
   a. Vinyl or nylon pre-insulated ring-tongue type.
   b. Ring tongue sized to match terminal stud size.
   c. Have insulation grip sleeve or ring to firmly hold to cable insulation.
   d. Application tooling designed to crimp the wire barrel (conductor grip) and the insulation grip sleeve or ring with a one-step crimp.
   e. Acceptable manufacturers are listed in the Acceptable Connector Manufacturers' Cross-Reference Chart at end of this Article.
3. Power Connectors (Sizes 2 AWG to 750 MCM):
   a. Uninsulated two-hole rectangular tongue.
   b. Application tooling shall be hydraulically operated.
   c. Acceptable manufacturers are listed in the Acceptable Connector Manufacturers' Cross-Reference Chart at end of this Article.
4. Control, Instrument, and Specialty Cable Connectors:
   a. Vinyl or nylon pre-insulated ring-tongue type. Spade lugs will not be permitted.
   b. Ring tongue sized to match terminal stud size.
   c. Have insulation grip sleeve to firmly hold to cable insulation.
   d. Insulation grip sleeve shall be funneled to facilitate wire insertion and prevent turned back strands.
   e. Application tooling designed to crimp the wire barrel (conductor grip) and the insulation grip sleeve with a one-step crimp.
   f. Acceptable manufacturers are listed in the Acceptable Connector Manufacturers' Cross-Reference Chart at end of this Article.

Acceptable Connector Manufacturers' Cross-Reference Chart						
Type	Size (AWG or MCM)	Amp Special Industries	Thomas & Betts	Panduit Corp.	Burndy	3-M
Control	22-18	PIDG	RA18	PN18	TP16	MNG-18
	16-14	PIDG	RB14	PN14	TP14	MNG-14
	12-10	PIDG	RC10	PN10	TP10	MNG-10
Power (600V and Below)	12-10	PIDG	C10	P10	TP10	M10
	8	Amplibond	D8	P8	YAEV	M8
	6	Amplibond	E6	P6	YAEV	M6
	4	Amplibond	F4	P4	YAEV	M4
	2	Amplibond	G2	LCA	YAEV	30000 Series
	1-750	Ampower	542 Series	LCC	YA-2LN YA39-2LN	31100 Series

CABLE SUPPORTS:

1. Cable supports for cables in vertical risers shall be O. Z. Gedney Type "R" wedging plug type or approved equal.

CABLE TIES:

1. Nylon self-locking type.
2. Have a normal service temperature range of -40ºC to 85ºC. Be weather resistant for outdoor use.
3. Be AMP Special Industries "AMP-TY," Dennison Manufacturing Company "BAR-LOK," Panduit Corporation "PAN-TY," or Thomas and Betts "TY-RAP", or Minnesota Mining and Manufacturing 3M Brand cable ties.

TERMINAL BLOCKS:

1. For Mounting in Terminal Boxes (TBs):
    a. Designed and sized for the cables being terminated.
    b. Phenolic block rated 600V.
    c. Binding-screw-type terminals for power cables and straight-strap stud terminals for control and instrument cables.
    d. Rated current-carrying capacity equal to or greater than the cable being terminated.
    e. Marking strip on blocks for power cables and control and instrument cables.
    f. General Electric Type CR2960SY139 for power cables and States Company Type NT Model M-251 for control and instrument cables.
2. For Mounting in Cabinets, Panels, Control Boards, etc.:
    a. Designed and sized for the cables being terminated.
    b. Phenolic block rated 600V.
    c. Binding-screw-type terminals for power cables and current transformer circuits and sliding link stud type terminals for control and instrument cables.
    d. Rated current-carrying capacity equal to or greater than the cable being terminated.
    e. Marking strip on blocks for power cables and control and instrument cables.
    f. Short-circuit strips with one shorting screw for each terminal for current transformer circuits.
    g. General Electric Type CR2960SY139 or approved equivalent for power cables. States Company Type NT Model M-250, or Stanwick Type SLS for control and instrument cables. General Electric Type EB-27 for current transformer circuits.

