PART 1 GENERAL

1.1 SUMMARY

A. Section includes general requirements and procedures related to preparation and transmittal of Submittals to include Schedules, Packager’s Drawings, Samples, Manuals, Methods of Construction, and Record Drawings to Engineer demonstrating performance of Work.

1. Other requirements for submittals are specified under applicable sections of the Specifications.

1.2 SUBMITTAL REQUIREMENTS

A. General.

1. Submit each under separate cover or transmittal.

2. Furnish neat, legible, and sufficiently explicit detail to enable proper review for Contract compliance.

3. Show complete and detailed fabrication; assembly and installation details; wiring and control diagrams; catalog data; pamphlets; descriptive literature; and performance and test data.

4. Include calculations or other information sufficient to show comprehensive description of structure, machine, or system provided and its intended manner of use.
   a. With each submission, furnish Engineer specific written notation and justification of each variation in Contractor's Submittals from requirements of Contract Documents.
   b. Fabrication, purchase or delivery of materials to the site, and installation of materials or Work performed before approval, or not conforming to approved submittals, shall be at Contractor's risk.

5. Engineer’s review and approval of submittals shall not relieve Contractor from responsibility for fulfillment of terms of Contract, unless Engineer has received specific written notice of each variation and has given specific written approval.

6. Contractor assumes all risks of error and omission.


B. Process and Requirements.
1. Not later than 30 days after Notice to Proceed, submit written list of materials and equipment to be purchased, giving name, address, and telephone number of Supplier, Manufacturer, or processor.
   a. Submit updated material and equipment list when changes are made.

2. Coordinate and schedule submittals with construction schedule and Engineer.

3. With the first submittal, but not later than 30 days after Notice to Proceed, submit a complete submittal schedule, listing as near as practicable and by Specification Section number, submittals required and approximate date submittal will be forwarded.
   a. Arrange submittals schedule so that related equipment items are submitted concurrently.
   b. Engineer may require changes to submittal schedule to permit concurrent review of related equipment.

4. To each submittal affix the following signed Certification Statement.
   a. "Certification Statement: By this submittal, we hereby represent that we have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and pertinent data and we have checked and coordinated each item with other applicable approved drawings and all Contract requirements."

5. Identification
   a. Submit identification data, as applicable, contained thereon or permanently adhered thereto:
      1) The Contract Number.
      2) Contract name and location.
      3) Submittal Numbers:
         a) Number by specification section followed by sequential number. Number format example is 12345-01.
         b) Resubmittals shall bear original submittal number and be sequentially lettered (Example 12345-01A).
      4) Product identification.
      5) Drawing title, drawing number, revision number, and date of drawing and revision.
      7) Subcontractor's, Vendor's and/or Manufacturer's name, address and phone number.
      8) Contractor's Certification Statement.
   b. Identify on exterior, catalog product data or brochures submitted in packages of multiple items. Include page and catalog item numbers for items submitted.
      1) Highlight catalog, product data, or brochures containing various products, sizes, and materials to show particular item submitted.
      2) Mark items not applicable to Contract "not applicable" or cross out.

6. Stamp Space: Blank space of approximately 2-1/2 inches high by 4 inches wide adjacent to the identification data to receive Engineer's status stamp.
7. Number of Copies: See requirements in Submittals specified herein.

   a. Follow submittal schedule provided to Engineer. Engineer will return submittal within 15 days.
   b. Submittals will be returned, marked with one of following classifications:
      1) APPROVED: Requires no corrections, no marks.
      2) APPROVED AS NOTED: Requires minor corrections. Items may be fabricated as marked without further resubmission. Resubmit 2 corrected copies to the Engineer for record.
      3) APPROVED AS NOTED - RESUBMIT: Requires corrections. Items not marked may be fabricated. Resubmit entire submittal following original submission with corrections noted. Allow 30 days for checking and Engineer’s appropriate action.
      4) REJECTED: Requires major corrections or is otherwise not following Contract Documents. No items shall be fabricated. Resubmit entire submittal following original submission with corrections noted. Allow 30 days for checking and Engineer’s appropriate action.
      5) INFORMATION ONLY: Items specified by Contract Documents.
   c. The Contractor shall be allowed up to three submissions (initial plus two resubmittals) of the same submittals for review. The Contractor shall bear all costs for reviews beyond three submissions.

C. Electronic Submittals: PDF Format, as approved by Engineer.

1.3 SUBMITTALS

A. Schedules: Submit project schedule, showing the following major milestones, to the Owner within seven (7) days of receiving Notice to Proceed (NTP).

1. Initial Design Completed
2. Shop Drawing Submittal
3. Owner’s Shop Drawing Review Period
4. Order Materials
5. Start of Construction
6. Factory Testing
7. Construction Complete
8. Equipment Ship Date
9. Equipment Date of Arrival at Owner’s Site
B. Equipment Warranty and Certification Form

1. Submit “EQUIPMENT WARRANTY AND CERTIFICATION FORM” with the first submittal for all equipment and systems listed below. Submittals that do not include the required form(s) will not be accepted.

2. The form shall be duly executed by an authorized principal of the manufacturer.

3. The principal shall warrant and certify that the equipment, component, or system proposed meets or exceeds contract specifications, is suitable for its intended purpose and installation, and will provide satisfactory performance at the design criteria specified.
   a. In the event that the manufacturer is not the supplier, an authorized principal of the supplier shall also execute the Equipment Warranty and Certification Form.

4. Provide Certificates for the items listed below:

<table>
<thead>
<tr>
<th>Section</th>
<th>Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>16147</td>
<td>Panelboards</td>
</tr>
<tr>
<td>16290</td>
<td>Relay Panels</td>
</tr>
</tbody>
</table>

C. Shop Drawings.

1. For original submittal and each subsequent re-submittal required, submit both electronic (via FTP site or email) and 2 hard copies of catalog data. Engineer will return 1 copy or electronic file at his/her discretion.

2. Show types, sizes, accessories, and layouts, including plans, elevations, and sectional views; component, assembly, and installation details; and all other information required to illustrate how applicable portions of Contract requirements will be fabricated and/or installed.

3. In case of fixed mechanical and electrical equipment, submit layout drawings drawn to scale, to show required clearances for operation, maintenance, and replacement of parts. Include manufacturer's certified performance curves, catalog cuts, pamphlets, descriptive literature, installation, and application recommendations, as required. Submit together shop drawings for closely related items. Additional shop drawings and information required for electrical and mechanical equipment are listed in appropriate Specification Sections.

4. Manufacturer shall have on file certified drawing(s) containing above information approved by the Owner, and items furnished shall be as described on certified drawing(s). If Standard Details or Specifications change after certified drawings are approved, new submittals are required.

D. Catalog Data.
1. For original submittal and each subsequent re-submittal required, submit both electronic (via FTP site or email) and 2 hard copies of catalog data. Engineer will return 1 copy or electronic file at his/her discretion.

2. Manufacturer's Catalog, Product, and Equipment Data: Certified and include material type, performance characteristics, voltage, phase, capacity, and similar data.
   a. Furnish wiring diagrams when applicable.
   b. Indicate catalog, model, and serial numbers representing specified equipment.
   c. Submit complete component information to verify specified required items.

E. Working Drawings.

1. For original submittal and each subsequent re-submittal required, submit both electronic (via FTP site or email) and 2 hard copies of catalog data. Engineer will return 1 copy or electronic file at his/her discretion.

2. Submit working drawings as required for changes, substitutions, Contractor design items, and Contractor designed methods of construction. Requirements for working drawings are listed in appropriate Specification Sections or in Special Provisions.

3. Include with drawings calculations or other information to completely explain structure, machine, or system described and its intended use. Review or approval of drawings by Engineer shall not relieve Contractor from responsibility for fulfillment of terms of Contract. Contractor assumes risks of error, and Engineer shall have no responsibility.

4. Submit any required structural drawings and calculations sealed, dated, and signed by Professional Engineer registered in State of Florida and experienced in the work or discipline involved.

F. Method of Construction.

1. For original submittal and each subsequent re-submittal required, submit both electronic (via FTP site or email) and 2 hard copies of catalog data. Engineer will return 1 copy or electronic file at his/her discretion.

2. When Engineer specifies or directs, submit proposed method of construction for specific portions of Work.
   a. Include detailed written description of phases of construction operation to fully explain to Engineer proposed method of construction.
   b. If required by Specifications, submit working drawings to supplement description.

3. Engineer review will follow the process herein and shall not relieve Contractor from responsibility for fulfillment of terms of Contract. Contractor assumes risks associated with proposed method.