CABLE IDENTIFICATION TAGS:

1. Designed to provide a permanent wire and cable identification system.
2. Show complete cable number. Cable numbers are defined in the Cable Schedule and/or Contract Drawings.
3. Cable numbers shall be legible and permanent, hand lettered, stamped or typed.
4. Character size for cable numbers shall be a minimum of 3/16 inch if hand lettered or 1/8 inch if stamped or typed.
5. Material shall be nonmetallic and impervious to moisture.
6. Be securely attached to cables and accessible for inspection.
7. Cable identification tags, marking, and attachment methods shall be subject to approval of the Owner's Representative.

PART 3

GENERAL REQUIREMENTS:

1. Install wire and cable in raceway system as indicated in Contract Documents.
2. Do not subject cable to pulling tensions or sidewall pressures in excess of manufacturer's recommendations.

3. Attach pulling grips over the cable sheath to prevent slipping of the insulation.
4. Do not subject cable to inside bending radius less than those recommended by the cable manufacturer or as noted below (whichever is greater) during or after installation:
    a. Twelve times the cable outside diameter for 5 kV or higher rated cables.
    b. Eight times the cable outside diameter for 600V or lower rated cables.
5. Install intermediate splices only as indicated in Contract Documents or as required to avoid subjecting cable to excessive pulling tension or sidewall pressures. Cable splicing locations shall be approved by Owner's Representative prior to cable installation.
6. Support cables at connections or termination points such that any strain on cable will not be transmitted to the connection or termination.
7. Install cable supports in vertical runs of tray or conduit, at boxes and at terminations in equipment, and as required to meet intermediate support requirements of NEC.
8. All pulling compounds shall be approved by wire and cable manufacturer as being compatible with cable materials.
9. Attach a cable identification tag to each cable at all terminations, splices, and end points.
10. Contractor shall provide a load cell tension monitoring device to aid the Contractor in assuring that cable pulling tension limits are not being exceeded. In addition, the Contractor shall monitor and record individual cable pulls as requested by the resident project representative to assure compliance with the cable limitations as published by the cable manufacturer.
11. All wire and cable installation shall comply with the applicable parts of the National Electrical Code (NEC).
12. Contractor shall test each wire for ground or shorts after installation but before any connections are made.
13. There shall be at least 12 inches of excess control or low-voltage wire remaining at all terminal blocks for the purpose of making connections or splices.
14. Foam fill cable tray openings to the building walls after cable installation.

STORAGE:

1. This Contract will establish a crushed rock laydown area for cable storage. All reels shall be stored off the ground on timbers.

POWER (600V AND BELOW), CONTROL, INSTRUMENT, AND SPECIALTY CABLE:

1. Install metallic barrier in all tray, trench, and boxes to separate power, control, and instrumentation from low-level signal (50V or less) instrumentation circuits where run in the same tray or box.
2. Secure with cable ties in cable tray risers at intervals not to exceed three feet.
3. Tie together with cable ties all single-conductor cable on each individual circuit in each junction box, equipment, or manhole and in cable tray or trench at intervals not to exceed 6 feet.
4. Control and instrument cable splices shall be as follows:
    1. Made only in junction or terminal boxes.
    2. Made on terminal blocks.
    3. Conductor color coding shall be maintained.
    4. For shielded cables, shield continuity and isolation shall be maintained.
    5. Power cable (600V or below) splices and motor terminations shall be as follows:
    6. Made only in junction or terminal boxes.
    7. Splices shall be made using compression-type connectors bolted together.

8. Splice to be covered with a cold-shrink connector insulator.
9. Terminate and ground control, instrument, and specialty cable shields as indicated in Contract Documents and recommended by the manufacturer of the equipment being connected.
10. Ground the shields at both ends for shielded control cable used in substations and substations.
11. Ground Cable: Install as specified in Section 33 79 23.

CABLE CONNECTIONS AND TERMINATIONS:

1. Make up clean and tight to assure a low-resistance joint.
2. Make only in terminal boxes, equipment, or other accepted enclosures and not in conduit or cable tray.
3. Install all connectors with tooling manufactured by the connector manufacturer and as specified.

End of Section 337243 – Substation wire, Cable and Accessories

Section 337539 – Surge Arresters

PART 1

1. This Section includes the individual specifications and requirements for all substation surge arresters to be furnished as noted on the Bill of Material. Quantities as indicated.
2. Erection and assembly required at the jobsite will be performed by the Contractor.
3. Items furnished under this Section shall comply with the Submittals requirements of Division 01.

REFERENCE STANDARDS:

1. Design, construct, test, and assemble all equipment and materials in conformance with the latest revisions and supplements of all applicable IEEE, OSHA and NESC standards including, but not limited to, the following:
    a. Institute of Electrical and Electronics Engineers (IEEE):
        i. C2 - National Electrical Safety Code.
        ii. C62.11 - Metal-Oxide Surge Arresters for AC Power Circuits.
        iii. C62.22 - Application of Metal-Oxide Surge Arresters for Alternating-Current Systems.
    b. Occupational Safety and Health Act (OSHA).
    c. JEA Substation Standards Reference Manual (2023 Edition)
2. Acceptable manufacturers are listed in PART 2 of this section. Other manufacturers than those listed may be employed with the approval of the Engineer and if the item to be furnished conforms to this specification.
3. Experience:
    a. The manufacturer of each item of equipment or material furnished shall be regularly engaged in the fabrication of the item and it shall have an acceptable history of satisfactory, reliable service in outdoor substation use for a period of at least five years under comparable environmental conditions.
    b. Newly-developed equipment with less than five years actual service will be considered from established manufacturers only if it has been adequately tested, meets the requirements of this contract, and is approved by the Engineer.

SUBMITTALS:

1. Submit as specified in Division 01.
2. Furnish the following types of drawings:
    a. Furnish drawings necessary for design, erection, installation, and operation of all equipment and materials furnished including, but not limited to, the following:
        i. Complete bill of material including item numbers and manufacturers' catalog numbers.
        ii. Complete drawings and descriptive bulletins for installation, adjustment, testing, maintenance, and operation of all equipment including bus weldments, connectors, insulators, corona fittings, etc.
        iii. General outline, nameplate, and internal wiring drawings of all equipment.
        iv. Drawings showing additional detail if requested by the Engineer or otherwise required for installation and maintenance.

b. Standard drawings of equipment which do not indicate clearly the exact size, model number, and optional items to be furnished will be returned to the Supplier for this information before review by the Engineer.

PART 2

SURGE ARRESTERS:

1. Ratings:
    a. Nominal system voltage (kV): 230
    b. Duty cycle rated voltage (kV): 180
2. Type and Design:
    a. Outdoor station class, metal oxide type.
    b. Polymer
    c. Mounting: Upright
3. Materials
    a. Provide corona-free and watertight welded end covers on all exposed ends.
    b. Provide corona/grading rings as required.
4. Acceptable Manufacturers:
    a. Hitachi Energy
    b. Cooper Power Systems.
    c. General Electric GRID Solutions
    d. The Ohio Brass Company (Hubbell).

PART 3

FACTORY TESTING

1. Supplier shall perform factory tests in accordance with IEEE standards.

FIELD SERVICES:

1. Correction of errors, discrepancies, or omissions shall be made immediately upon notification from the Resident Engineer in order to prevent delay of construction. All corrections resulting from errors, discrepancies, shipping damage, etc., approved by the Resident Engineer to avoid delay in construction and required for the installation and proper use of equipment shall be paid for by the Supplier.

SHIPMENT:

1. All surge arresters shall be delivered to the site in vehicles which facilitate unloading by crane.

STORAGE:

1. Surge Arresters shall be stored according to the requirements listed in Section 330570 PART 2.
2. Arresters shall be stored upright with container supported to prevent toppling (if needed).

INSTALLATION

1. Surge Arresters shall be installed in accordance with the manufacturers requirements.

End of Section 337539 – Surge Arrestors

Section 337919 - Grounding

PART 1

This Division includes the installation of permanent above grade grounding for structures, fences, gates and buildings.