4. After review, submit requests for modifications in detail, including justification for them. Do not implement modifications prior to Engineer’s review.
G. Manufacturer's Installation Recommendations.

1. For original submittal and each subsequent re-submittal required, submit both electronic (via FTP site or email) and 2 hard copies of catalog data. Engineer will return 1 copy or electronic file at his/her discretion.

2. Furnish written detail for step by step preparation and installation of the materials and products, including recommended tolerances and space for maintenance and operation.

H. Record Drawings (As-builds).

1. Prepare and maintain record drawings for work performed.
   a. Before preliminary inspection, furnish record drawings to the Engineer. At completion of Contract and before final payment is made, furnish Engineer one (1) set of finally approved record drawings. Furnish Engineer record drawing data on disk or CD, in format compatible with the Owner’s software.

I. Operation and Maintenance Manuals.

1. Furnish Operation and Maintenance Manuals for various types of equipment and systems, as required by Contract Documents.

2. Unless otherwise indicated, furnish a separate manual for each piece of equipment and system. If a manual contains other items or equipment, indicate where specified items are located in manual. Include in manual complete information necessary to operate, maintain, and repair specific equipment and system furnished under this Contract, and include the following specific requirements;
   a. Contents.
      1) Table of Contents and Index.
      2) Brief description of equipment/system and principal components.
      3) Starting and stopping procedures, both normal and emergency.
      4) Installation, maintenance, and overhaul instructions including detailed assembly drawings with parts list and numbers, and recommended spare parts list with recommended quantity, manufacturer's price, supplier's address, and telephone number.
      5) Recommended schedule for servicing, including technical data sheets that indicate weights and types of oil, grease, or other lubricants recommended for use and their application procedures.
      6) One copy of each component wiring diagram and system wiring diagram showing wire size and identification.
      7) One approved copy of each submittal with changes made during construction properly noted, including test certificates, characteristic curves, factory and field test results.
      8) For electrical systems, include dimensioned installation drawings, single line diagrams, control diagrams, wiring and connection diagrams, list of material for contactors, relays and controls, outline drawings showing relays, meters, controls and indication
equipment mounted on equipment or inside cubicles, control and protective schematics, and recommended relay settings.

b. Material:
   1) Covers: Oil, moisture, and wear resistant 9 inches by 11-1/2 inches size.
   2) Pages: 60 pound paper 8-1/2 inches by 11 inches size with minimum of 2 punched holes 8-1/2 inches apart reinforced with plastic, cloth, or metal.
   3) Fasteners: Metal screw post or Acco metal strap type.
   4) Diagrams and Illustrations: Attach foldouts, as required.
   5) Legible Original Quality: Reproduced by dry copy method.

3. Copies:
   a. Submit preliminary electronic copies of manuals (via FTP site or email) for review and approval no later than date of shipment of equipment. Installation shall not begin until manuals are accepted by Engineer. Include in preliminary copies all items required under “Contents” above. Three copies will be marked and returned to Contractor.
   b. Deliver 3 copies of finally approved manuals to Engineer before Engineer's inspections and tests.

PART 2 PRODUCTS
(Not Used)

PART 3 EXECUTION
(Not Used)

PART 4 MEASUREMENT AND PAYMENT

4.1 Providing for and complying with requirements in this Section will not be measured for payment, but cost will be considered incidental to Contract.

END OF SECTION
SPECIFICATIONS
SECTION 01600
MATERIAL DELIVERY STORAGE & HANDLING

PART 1 GENERAL

1.1 SUMMARY
A. Provide, transport, handle, store and protect material and equipment used on this project as specified herein.
B. Conform to applicable technical specifications, codes, and standards.

1.2 GENERAL REQUIREMENTS
A. Comply with size, make, type, and quality specified, or as approved.
B. Manufactured and fabricated products
   1. Design, fabricate and assemble in accordance with the best engineering and shop practices.
   2. Manufacture like parts to be interchangeable, with standard sizes and gauges.
   3. Two or more items of the same kind shall be identical and by the same manufacturer.
   4. Provide products which are suitable for the service conditions in which they are installed.
   5. Adhere to equipment capacities, sizes, and dimensions shown or specified unless variations are specifically approved by the Engineer.
   6. Do not use material or equipment for any purpose other than that for which it is designed or is specified.

1.3 APPROVAL OF MATERIALS
A. Incorporate only new materials and equipment into the Work.
   1. The Engineer shall inspect and approve all materials and equipment incorporated into the Work.
   2. Do not deliver material to the site or incorporate it into the Work without prior approval of the Engineer.
B. Provide the Engineer with a list of proposed materials and equipment to be used as described in Section 01330.
C. Provide all facilities and labor for handling and inspecting materials and equipment for the project.
D. Submit data sufficiently early to permit their review and approval.
1. Approval is required before the items are incorporated into the Work.

2. Failure to submit data in a timely manner shall not be an acceptable basis of claim for additional costs or time.

E. Use materials and equipment in the work that corresponds to approved samples or other data.

1.4 MANUFACTURER’S INSTALLATION INSTRUCTIONS

A. Provide manufacturer’s written installation instructions to all parties involved.

1. Submit in accordance with Section 01330.

1.5 TRANSPORTATION AND HANDLING

A. Arrange product deliveries in accordance with the approved delivery schedule. Coordinate to avoid conflict with work and conditions at the project site.

1. Deliver products in undamaged condition and in the manufacturer’s original containers or packaging with identifying labels intact and legible.

2. Inspect shipments immediately upon delivery.
   a. Ensure compliance with requirements of Contract Documents and approved submittals,
   b. Ensure that products are properly protected and undamaged.

B. Handle products and packaging using methods designed to prevent soiling or damage.

C. The successful Bidder (Contractor) shall ship all materials “FOB Destination” to the designated substation site as defined below, New Smyrna Beach, Florida area, freight prepaid and allowed.

D. The Contractor shall assume responsibility for safe arrival of the items and shall handle all claims, if damaged in transit.

E. The Contractor shall offload all items at the delivery sites. Ownership will only be transferred once the items are installed and accepted by Owner.

F. All equipment furnished which requires packaging shall be labeled with the following information:
   City P.O. Number
   Packager’s Job/Order Number
   Substation Name
   Item Number per Packager’s Bill of Material
   Content Description

G. With shipment the Contractor shall furnish any special tools required for assembly and installation, and shall furnish touch-up paint to match any painted surfaces. These items shall be packed separately and marked with descriptive information and the City P.O. number.
H. Packages of any supplemental parts or materials shall be shipped either on pallets or bundled in an acceptable manner for off-loading. Packing shall be such as to adequately protect the contents from any damage that might reasonably encountered during transportation and handling. Packing crates shall be sturdy enough to withstand up to one (1) year of outdoor storage without deterioration of crates or damage to the contents. Any packages that require indoor storage shall be clearly marked to that effect.

1.6 PROTECTION DURING STORAGE

A. Provide covered, weather-protected structures to store products and equipment. Examples of suitable enclosures include buildings or trailers which have a concrete or wooden floor, a roof, and fully closed walls on all sides.

1. Provide a clean, dry, non-corrosive environment for all electrical equipment, architectural items, instrumentation equipment, and special equipment.
   a. Protect mechanical and electrical equipment from contamination by dust, dirt, water, atmosphere moisture, chemicals, insects, animals, vandals, or other sources of damage.
   b. Store equipment in strict accordance with the manufacturer’s instructions and also in temperature and humidity controlled storage area.
      1) Include heating and moisture control when required. Maintain temperature and humidity within the ranges recommended in manufacturers’ instructions.
   c. Equipment designed and rated for outdoor installation may be stored outdoors subject to Owner’s approval.

2. Replace corroded, damaged, or deteriorated equipment and parts before project acceptance.

3. Do not include improperly stored equipment and materials in payment estimates.

4. Ensure that all seals and labels remain intact and legible during storage.

5. Store fabricated products above the ground or floor and on blocking or skids.
   a. Prevent soiling or staining.
   b. Cover products which are subject to deterioration with impervious sheet coverings.
   c. Provide adequate ventilation to avoid condensation.

6. Provide heated storage for materials subject to damage by freezing or low temperatures.

7. Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.
   a. Store cement, sand, and lime under roof and off the ground.
   b. Keep material completely dry at all times.

B. Handle and store all material and equipment in a manner to prevent warping, twisting, bending, breaking, cracking, chipping, spalling, rusting, staining, and any injury, theft, dampness, corrosion or damage of any kind whatsoever.
C. Remove all material which, in the sole opinion of Engineer, is damaged from the project site. The Contractor shall receive no compensation for either the damaged material or its removal.