REFERENCES:

1. American National Standards Institute (ANSI):
    a. C2 - National Electrical Safety Code (NESC).
2. Rural Utility Service (RUS):
    a. Bulletin 202-1 - List of Materials Acceptable for Use on Systems of REA USDA Rural Development Electrification Borrowers.
3. JEA Substation Standards Reference Manual (2023 Edition)
4. Institute for Electrical and Electronics Engineers (IEEE)
    a. IEEE Std 80-2013: IEEE Guide for Safety in AC Substation Grounding

SUBMITTALS:

1. Submit as specified in DIVISION 1.
2. Compliance Submittals:
    a. Including, but not limited to, the manufacturer's catalog entries and information for the following:
        i. Ground wires.
        ii. Ground rods.
        iii. Ground rod clamps.
        iv. Parallel compression connectors.
        v. Ground wire splices.
        vi. OHGW jumper wire.
        vii. OHGW jumper clamp.
        viii. OHGW clamp.
        ix. Steel structure ground clamp.
        x. Guy strand clamp.
        xi. Ground rod couplings.
        xii. 60-hertz filter.
        xiii. Bentonite.
    b. Test Reports:
        i. Grounding tests.
        ii. Megger calibration reports.

PART 2

GENERAL:

1. Materials provided as indicated on Bill of Materials. Grounding assemblies followed by (C) or (G) shall designate copper or galvanized coatings respectively.
2. Components that do not have (C) and (G) designations shall be used for both (C) and (G) applications.

GROUND WIRES:

1. Copper (C): 7/#5 copper-clad steel solid wire dead soft annealed with 40 percent conductivity shall be used for equipment, structures, control enclosures, fence and gate ground riders (stingers) to connect to ground grid except where indicated.

GROUND ROD CLAMP:

1. Copper (C): Bronze or copper alloy Amp 81230-1 "Wrench-Lok," or equal.

GROUND WIRE SPLICES:

1. Copper (C): Bronze, Bolted, 7#5 to 7#5 CCS. Anderson Catalog No. GC-143A-GS or equal.

OHGW JUMPER WIRE:

1. 7#5 Copper Clad Steel wire.

OHGW JUMPER CLAMP:

1. Bronze, Bolted, 7#5 CCS to flat. Anderson Catalog No. GC-141A-G2 or equal.

STEEL STRUCTURE GROUND CLAMP:

1. Bronze, Bolted, 7#5 CCS to flat. Anderson Catalog No. GC-141A-G2 or equal.

GROUND ROD COUPLINGS:

1. Copper (C): Threaded coupler for copper-clad steel sectional rod.

EQUIPMENT GROUNDS

1. Terminal, Bronze Bolted, 7#5 Copperweld to 2-HP

PART 3

STEEL STRUCTURES:

1. All steel structures shall be grounded as indicated. Engineer shall be notified if rock is encountered which prevents driving ground rods to full required depth.

RESISTANCE TESTS AND ADDITIONAL GROUND RODS:

1. Contractor, in the presence of the Engineer or Field Site Manager, shall measure the resistance of all structure and equipment grounds by the three-point fall of potential method with a minimum of three measurements being taken at different distances from the current probe. All meggers shall be calibrated within the last three months.
2. The ground resistance test shall be completed prior to the installation of the OHGW.
3. Grounds shall be measured when ground is dry and no less than 24 hours after measurable precipitation has occurred at the measuring site.
4. Maximum resistance shall be no greater than 10 ohms when all grounds have been installed and connected by temporary jumpers so that the grounds may be tested as a system.
5. Additional ground rods may be installed at each self-supporting structure foundation, after engineer approval, as indicated until either a structure ground resistance not greater than 10 ohms is achieved or a total of four ground rods per foundation on self-supporting steel structures have been installed or an alternate grounding system has been installed as directed by the Engineer.

6. If resistance of ground system does not fall below 10 ohms, Engineer may require alternate grounding assemblies.

End of Section 337919 – Grounding

Section 337923 – Utility Substation Grounding

PART 1

Equipment and materials shall be furnished as noted in the Bill of Materials.

This Section includes the following:

1. Substation buried ground grid and ground rod system.
2. Ground grid connections for riser extensions to structural steel, electrical equipment, power circuit breakers, duct banks, raceway and manholes, and other miscellaneous equipment.

REFERENCE STANDARDS:

1. Applicable Standards (conform to all standards applicable to each item utilized) shall be latest revisions, supplements, and amendments to the following:
    a. ASTM International (ASTM):
        i. B8 – Standard Specification for Concentric-Lay-Stranded-Copper Conductors, Hard, Medium-Hard, or Soft.
    b. Institute of Electrical and Electronics Engineers (IEEE):
        i. C2 - National Electrical Safety Code.
        ii. 80 - Safety in AC Substation Grounding.
        iii. 837 - Qualifying Permanent Connections Used in Substation Grounding.
    c. National Fire Protection Association (NFPA):
        i. 70 - National Electrical Code.
        ii. 780 - Lightning Protection Code.
    d. JEA Substation Standards Reference Manual (2023 Edition)

SUBMITTALS:

1. Include, but are not limited to, catalog cuts for the following:
    a. Ground Rods.
    b. Grounding conductor.
    c. Grounding Lugs.
    d. Exothermic Weld Materials.
    e. Compression Connectors.
    f. Certification of connectors meeting IEEE Std. 837.

PART 2

ACCEPTABLE MANUFACTURERS:

1. Ground Rods:
    a. Hubbell Power Systems Inc.
    b. Copperweld Steel Company.
    c. Blackburn Grounding Systems.
    d. Joslyn Manufacturing
    e. Wesco Company.
    f. Houston Wire & Cable.
    g. Harger Lightning and Grounding.

   h. Erico products.
   i. Approved equivalent.
2. Cable-to-Equipment Ground Lugs:
   a. Anderson Products (Hubbell Power Systems).
   b. Burndy (Hubbell Power Systems).
   c. Erico Products.
   d. Hubbell Power Systems Inc.
   e. DMC Power
   f. Approved equivalent.
3. Cable-to-Cable, Cable-to-Ground Rod, Cable-to-Steel Bar, Exothermic Weld Connections:
   a. Erico Products (Cadweld).
   b. TerraWeld.
   c. Thermoweld (Hubbell Power Systems).
4. Grounding enhancement materials (Engineer approval required before use):
   a. Colloid Environmental Technologies Company (CETCO) - Bentonite.
   b. LORESCO

WIRE AND CABLE:

1. Conductor Sizes:
   a. As indicated on contract drawings for specific connections.
   b. For required connections not indicated, use conductor size not less than 19#8 CCS if buried in earth or cast in concrete, or 7#5 CCS at other locations.
   c. Unless otherwise shown on drawings size in accordance with size in accordance with, but do not limit to, the following:

Equipment or Structure	**Wire Size-Type**
Main Grid	19#8 CCS
Power Circuit Breakers	7#5 CCS
Steel Structures	7#5 CCS
Transmission Structures	7#5 CCS
Surge Arresters	7#5 CCS
CCVT's	7#5 CCS
CT/PT Transformers	7#5 CCS
Disconnect Switch Operators	BY MFR.
Switch Structures	7#5 CCS
Panelboard Neutral Buses	7#5 CCS
Substation Light Fixtures	7#5 CCS
Fence Ground Risers	7#5 CCS
Fence Fabric and Barb Wire	#2 SOL. CU
Cable Trench	(2) 7#5 CCS
Fuse and Terminal Cabinets	7#5 CCS
Motor Operators	7#5 CCS

GROUND RODS:

1. Copper-clad steel or copper-alloy sectional-type rods.
2. One end pointed to facilitate driving.

3. Unless otherwise shown on drawings 5/8-inch diameter and 10 feet long with diameter and length stamped near top of rod.
4. Threaded Interconnectable rods to allow them to be stacked to obtain a greater length.