D. Arrange stored items in a manner to provide easy access for inspection.
   1. Make periodic inspections of stored products
   2. Ensure that products are maintained under specified conditions, and free from damage or deterioration.

E. Protect installed products from damage due to traffic, fallen objects, incidental contact by equipment or other materials during placement, and any other subsequent construction operations. Include temporary electrical connections to motor and cabinet heaters if required by the manufacturer. Remove protection prior to testing.

F. Correct storage and handling issues that do not conform to these specifications within seven days after receiving written notice to do so.
   1. If the Contractor fails to act within the specified length of time, the Owner may correct all deficiencies identified in the written notice and deduct the costs associated with these corrections from Contractor’s payments.
   2. The Owner’s costs shall include labor, equipment usage, administration, clerical, engineering, and any other costs associated with making the necessary corrections.

1.7 EQUIPMENT DELIVERY, STORAGE, AND HANDLING ON SITE

A. Deliver equipment to the project site at the date and time agreed upon. Delivery dates shall be agreed upon by both the Contractor and the Owner in writing.

B. Handle all material and equipment in a manner to prevent warping, twisting, bending, breaking, cracking chipping, spalling, rusting, staining, and any injury, theft, dampness, corrosion or damage of any kind whatsoever.

C. Deliveries will be accepted only on normal business days between 8:00am and 3:00pm.

D. Deliveries shall be coordinated with the Owner to assure accessibility to site and availability of manpower and equipment.

E. Deliver materials with manufacturer's tags and labels and UL labels intact. Deliver packaged material in manufacturer's original, unopened containers bearing manufacturer's name, brand and UL Label. All materials delivered shall be packaged suitably for outdoor storage prior to being installed.

F. Contractor shall perform an independent inspection of all Owner furnished materials and equipment when they are turned over to his control by the Owner. Any damage shall be noted at this time, and the Owner shall be immediately informed in writing. Subsequent damage to Owner furnished items shall be the responsibility of the Contractor to repair or replace.

G. Contractor’s employees or subcontractors for shipping and off-load shall be trained and insured to operate heavy machinery within an energized substation.
H. The Contractor shall coordinate with Utilities Commission of New Smyrna Beach (UCNSB) for site access and for receipt and offloading of supplemental packages. Notice of at least 48 hours (not counting weekends and holidays) must be given prior to delivery to enable UCNSB to make necessary arrangements. Notice will be given to:

Tad Moon
Electrical Engineer
Utilities Commission of New Smyrna Beach
200 Canal Street
New Smyrna Beach, FL 32168
(386) 424-3029

PART 2 PRODUCTS
(Not Used)

PART 3 EXECUTION
(Not Used)

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
   2. Field engineering and surveying.

B. Project Record Documents: Submit a record of Work performed (materials tests, inspections, acceptance tests, etc.) and record data as required under provisions in Division 1 Sections "Submittal Procedures" and "Contract Closeout."

PART 2 PRODUCTS
(Not Used)

PART 3 EXECUTION

3.1 EXAMINATION

A. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information (RFI) to Owner. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

3.2 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
   1. Make vertical work plumb and make horizontal work level.
   2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Maintain conditions required for product performance until Substantial Completion.

D. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
   1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Owner.

E. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

F. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

G. Limiting Exposures: Supervise construction operations to ensure that no part of the construction completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.3 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction.
   1. Repairing includes replacing defective parts, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Preparing subgrades for slabs-on-grade, walks, pavements, lawns, and plantings.

2. Excavating and backfilling for buildings and structures.

3. Drainage course for slabs-on-grade.

1.2 DEFINITIONS

A. Backfill: Soil materials used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over utility in a trench, including haunches to support sides of utility.

2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Bedding Course: Layer placed over the excavated subgrade in a trench before placing utility.

C. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.

D. Drainage Course: Layer supporting slab-on-grade used to minimize capillary flow of pore water and serve as under slab subdrainage.

E. Excavation: Removal of material encountered above subgrade elevations.

1. Additional Excavation: Excavation below subgrade elevations as directed. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

2. Bulk Excavation: Excavations more than 10 feet in width and pits more than 30 feet in either length or width.

3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated dimensions without direction by Owner. Unauthorized excavation, as well as remedial work directed by Owner, shall be without additional compensation.

F. Fill: Soil materials used to raise existing grades.
G. Natural soil or existing fill soil: all naturally occurring soils or fill soils occurring above rock, or weathered rock materials that do not meet the definition of “rock” below.

H. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material 3/4 cu. yd. or more in volume confirmed visually by an independent geotechnical testing agency. Visual examination of rock requires removal of soil and weathered rock overburden.

I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

J. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

K. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.3 SUBMITTALS

A. Product Data: For the following:
   1. Each type of plastic warning tape.

B. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
   1. Laboratory compaction curve according to ASTM D 698 for each on-site or borrow soil material proposed for fill and backfill.
   2. Field reports; in-place soil density tests.
   3. One optimum moisture-maximum density curve for each type of soil encountered.
   4. Report of actual unconfined compressive strength and/or results of bearing tests of each strata tested.
   5. Test reports must be submitted to the Owner and Engineer

1.4 QUALITY ASSURANCE

A. Field Requirements
   1. The contractor shall furnish a guarantee that filled areas will not suffer from ponding or settlement in excess of the following limitations for a period of one year from the date of final acceptance.
a. Type I: (paved areas and areas within five feet of structures) 0.05 foot.

b. Type II: (unimproved areas) 0.50 foot, sloped to provide positive drainage.

c. Type III: (all other areas) 0.10 foot.

2. Fill material which settles in excess of the above limitations shall be removed and replaced with suitable material at no cost to the Owner. Structures, paving, landscaping and other site improvements damaged by settlement, shall be removed and replaced at no cost to the Owner.

3. Inspection and testing: Placing fill material and performing earthwork will be subject to continuous inspection. Contractor will make field density tests as necessary to provide the guarantee against ponding or settlement. Submit test reports the next work day after conducting tests to the engineer for review.

1.5 PROJECT CONDITIONS

A. Site Information: Contractor shall locate all underground utilities prior to digging.

PART 2 PRODUCTS

2.1 FILL MATERIAL

A. General Requirements

1. Fill material shall be free of organic or frozen material, waste metal products, unsightly debris, toxic material or other deleterious materials. In non-tidal wetlands and non-tidal wetlands buffers fill material from 6 inches over the pipe up to the surface shall consist of previously excavated material which can include organic matter.

2. All soil for fill shall be of a quality acceptable to the Engineer, and adhere to the July 2017 FDOT Section 902 of the Standard Specifications for Road and Bridge Construction.

a. The fill material shall be free from roots, rubbish or other extraneous material.

b. The fill material for areas outside the rock yard to be compacted shall be sand similar to materials classified in the A-3 group as shown in AASHTO M145.

c. The fill material for rocked areas shall be sand with less than 5% fines similar to materials classified in the A-3 group as shown in AASHTO M145 and Section 902 of the FDOT Specs.

d. Where fill is added, at least the top underlying twelve (12) inches of the rock yard site shall be compacted to 98% of maximum density as per ASTM D-1557. All fill areas outside the rock yard shall be compacted to 95% of the maximum density as per ASTM D-1557.
e. Borrow, where necessary, shall be provided from sources off the site in areas provided by the Contractor. The borrow pit shall be available for inspection by the Engineer. Geotechnical testing will be performed on the station yard fill before the fill will be accepted for the building structures or anything that would interfere with the Geotechnical Borings needed to verify the fill is acceptable.

3. Excavated materials meeting requirements stipulated herein shall be used, when approved by the engineer. Otherwise the contractor shall excavate, haul and place material from other approved sources.

   a. Fill material shall be at a moisture content which will permit compaction to the density specified.
   
   b. Soils material that is within the unified soil classification system, types OL, OH, CH and PT, ASTM D2488, shall not be used as fill material. Material classified as types CL and ML may be used if the liquid limit does not exceed 30 and the plasticity index does not exceed 6.
   
   c. Fill material in type I areas, under future paving and within five feet of a structure, and type III areas shall meet requirements of 2.a. Except from three feet over the top of the pipe up to the top twelve inches below the proposed pavement base course or finished grade no rocks larger than eight inches in their greatest dimension will be permitted and no rocks or gravel larger than three inches will be permitted in the top twelve inches.
   
   d. Prior notification of at least twenty four hours shall be given by the contractor as to the source and quantity of borrow material to be used. Acceptance of the material from any location shall not be construed as approval of entire location but only insofar as the material continues to meet the specification requirements.