CONNECTION MATERIALS:

1. Cable-to-rod, cable-to-cable and cable-to-connector connections of exothermic-welding-type process with proper molds and charges only to be used when connections are made below grade.
2. Cable-to-equipment and cable-to-cable ground connections above grade shall be mechanical bolted type Exothermic, Erico Products "Cadweld" or approved equivalent.
    a. Use silicon bronze hex-bolts and nuts.
    b. Use 304 stainless steel flat washers and Belleville washers.
    c. All grounding connectors in contact with galvanized structure shall be tinned bronze material.
3. Cable-to-cable connections made below grade shall be the following:
    a. Exothermic, Erico Products "Cadweld" or approved equivalent.

TEMPORARY EQUIPMENT TERMINAL GROUNDS:

1. Power circuit breaker terminals, CCVT terminals, etc., shall be effectively grounded to the grid by 7/#5 CCS or larger cable until such time as the ground grid is properly connected.
2. Connections shall be of a bolted type to the equipment connector and of a clamp type to the ground grid.

TEST EQUIPMENT:

1. Commercial model three-point ground test set, Megger DET 2/2 or approved equivalent.

PART 3

1. All buried grounding system conductors shall be copper clad steel in accordance with project drawings sized to withstand the design basis fault current of 28.32kA.
2. All exposed non-energized metal objects in the substation including but not limited to support structures, fences, gates and equipment control cabinets shall be connected to the buried grounding system with copperclad steel wire ground conductors sized to withstand the design basis fault current.

INSPECTION:

1. Do not bury connections prior to inspection by the Owner’s Representative.
2. All exothermic molds shall be made available for daily inspection by the Owner’s Representative before ground installation begins.

INSTALLATION:

1. Wire and Cable:
    a. Install using as few joints as possible. Soldered joints are not permitted.
    b. Protect against abrasion by several wrappings of rubber tape at all points where cable leaves concrete in exposed areas.
    c. Suitably protect cable against damage during construction.
    d. Replace or suitably repair cable if damaged by anyone before final acceptance.
    e. In Exposed Installations:

i. Exposed grounding and bonding connections such as those at equipment, enclosures and ground busbars shall be visible and accessible.
ii. Route runs as indicated.
iii. Route along the webs of columns and beams, and in corners where possible for maximum physical protection.
iv. Support at intervals of 3 feet or less with nonmagnetic clamp-type supports.

f. In Buried Installations:
i. Lay in bottom of trench or in other excavations at least 30 inches below finish grade.
ii. Maintain clearance of at least 12 inches from all underground metal piping or structures, except where connections thereto are specifically indicated.
iii. Backfill with clean earth, free from rocks or stones. Thoroughly compact backfill as required.
iv. Excavation and backfill shall conform to the requirements of Division 02.

g. In concrete: Where grounding is shown going through concrete, install PVC conduit of suitable size to enclose the ground cable.

2. Ground Rods:
a. Install rods as indicated by driving and not by drilling or jetting.
b. Drive rods into unexcavated portion of the earth where possible.
c. Where rods must be installed in excavated areas, drive rods into earth after compaction of backfill is completed.
d. Drive to a depth such that top of rods will be approximately 24 inches below final grade and connect main grid ground cable thereto.
e. Total rod length shall be 30 feet unless otherwise specified on project drawings. Contractor shall install additional rods and/or stack sections of rods for greater depth as directed by the Owner's Representative.

3. Connections:
a. Conform to manufacturer's instructions.
b. Chemically degrease and dry completely before making connection.
c. For exothermic connections, clean molds thoroughly after each weld is completed. Dirty molds or excessively worn molds that will not contain the weld, shall not be used.
d. Make connections to equipment as follows:
i. Make up clean and tight to assure a low-resistance connection with resistance drop not exceeding 40 millivolts per 1000-A.
ii. Install so as not to be susceptible to mechanical damage during operation or maintenance of equipment.
iii. Provide direct copper connection to buried ground grid system.

4. Metallic Conduit Grounds:
a. Adequately and properly ground at all terminal points and wherever isolated from equipment or grounded steel.
b. Where extending into switchgear or other floor-mounted equipment from below, connect to equipment ground bus or frame.
c. Where extending into a manhole, handhole, or cable trench, connect to the ground riser or cable at that structure using grounding bushings.

5. Manhole and/or Handhole Grounds:

   a. Ground all hardware to ground rod extensions in manholes with 7#5 CCS unless indicated otherwise.
   b. Connect manhole ground rods to the underground duct system ground conductors, cable trench system ground conductors, and substation ground grid conductors.
6. Box Grounds: Ground all boxes by direct copper connection to the buried ground grid system.
7. Equipment enclosure doors shall be bonded with flexible metal bonding straps, instead of reliance on hinges for electrical continuity.
8. Surge Arrester Grounds:
   a. Where three arresters are mounted together on the same structure or transformer, connect to a riser loop ground cable connected at each end to the buried ground grid and connect to ground rods as indicated.
   b. Do not enclose in magnetic conduit or permit close magnetic encirclement of conductors.
   c. Where arresters are mounted individually, or leakage detector/counter is used, connect directly to buried ground grid and connect to ground rods as indicated.
9. Switch and Switch Platform Grounds:
   a. Provide number and size of riser cables as indicated.
   b. Connect only in the manner indicated on detail drawings.
   c. Provide bolted ground connector and flexible type grounding jumper for the operating handles of the disconnect switches.
10. Instrument Transformer Fuse and Terminal Cabinet Grounds:
   a. Connect to the riser with a split bolt connector.
   b. Connect to the cabinet with a connector capable of being used to ground control cable shields or internal ground bus in the cabinet. Connector type to be Anderson Type TLS or approved equivalent.
   c. In the fuse and terminal cabinets, furnish and install a 1/4-inch x 1-inch copper ground bus to be used for grounding of control cable shields and spare wires. Connect the ground bus to the ground lug.
11. Steel Structures:
   a. Provide the number and size of riser cables as indicated and specified.
   b. Each multi-legged structure shall have at least two (2) independent connections to two (2) separate locations on the ground grid.
   c. Single-legged structures shall have two (2) independent connections from two (2) separate locations on the ground grid.
   d. Connect riser cables to steel structure legs with grounding clamps.
   e. For steel structures, the structure can be used as the circuit path provided all parts of the structure are connected with adequate connections so the current transfer capacity across the entire structure is at least equal to the grounding conductor capacity. Bonding shall be provided around inadequate structure connections, where required, to ensure an effective path for ground current.
   f. For structures supporting lightning masts and shield masts install a continuous length of conductor (not the steel structure) to the ground pigtail.
   g. For transmission line dead end structures bond the shield wire with a continuous length of conductor (not the steel structure) to the ground pigtail with a ground rod in proximity.
12. Precast Cable Trench Grounds:

   a. Provide two (2) parallel continuous ground cables of the size specified for the entire length of trench. Connect ground jumpers from trench ground conductor to each main grid conductor crossed by the trench and at additional locations indicated.
   b. The ground conductor shall be supported from the side wall of the trench with brackets to be spaced a maximum of 5'-0" apart.
   c. To provide continuous ground path for the steel road crossing lids, the precast road crossing sections shall be provided with steel angles embedded in the concrete sections, on which the steel lids will be supported and in constant contact with the angles. Each section of angle shall be connected to the trench ground conductor.
   d. Bolted connectors shall be used for jumper connections to the trench ground conductor.
13. The building structural steel, foundation reinforcing steel, and metallic shell (if present) should have at least the two opposite corners connected to the ground grid.
14. Floor Trench and Cable tray Grounds:
   a. Provide a continuous ground cable of the size specified throughout the entire Floor Trench and Cable tray system.
   b. Connect the Floor Trench and Cable tray ground conductor to the cable trench ground conductor extended into the control building.
   c. Use bolted connectors for all ground connections in the Floor Trench and Cable tray.

End of Section 337923 – Utility Substation Grounding

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