B. Structural Fill, Embankment Fill and Other Fill Areas

1. Soils material for these fills shall meet requirements of ASTM D2488, material classification types GW, GP, GM, GC, SW, SP, SM and SC. Soil classification CL-ML may be used provided it has a liquid limit not exceeding 30 and plasticity index not exceeding 6. Soils material shall not contain stones larger than three inches in the greatest dimension

2. Gravel Backfill Below Subgrade

   a. Gravel backfill below subgrade, replacement for unsuitable material shall be ASTM C33, coarse aggregate, size number 4 or 3, or surge stone as specified in accordance with standard industry practice and as directed by the engineer. Gravel backfill below subgrade in non-tidal wetlands and non-tidal wetlands buffers shall be bank run gravel.

3. Gravel Base for On Grade Slabs (Porous Fill)
a. Gravel base for on grade slabs, where indicated, shall be ASTM C33, coarse aggregate, size number 4.

C. Placement

1. Embankments shall be constructed true to lines, grades and cross sections shown on the plans. Fill shall be placed in successive layers of not more than twelve (12) inches in thickness, loose measure. Each layer shall be compacted to a density of at least 95% of the maximum density as determined by AASHTO T99 except that the final 9 inches of stabilized fill shall be compacted to maximum density as per AASHTO T99. Elevations after final grading shall be within 0.1 foot above or below plan dimensions.

2. No fill material for the rock yard shall be placed until receipt of a Letter of Certification from an independent testing company stating that the fill material is in compliance with the A-3 group of AASHTO M145 containing less than 5% fines.

D. Sheet, Shoring and Bracing

1. Sheet, shoring and bracing materials shall be timber, steel or aluminum, or a combination thereof, designed as required, to retain the earth around structures, prevent cave in and settlements, and to fulfill all safety requirements.

   a. Timber shall be structural grade with minimum working stress of 1,100 psi.

   b. Steel sheet piling shall conform to requirements of ASTM A328, continuous interlocking type. Struts, bracing and all other accessories required for the sheet piling system shall meet requirements of ASTM A36.

E. Trench Erosion Check

1. Wood for trench erosion checks shall be pine treated with chromated copper arsenate in accordance with AWPA C2.

F. Dewatering Material

1. Material used for dewatering within non-tidal wetlands and non-tidal wetlands buffers in areas from bottom of pipe to bottom of trench shall be coarse aggregate meeting requirements of ASTM C33, size number 67 and size number 3 or number 4 for areas below subgrade. Dewatering material shall be limited to three linear feet for every twenty linear feet of trench.

2.2 ACCESSORIES

A. Drainage Fabric: Nonwoven geotextile, specifically manufactured as a drainage geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:

   1. Grab Tensile Strength: 110 lbf; ASTM D 4632.
2. Tear Strength: 40 lbf; ASTM D 4533.


5. Apparent Opening Size: No. 50; ASTM D 4751.

**PART 3 EXECUTION**

3.1 **PREPARATION**

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

C. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.2 **DEWATERING**

A. Should ground water be encountered, Contractor shall be responsible for utilizing a dewatering system(s) to remove water from the excavations. The Contractor will obtain any necessary FDEP Dewatering Permit for the project. Contractor shall ensure that permit is onsite and comply with all monitoring requirements with documentation listed in FDEP Dewatering Permit for the entire time dewatering occurs on this project site. Additionally, prior to any dewatering.

B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area. Requirements for dewatering should be coordinated with the qualified independent testing agency.

C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.3 **BLASTING**

A. Blasting shall not be performed.
3.4 EXCAVATION, GENERAL

A. Perform excavation of every type of material encountered within the limits of the work to the lines, grades and elevations indicated on the plans, and/or as required for foundation or other subsurface construction. Compact excavated area to 95% of maximum density per AASHTO T99 before filling operations are commenced.

B. Unclassified Excavation: Excavation to subgrade elevations regardless of the character of surface and subsurface conditions encountered, including rock, soil materials, and obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.5 EXCAVATION PRECAUTIONS

A. Depressions: Where depressions result from, or have resulted from, the removal of surface or subsurface obstructions, remove all debris and soft material as directed by the Field Representative.

B. Overexcavation: Backfill and compact all overexcavated areas as specified at no additional cost to the Owner.

C. Shoring: Shoring, sheeting and bracing shall be provided as may be required to properly accomplish the work.

D. Protection of In-Place Structures: Excavation likely to misalign, damage or impair the strength of structures already in place shall be made only after adequate protection has been provided. The Contractor shall repair any damage that occurs as a result of insufficient protection at no cost to the Owner. It is the responsibility of the Contractor to coordinate with the utility owners to adjust any utilities conflicting with the work under this contract at no additional cost to the Owner. It is the Contractor’s responsibility to locate all underground utilities prior to digging.

E. Underground Utilities: The Contractor shall determine the location of all underground utilities before proceeding with the work. Should any utilities be encountered that were not expected, work in the area shall be halted and the Engineer notified immediately.

F. Classification: All material shall be unclassified and considered as excavation regardless of the material encountered and no additional compensation will be allowed because of difficulties met in removing such materials.

G. Dewatering: Provide and maintain at all times during construction, ample means and devices with which to remove promptly and dispose of all water from every source entering the excavations or other parts of the work. The Contractor shall utilize quiet pumps and socks, with noise deflectors installed around the pumps, to comply with all allowable night time local noise ordinances. Dewater by means which will ensure dry excavations and the preservation of the final lines and grades of bottoms of excavations. If dewatering is performed by use of a sock system, Contractor shall completely grout fill the abandoned sock(s) upon completion of dewatering activities. Locations of all abandoned socks shall be indicated on Contractor submitted “as-built” drawings.

H. Muck Removal: Where muck or other soft material occurs, the Contractor shall excavate such material to suitable foundation soil or to a depth designated by the Engineer and backfill in
acccordance with Civil Site Work Technical Specifications, paragraph 1.7. The Contractor is responsible for removal of a maximum of one (2) foot of the muck. Where the Engineer directs the removal of such material to a depth in excess of one (2) foot, an adjustment in the contract price will be allowed.

3.6 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

   1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work. All overblasted or loose rock fragment materials shall be removed from the bottom of footing excavations. Over-excavations to remove loose rock materials below foundation subgrades shall be replaced by lean mixed concrete (2,000 psi at 28 days) up to design footing subgrades. Do not lower footing subgrades to meet excavation limits if over excavation or unauthorized excavation occurs.

B. Shafts for piers shall be either drilled or augured by the use of a combination of power driven rotary type rig and bits or augers of a size and type to excavate the required diameter and depth as specified on the drawings.

C. Removal of materials from the shaft shall be by the use of the auger or a drilling mud slurry recirculated from a sump through the hollow drill stem back up the open shaft and into the sump. Excavated material shall be disposed of in a manner subject to the approval of the Owner.

3.7 APPROVAL OF SUBGRADE

A. Notify Owner when excavations have reached required subgrade.

B. If approved testing agency determines that unsatisfactory soil or rock material is present, continue excavation and replace with lean mixed concrete (2,000 psi at 28 days).

   1. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

C. Proof roll subgrade with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated subgrades.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Geotechnical Engineer.

3.8 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by placing lean mixed concrete (2,000 psi at 28 days) without altering bottom of foundation subgrade. Lean concrete fill may be used when approved by the independent testing agency.
1. Fill unauthorized excavations under other construction or utility pipe as directed.

3.9 STORAGE OF SOIL MATERIALS

A. Stockpile borrowed materials and satisfactory excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.10 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, damp proofing, waterproofing, and perimeter insulation.

2. Surveying locations of underground utilities for record documents.

3. Removing concrete formwork.

4. Removing trash and debris.

5. Removing temporary shoring and bracing, and sheeting.

6. Installing permanent or temporary horizontal bracing on horizontally supported walls.

3.11 FILL

A. Preparation: Remove vegetation, topsoil, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface before placing fills.

B. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

C. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.

2. Under walks and pavements, use satisfactory soil material.

3. Under steps and ramps, use structural backfill.

4. Under slabs, use drainage fills.

5. Under footings and foundations, use structural backfill.
3.12 TESTING FOR SOILS

A. The Contractor shall employ an approved independent laboratory to do all testing. Two copies of test reports shall be submitted to the Engineer.

B. Soil Properties: The Contractor shall submit an analysis of borrow material proposed for site fill including the following tests: Particle Size Analysis of Soils (per AASHTO T88) and Permeability of Granular Soils - Constant Head (per AASHTO T215).

1. Three (3) additional Particle Size and Permeability tests shall be performed on truck loads of fill material randomly selected by the Field Representative. If any of the truck loads tested does not comply with the A-3 group of AASHTO M145 containing less than 5% fines, the material shall be rejected, and the Contractor shall perform six (6) additional sets of tests on material in place. Any material in place that does not comply with the A-3 group of AASHTO M145 containing less than 5% fines shall be removed and replaced with acceptable material at no additional cost to the Owner. The Contractor shall pay for all of the above testing.

C. Compaction: In-place density tests shall be made in accordance with AASHTO T191-61, ASTM D1556-74, ASTM D2167-77, or ASTM D2922-78 at the following locations:

1. Ten (10) tests per layer of site fill at locations determined by the Field Representative for site compaction.

2. One (1) test under each of ten (10) foundations as selected by the Field Representative. Compaction tests shall be made no sooner than one day before the placing of a succeeding layer of fill or the pouring of a foundation, as the case may be. The intent of the time stipulation is to minimize the loss of compaction due to moisture loss after the compaction test has been made.

D. Utilities Commission of New Smyrna Beach (UCNSB) Provided Soils Tests

1. UCNSB has obtained a representative number of core borings; the boring logs are included in Appendix “A”. Investigations conducted by the UCNSB of subsurface conditions are for the purpose of study and design only. The UCNSB does not assume any responsibility with respect to the sufficiency or accuracy of the borings, or of the interpretations made thereof. There is no warranty or guarantee, either expressed or implied, that the conditions indicated by such investigations are representative of those existing throughout the site, or any part thereof, or that unforeseen developments may not occur. After the contract has been awarded, the Contractor shall make an inspection of the site to determine the conditions under which the work is to be performed and may obtain additional core borings, if deemed necessary.

3.13 MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.
1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

2. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified density.

3.14 COMPACTION OF BACKFILLS AND FILLS

A. Place backfill and fill materials in layers not more than 6 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil to not less than the following percentages of maximum dry density according to ASTM D 698:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill material at 95 percent.

2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material at 95 percent.

3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material at 85 percent.

3.15 GRADING

A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.

2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding.

3.16 DRAINAGE COURSE

A. Under slabs-on-grade, install drainage fabric on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends. Place drainage course on drainage fabric and as follows:

B. Under slabs-on-grade, place drainage course on prepared subgrade and as follows:
1. When compacted thickness of drainage course is 6 inches or less, place materials in a single layer.

2. When compacted thickness of drainage course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

3.17 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by the testing agency; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Drilled piers.

B. Related Sections include the following:
   1. Section 03300 "Cast-in-Place Concrete" for general structural and building applications of concrete.

1.3 UNIT PRICES

A. Basis of Bids: Base bids on indicated number of drilled piers; design length from top elevation to bottom of shaft, extended through the bell, if applicable; and diameter of shaft and bell.

B. Basis for Payment: Payment for drilled piers will be made on actual net volume of drilled piers in place and approved.
   1. Unit prices include labor, materials, tools, equipment, and incidentals required for excavation, trimming, shoring, casings, dewatering, reinforcement, concrete fill, and other items for complete drilled-pier installation.
   2. Provide unit prices for special excavation and obstruction removal as established in Part 3 of this Section.

1.4 SUBMITTALS

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

B. Shop Drawings: For concrete reinforcement detailing fabricating, bending, and placing.

C. Design Mixes: For each class of concrete. Include revised mix proportions when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
1. Laboratory Test Reports: For evaluation of concrete materials and mix design.
2. General mix design requirements are specified in Section 03300 “Cast-in-Place Concrete.”

D. Welding certificates.

E. Qualification Data: For Installer.

F. Project Record Documents:
   1. Provide written reports which outline amount and nature of work accomplished each day.
   2. Include driven pier location, diameter, length, elevation of bottom and top of driven pier, quantity of grout material actually pumped for each 5-foot pile increment and corresponding grout factor, documentation of reinforcing steel installation, and explanation of anything unusual related to pile installation or operation of equipment.
   3. Submit written reports to Job Superintendent daily.
   4. Submit formal weekly reports to Engineer weekly.
   5. Submit final cumulative report to Engineer within 30 days of completion of installation.

1.5 QUALITY ASSURANCE

A. Applicable Standards: Comply with provisions in ACI 336.1, "Specification for the Construction of Drilled Piers," unless modified in this Section or on Drawings.

B. Survey Work: The Contractor SHALL engage the services of a State of Florida Registered Land Surveyor, to perform surveys, layouts, and measurements for drilled piers. Before excavating, lay out each drilled pier to lines and levels required. Record actual measurements of each drilled pier's location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.

   1. Record and maintain information pertinent to each drilled pier and cooperate with testing and inspecting agency to provide data for required reports.

C. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 to perform material evaluation tests and to design concrete mixes, as documented according to ASTM E 548.

D. Welding Standards: Qualify procedures and personnel according to the following:

   1. AWS D1.1, "Structural Welding Code--Steel."

E. Preinstallation Conference: Conduct conference at Project site

1.6 PROJECT CONDITIONS

A. Existing Utilities: Locate existing underground utilities before excavating drilled piers. If utilities are to remain in place, provide protection from damage during drilled-pier operations.

   1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, adapt drilling procedure if necessary to prevent damage to utilities.
Cooperate with Owner and utility companies in keeping services and facilities in operation without interruption. Repair damaged utilities to satisfaction of utility owner.

B. Site Information: A geotechnical report has been prepared for this Project and is referenced elsewhere in the Project Manual for information only.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

A. See Section 03300: Cast-in-Place Concrete.

2.2 CONCRETE MATERIALS

A. See Section 03300: Cast-in-Place Concrete.

2.3 CONCRETE MIX

A. Prepare design mixes according to ACI 211.1 and ACI 301 for each type and strength of concrete determined by either laboratory trial mix or field test data bases.

1. Use a qualified testing agency for preparing and reporting proposed mix designs for laboratory trial mix basis.

B. Proportion mixes according to ACI 211.1 and ACI 301 to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): As indicated on drawings.

2. Minimum Slump: Capable of maintaining the slump as specified in ACI 336.1 until completion of placement.

3. Do not air entrain concrete for drilled piers.

C. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 limits as if concrete were exposed to deicing chemicals.

D. Limit water-soluble, chloride-ion content in hardened concrete to [0.30] percent by weight of cement.

E. Concrete-mix design adjustments may be considered if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant. Resubmit and obtain approval of proposed changes to concrete-mix proportions.
2.4 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
   1. Do not add water to concrete mix after mixing.
   2. Maintain concrete temperature to not exceed 90 deg F (32 deg C).

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by drilled-pier operations.

3.2 EXCAVATION

A. Unclassified Excavation: Excavation is unclassified and includes excavation to bearing elevations regardless of character of materials or obstructions encountered.
   1. Obstructions: Unclassified excavation includes removal of unanticipated boulders, concrete, masonry, or other subsurface obstructions.

B. Prevent surface water from entering excavated shafts. Conduct water to site drainage facilities.

C. Excavate shafts for drilled piers to indicated elevations. Remove loose material from bottom of excavation.
   1. Excavate bottom of drilled piers to level plane within 1:12 tolerance.
   2. Remove water from excavated shafts before concreting.

D. Notify testing and inspecting agency to test and inspect bottom of excavation. If unsuitable bearing stratum is encountered, make adjustments to drilled piers as determined by Engineer.
   1. Do not excavate shafts deeper than elevations indicated, unless approved by Engineer.
   2. Additional authorized excavation will be paid according to Contract provisions for changes in the Work.

E. Excavate shafts for closely spaced drilled piers and those occurring in fragile or sand strata, only after adjacent drilled piers are filled with concrete and allowed to set.

F. Temporary Casings: Install watertight steel casings of sufficient length and thickness to prevent water seepage into shaft; to withstand compressive, displacement, and withdrawal stresses; and to maintain stability of shaft walls.
   1. Remove temporary casings, maintained in plumb position, during concrete placement and before initial set of concrete.

G. Tolerances: Construct drilled piers to remain within ACI 336.1 tolerances.
1. If location or out-of-plumb tolerances are exceeded, provide corrective construction. Submit design and construction proposals to Engineer for review before proceeding.

H. Inspection: Each drilled pier must be inspected and tested before placing concrete.

1. Provide and maintain facilities with equipment required for testing and inspecting excavations. Cooperate with testing and inspecting personnel to expedite the Work.
2. Notify Engineer and testing agency at least six hours before excavations are ready for tests and inspections.

3.3 STEEL REINFORCEMENT

A. Comply with recommendations in CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy bond with concrete.

C. Fabricate and install reinforcing cages symmetrically about axis of shafts in a single unit.

D. Accurately position, support, and secure reinforcement against displacement during concreting. Maintain minimum cover to reinforcement.

E. Use templates to set anchor bolts, leveling plates, and other accessories furnished in work of other Sections. Provide blocking and holding devices to maintain required position during final concrete placement.

F. Protect exposed ends of extended reinforcement, dowels, or anchor bolts from mechanical damage and exposure to weather.

3.4 CONCRETE PLACEMENT

A. Place concrete in continuous operation and without segregation immediately after inspection and approval of shaft by Owner's independent testing and inspecting agency.

B. Means and methods of concrete placement shall be determined by the contractor after review of site, soil, and groundwater conditions and shall be in accordance with ACI 336.1.

1. Provide mechanical vibration for top 60 inches (1500 mm) of concrete.

C. Coordinate withdrawal of temporary casings with concrete placement to maintain at least a 60-inch (1500-mm) head of concrete above bottom of casing.

1. Vibrate top 60 inches (1500 mm) of concrete after withdrawal of temporary casing.

D. When hot-weather conditions exist that would seriously impair quality and strength of concrete, place concrete according to ACI 301 to maintain delivered temperature of concrete at no greater than 90 deg F (32 deg C).
1. Place concrete immediately on delivery. Keep exposed concrete surfaces and formed shaft extensions moist by fog sprays, wet burlap, or other effective means for a minimum of seven days.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit reports during excavation and concrete placement for drilled piers.

B. A drilled-pier report will be prepared by testing and inspecting agency for each drilled pier as follows:

1. Actual top and bottom elevations.
2. Description of soil materials.
3. Description, location, and dimensions of obstructions.
4. Final top centerline location and deviations from requirements.
5. Variation of shaft from plumb.
7. Design and tested bearing capacity of bottom.
8. Depth of rock socket.
9. Levelness of bottom and adequacy of cleanout.
10. Ground-water conditions and water-infiltration rate, depth, and pumping.
11. Description, diameter, and top and bottom elevations of temporary casings.
12. Description of soil or water movement, sidewall stability, loss of ground, and means of control.
13. Date and time of starting and completing excavation.
15. Position of reinforcing steel.
16. Concrete placing method, including elevation of consolidation and delays.
18. Remarks, unusual conditions encountered, and deviations from requirements.
19. Concrete testing results.

C. Concrete: Sampling and testing of concrete for quality control may include the following:

1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94/C 94M.
   a. Slump: ASTM C 143/C 143M; one test at point of placement for each compressive-strength test, but no fewer than one test for each concrete load.
   b. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each set of compressive-strength specimens.
   c. Compression Test Specimens: ASTM C 31/C 31M; one set of four standard cylinders for each compressive-strength test, unless otherwise indicated. Mold and store cylinders for laboratory-cured test specimens, unless field-cured test specimens are required.
d. Compressive-Strength Tests: ASTM C 39; one set per 50 cubic yards. One specimen will be tested at 7 days, 2 specimens will be tested at 28 days, and one specimen will be retained in reserve for later testing if required.

2. When frequency of testing will provide fewer than five strength tests for a given class of concrete, testing will be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

3. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing in-place concrete.

4. Strength level of concrete will be considered satisfactory if averages of sets of 3 consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi (3.45 MPa).

5. Test results will be reported in writing to Engineer, concrete manufacturer, and Contractor within 24 hours of testing. Reports of compressive-strength tests will contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, concrete type and class, location of concrete batch in drilled pier, design compressive strength at 28 days, concrete-mix proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

6. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as sole basis for acceptance or rejection.

7. Additional Tests: Testing and inspecting agency will make additional tests of concrete when test results indicate concrete strengths or other requirements have not been met.

   a. Continuous coring of drilled piers may be required, at Contractor's expense, when temporary casings have not been withdrawn within specified time limits or where observations of placement operations indicate deficient concrete quality, presence of voids, segregation, or other possible defects.

3.6 DISPOSAL OF MATERIALS

   A. Remove surplus excavated material and slurry and legally dispose of it off Owner's property.

END OF SECTION
PART 1  GENERAL

1.1  SUMMARY

A. Provide chain link fencing, gates and accessories as specified and as shown on the Contract Documents.

1.2  QUALITY ASSURANCE

A. Provide components that are the standard product of a manufacturer regularly engaged in the production of the required materials and equipment.

1.  A single manufacturer shall provide all fencing, gates and appurtenances.

2.  The manufacturer shall be responsible for the design, construction and proper operation of all components.

B. Comply with referenced standards as applicable.

1.3  REFERENCES

A. ASTM A121 Specification for Metallic-Coated Carbon Steel Barbed Wire

B. ASTM A392 Specification for Zinc-Coated Steel Chain-Link Fence Fabric

C. ASTM A491 Specification for Aluminum-Coated Steel Chain-Link Fabric

D. ASTM A780 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

E. ASTM A817 Specification for Metallic-Coated Steel Wire for Chain Link Fence Fabric and Marcellled Tension Wire

F. F. ASTM A824 Specification for Metallic-Coated Steel Marcellled Tension Wire for Use With Chain Link

G. ASTM F552 Standard Terminology Relating to Chain Link Fencing

H. ASTM F567 Standard Practice for Installation of Chain Link Fence

I. ASTM F626 Specification for Fence Fittings

J. ASTM F668 Specification for Polymer Coated Chain Link Fence Fabric
K. ASTM F900 Specification for Industrial and Commercial Swing Gates

L. ASTM F934 Specification for Standard Colors for Polymer-Coated Chain Link

M. ASTM F1043 Specification for Strength and Protective Coatings of Steel Industrial Chain Link Fence Framework

N. ASTM F1083 Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures

O. ASTM F1184 Specification for Industrial and Commercial Horizontal Slide Gates

P. ASTM F1345 Specification for Zinc-5% Aluminum-Mischmetal Alloy-Coated Steel Chain-Link Fence Fabric

Q. ASTM F1664 Specification for Poly (Vinyl Chloride) (PVC) and Other Conforming Organic Polymer-Coated Steel Tension Wire Used with Chain-Link Fence

R. ASTM F1665 Specification for Poly (Vinyl Chloride) (PVC) and Other Conforming Organic Polymer-Coated Steel Barbed Wire Used with Chain-Link Fence

S. ASTM F1910 Specification for Long Barbed Tape Obstacles

T. ASTM F1911 Standard Practice for Installation of Barbed Tape

U. ASTM F2200 Specification for Automated Vehicular Gate Construction

V. ASTM F3000 / F3000M Standard Specification for Polymer Privacy Insert Slats for Chain Link Fabric and Privacy Chain Link Fabric Manufactured Containing Pre-Installed Privacy Slats

W. UL325 Automatic operators: Door, Drapery, Gate, Louver and Window

1.4 SUBMITTALS

A. Comply with Section 01330. Include the following information:

1. Shop Drawings showing:
   a. Site plan showing layout of fence location with dimensions, location of gates and opening size, cleared area, elevation of fence, gates, footings and details of attachments.
   b. Cross sectional dimensions of posts, braces, rails, fittings, accessories, and gate frames, design of gates and details of gate hardware.
   c. Spacing of posts and location of gates, abrupt changes in grade, and corner, gate, anchor, end, and pull posts.

2. Manufacturer’s catalog information that describes each fencing system component provided. Include
a. Specifications, manufacturer’s information and cut sheets.

b. A complete bill of materials that identifies all materials of construction.

3. Manufacturer’s installation instructions.

1.5 QUALITY ASSURANCE

A. Manufacturer: Company headquartered in the United States having U.S. manufacturing facility/facilities specializing in manufacturing chain link fence products with at least 5 years experience.

B. Fence contractor: Company with demonstrated successful experience installing similar projects and products in accordance with ASTM F567 and have at least 5 years experience.


1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver, handle, and store the equipment in accordance with Section 01600.

B. Deliver materials to the project site undamaged.

1. Attach tags to every roll of fabric.

2. Indicate mesh size, coating weight and wire gauge.

C. Store off the ground to protect against oxidation caused by ground contact.

PART 2 PRODUCTS

2.1 MATERIALS

A. Conform to applicable parts of FS RR-F-191 K/GEN as modified herein.

B. Use Type I zinc coated steel, with weight of zinc coating not less than 1.2 oz. per square foot.

C. Fabric: Fabricated from minimum 9-gage, 0.148 inch diameter wire, helically wound and interwoven to provide continuous 2-inch nominal mesh without knots or ties except selvages.

1. Attach tags to every roll, indicating mesh size and wire gage.

2. Height: See Drawings.

3. Selvage: Twisted and barbed at top and bottom except top selvage may be knuckled when top rail is provided.
4. Individual Fabric Ties: Same material as fabric for attaching fabric to line posts and top and bottom tension wires or rails.

5. Gate Fabric: Same material as fabric for fencing.

D. Posts and Accessories.

1. Posts: Tubular with appropriate caps driven to fit over outside section to exclude moisture.

2. Top Rails, Braces, Tie Rods, Stretcher Bars, and Accessories: Shape, dimensions, and weights following Contract Documents.

3. All corner, pull and line posts shall have barbed wire support arms at 45 degree angles oriented towards the outside of the fence. Arms shall be provided to support three runs of barbed wire, evenly spaced to a vertical height of 1'-0".

4. All posts without barbed wire extension arms shall be capped with galvanized malleable iron, outside fit, dome shaped post tops.

E. Swing Gates

1. Swing Gates: Galvanized steel pipe welded fabrication in compliance with ASTM F900. Gate frame members 1.900 in. OD (48.3 mm) ASTM F 1083 schedule 40 galvanized steel. Frame members spaced no greater than 8 ft. (2440 mm) apart vertically and horizontally. Welded joints protected by applying zinc-rich paint in accordance with ASTM Practice A780. Positive locking gate latch, pressed steel galvanized after fabrication. Galvanized malleable iron or heavy gauge pressed steel post and frame hinges. Provide lockable drop bar and gate holdbacks with double gates. Match gate fabric to that of the fence system. Gateposts per ASTM F1083 schedule 40 galvanized steel pipe. Gatepost diameter as shown on the drawings. Electrically operated gates must comply with ASTM F2200 and UL325.

2. Frames: Round tubular members made of 1.625” Nominal OD (1-1/4” NPS) steel pipe. Top and bottom framing shall be welded between two vertical pipes.

3. Bracing: Round tubular members made of 1.375” Nominal OD (1” NPS) steel pipe.

4. One vertical brace is required every 8’.

5. One horizontal brace is required between each vertical brace and frame member.

6. Barbed Wire: Extend top of gate frame members at least 1 foot above top horizontal member and attach 3 strands of barbed wire, uniformly spaced, by means of bands, clips, or hook bolts.

7. Fabric: Shop-attach gate fabric to gate frame at intervals of not more than 15 inches.
8. Accessories: Fittings and accessories, including locking and padlocking device required making complete installation.

9. Hinges:
   a. 180° offset type, with a bolt and self-locking nut (or approved equivalent means) to prohibit removal. Arrange so closed gate cannot be lifted off its hinges.
   b. Sufficient size and number to prevent twist or turn under action of gate.
   c. The maximum permissible gap between the gate post and frame is 1-3/4” when the gate is closed.

10. Opening: Full with minimum 180 degree swing.

11. Gates shall be inward swinging from closed to 180 degrees unless otherwise noted on the contract drawings. Gates shall be physically prevented from swinging outward.

12. Swing gates with an overall width greater than 24’ shall include wheels for support on each swinging edge.

13. Gate Keeper: A galvanized iron or cast aluminum gate keeper shall be provided to hold gate at maximum open position. Anchor pipe shall be approximately 2” Nominal OD and set in concrete to a minimum depth of 1’-6”. Double gates shall be provided with two gate keepers.

F. Type I, Zinc Coated Steel Fencing.

1. Fabric: FS RR-F-191/1D, Type I, with minimum zinc coating of 1.2 ounces per square foot.
   a. Color: Match existing unless otherwise indicated.

2. Posts, Top Rail, and Braces: FS RR-F-191/3D with zinc coating of 2.0 ounces per square foot.
   a. End, corner and pull post:
      (1) 4.5” Nominal OD (4” NPS) hot-dip galvanized schedule 40 steel pipe with a minimum of 2.0 ounces of zinc per square foot.
   b. Line and intermediate posts:
      (1) 2.375” Nominal OD (2-1/2” NPS) hot-dip galvanized schedule 40 steel pipe with a minimum of 2.0 ounces of zinc per square foot.
   c. Gate posts:
(1) Double gates with total opening of 12 feet and under (individual panels 6 feet and under): 4.5” Nominal OD (4” NPS) hot-dip galvanized schedule 40 steel pipe with a minimum of 2.0 ounces of zinc per square foot.

(2) Double gates with total opening between 12 feet and 20 feet (individual panels between 6 feet and 10 feet): 4.5” Nominal OD (4” NPS) hot-dip galvanized schedule 40 steel pipe with a minimum of 2.0 ounces of zinc per square foot.

d. Top Rail:

(1) A top rail consisting of 1.625” Nominal O.D. (1-1/4” NPS) schedule 40 galvanized steel pipe with 2.0 ounces of zinc per square foot shall be installed at the top of the fence fabric.

(2) Provide top rail couplings every 20’-0”.

e. Tension Wire:

(1) A tension wire consisting of No.7 AWG, extra galvanized, high carbon, coiled steel shall be installed at the bottom of the fence fabric.

(2) Tension wire shall be continuous between fabric terminations.

3. Accessories: FS RR-F-191/4D with galvanized zinc coating

4. Gates:

a. FS RR-F-191/2D with fabric same as used for fence.

b. Dimensions: Same as required for Type I fencing.

c. Gates frames shall be hot-dip galvanized after fabrication with a minimum of 2.0 ounces of zinc per square foot.

5. Barbed Wire: ASTM F1665-01, using 12-1/2 gauge wire with 4-point 14 gauge barbs, round, spaced at maximum of 4 inches on center and zinc coating of 0.8 ounces per square foot.

G. Padlocks: Provided by Owner.

H. Touch-Up Paint: Zinc-rich paint. See ASTM A780

I. Concrete

1. Comply with Section 03300

2. Use 3,000 psi concrete.
J. Grout

1. Mix regular grout using one part cement to three parts concrete sand.

2. Add minimum amount of water to produce a workable mix.

PART 3 EXECUTION

3.1 INSTALLATION

A. Perform the necessary clearing, excavation, backfilling and grading to provide clear line-of-fence runs.

B. Encasement.

1. Post:

   a. Extend concrete at least 4 inches below bottom of posts.

   b. Extend concrete to 1 inch above ground line at posts and slope to drain away from posts.

   c. Encase minimum 10 inch diameter for line posts and 12 inch diameter for end, corner, pull, and gate posts.

2. Fence Encasement:

   a. 5 feet and less in height: Minimum of 2.5 feet deep.

   b. Over 5 feet in height: Minimum of 3.0 feet deep.

3. Gate Post Encasement:

   a. For gates with swing of 6 feet and less: Minimum of 3.0 feet deep.

   b. For gates with swing over 6 feet: Minimum of 3.0 feet deep and at least 16 inch diameter.

C. Post Placement.

1. Evenly space posts at not more than 10 feet or less than 8 feet on centers. Place additional posts at each change in line and abrupt change in grade.

2. Posts on rock: Drill holes 2 inches deeper than depth shown or specified.

   a. Drill holes 2 inches greater all around than outside diameter of post or square section.

   b. Fill rock portion of hole with grout.
3. Posts on Concrete Structure: Cast section of steel pipe at least 12 inches long in concrete at correct location for fence posts.
   a. Steel pipe sleeve: Inside diameter not more than 3/8 inch larger all around than post to be inserted.
   b. Grout fence posts into steel pipe with non-shrink grout.
4. Set corner or pull posts at each horizontal or vertical angle point of 15 or more degrees and at no more than 75-foot intervals.
5. Set corner, end, and pull posts with horizontal or diagonal brace rail and tie rod to nearest line post.

D. Rails, Tension Wire, and Braces.
   1. After posts are installed and concrete has set firmly, place top rail or tension wire, and bottom tension wire approximately 4 inches above grade.
      a. Anchor and brace end, corner, and pull posts before hanging fabric.
      b. Brace gate posts for fabric 6 feet or more in height.

E. Fabric Placement.
   2. Splice fabric lengths together by reweaving without breaking continuity of knuckled or twisted and barbed selvage.
   3. Place fabric by securing 1 end and applying sufficient tension by means of mechanical fence stretchers to remove slack before making attachments.
   4. Fasten fabric with appropriate tie wires to top rails and bottom tension wire at 18 inches on center maximum, and to posts at 12 inches on center maximum.
   5. Hold bottom of fabric uniformly as possible to not more than 2 inches above finished grade.

F. Barbed Wire: Where indicated, provide 3 strands of barbed wire above fence fabric.
   1. Stretch strands to remove sag and anchor firmly to extension arms.
   2. Incline extension arms on line posts pointing away from the substation property at approximately 45 degree angle.

G. Gates:
   1. Install fence gates, gate stops, and fan guards as shown.
2. Locate gate stops set in concrete accurately so that gate stop or latch can be fully engaged.

   1. Drive post into ground and hold rigidly in position by means of 2 steel angle anchors driven diagonally and attached to post on opposite sides.

3.2 DEFECTIVE WORK

A. Remove and replace fencing improperly located, not true to line and grade, and not plumb posts.

B. Repair damaged polyvinyl chloride by following fence manufacturer's recommendations.

3.3 EXISTING CHAIN LINK FENCE

A. When required to remove chain link fence to permit construction, remove and store fence to prevent damage.
   1. Restore fence to original location following applicable requirements herein or relocate as shown.
   2. Repair damaged chain link fence or when directed, replace with applicable in-kind material following requirements specified herein.

B. When connecting to existing chain link fence, connect as shown on Drawings, or as directed, following requirements specified herein.

3.4 TEMPORARY CHAIN LINK FENCE

A. Provide temporary chain link fence and gates where required for protection of work.
PART 1     GENERAL

1.1     SUMMARY

A.     Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

B.     Related Sections:

1.     Section 02300 "Earthwork" for drainage fill under slabs-on-grade.

1.2     REFERENCES

A.     American Society for Testing and Materials (ASTM)

1.     A36/A36M Carbon Structural Steel

2.     A82/A82M Steel Wire, Plain, for Concrete Reinforcement

3.     A153/A153M Zinc Coating (Hot-Dip) on Iron and Steel Hardware

4.     A307    Carbon Steel Bolts, Studs, and Threaded Rod

5.     A615/A615M    Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

6.     A1064/A1064M Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

7.     C31/C31M Making and Curing Concrete Test Specimens in the Field

8.     C33/C33M Concrete Aggregates


10.    C94/C94M Ready-Mixed Concrete


12.    C143/C143M Test Method for Slump of Hydraulic-Cement Concrete

13.    C150/C150M Portland Cement

14.    C231/C231M Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
15. C260/C260M Air-Entraining Admixtures for Concrete
16. C494/C494M Chemical Admixtures for Concrete
17. C579 Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
18. C595/C595M Blended Hydraulic Cements
19. C618 Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
20. C827/C827M Test Methods for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures
21. D1752 Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
22. F1554 Anchor Bolts, Steel

B. American Concrete Institute (ACI)
   1. 117 Tolerances for Concrete Construction and Materials
   2. 301 Specifications for Structural Concrete
   3. 304R Guide for Measuring, Mixing, Transporting and Placing Concrete
   4. 305R Guide to Hot Weather Concreting
   5. 306R Guide to Cold Weather Concreting
   6. 318 Building Code Requirements for Structural Concrete
   7. 347R Guide to Formwork for Concrete
   8. SP-66 ACI Detailing Manual

C. Florida Department of Transportation (FDOT) Standard Specifications for Road and Bridge Construction
   1. Section 901 Coarse Aggregate
   2. Section 902 Fine Aggregate

D. American Plywood Association (APA)
   1. PS1 Structural Plywood

E. American Lumber Standards Committee (ALSC)
1. PS20 American Softwood Lumber Standard

F. US Army Corps of Engineers (COE)
   1. CRD-C 621 Spec for Non-Shrink Grout

1.3 SUBMITTALS

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

B. Design Mixtures: For each concrete mixture submit copies of proposed concrete design mixes for each class of concrete, at the appropriate slump, expected to be used in the job. The Contractor shall submit complete reports of concrete materials and mix proportions of the design mixes to the Owner for approval at least 14 days before any concrete is required on the project. Results of concrete cylinder tests for unproven design mixes shall be submitted to the Owner with the proposed mixes. Approval of such mixes tests will be only a check to assist the Contractor in his compliance with specification requirements and will be contingent upon acceptance of final tests for the concrete used in the project.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement.

D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.

E. Material certificates.

F. Material test reports.

G. Floor surface flatness and levelness measurements.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
   1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. Survey Work: The Contractor SHALL engage the services of a State of Florida Registered Land Surveyor, to perform surveys, layouts, and measurements for all concrete foundations. Before excavating, lay out each foundation to lines and levels required. Record actual measurements of each foundation’s location, major dimensions, bottom and top elevations, deviations from specified tolerances, and other specified data.
   1. Record and maintain information pertinent to each foundation and cooperate with testing and inspecting agency to provide data for required reports.
C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."

E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
   1. ACI 301, "Specifications for Structural Concrete"
   2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials"

F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

G. Preinstallation Conference: Conduct conference at project site.

PART 2  PRODUCTS

2.1 FORM-FACING MATERIALS
   A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

2.2 STEEL REINFORCEMENT
   A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
   B. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
   C. Wire: Plain cold-drawn wire, ASTM A82/A82M, deformed steel wire.
   E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice.
   F. Anchor Rods: Anchor rods shall conform to ASTM F1554 and be furnished in the grade and length as shown in the Anchor Rod Schedule on the Foundation Detail Drawings. Anchor rods shall be Hot Dipped galvanized full length.

2.3 CONCRETE MATERIALS
   A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
   
   a. Fly Ash: ASTM C 618, Class F
   
   b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C 33, graded.


C. Fine Aggregate:

1. Free of materials with deleterious reactivity to alkali in cement. Sand or rock screenings conforming to Section 902 of the FDOT Standard Specifications for Road and Bridge Construction.

D. Water: ASTM C 94 and potable

2.4 ADMIXTURES


B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

2.5 FIBER REINFORCEMENT

A. Synthetic Micro-Fiber: fibrillated polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116, Type III, 1/2 to 1-1/2 inches long.

2.6 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

C. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

2.7 BONDING AGENT

A. The material shall be a two-component epoxy-polysulphide resin system, with strong adhesion to both wet and dry concrete either the hardened or the plastic state markings.
2.8 GROUT

A. Cementitious Grout: Grout shall be cement-based, nonmetallic, non-shrink type specially formulated for hot weather, high sulfate and salt water resistance. Plastic form shall have 0% shrinkage in accordance with ASTM C827/C827M and 0% shrinkage and expansion in the hardened form in accordance with CRD-C621. Grout shall have a compressive strength of 5,000 psi at 7 days in accordance with ASTM C109/C109M. Grout shall be Five Star Special Grout 550 or equal.

B. Epoxy Grout: Grout shall be non-shrink type, 100% solids, three-component system consisting of resin, hardener and aggregate. Grout shall have 0% shrinkage in the plastic form and 0% expansion in the hardened form in accordance with ASTM C827/C827M. Compressive strength shall be 5,000 psi in 24 hours and 12,000 psi in 7 days, in accordance with ASTM C579, Method B. Grout shall be Five Star Epoxy Grout or equal.

2.9 RELATED MATERIALS


2.10 CONCRETE MIXTURES

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.

C. Admixtures: Use admixtures according to manufacturer's written instructions.

D. Proportion normal-weight concrete mixture as follows:

E. Coordinate compressive strength with water-cementitious materials ratio if concrete will be subject to special exposure conditions or sulfate exposure as identified in ACI 318 (ACI 318M).

1. Design Strength, 5,000 PSI Concrete: Use for pre-stressed concrete and where indicated on the drawings or specified herein.

2. Design Strength 4,000 PSI Concrete: Use unless otherwise indicated on the drawings, for all structures, buildings, manhole concrete, concrete driveways, and paving.

3. Design Strength 3,000 PSI Concrete: Unless otherwise noted indicated on drawings, may be used for concrete foundations, sidewalks, curbs and gutters, splash blocks, pipe encasements, pipe supports, electrical conduit ducts, and where indicated on the drawings.

4. Design Strength 2,500 PSI Concrete: May be used only for thrust blocks and anchors, fill concrete and where indicated on the drawings.
5. Maximum Water-Cementitious Materials Ratio: 0.45

6. Slump Limit: 4 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.

7. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.

8. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

9. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.5 lb/cu. yd.

2.11 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.12 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Chamfer exterior corners and edges of permanently exposed concrete.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Space chairs and bolsters in accordance with ACI 318 and SP-66 using height to furnish cover over reinforcing required. Chairs with plastic feet shall be used in all beams and elevated slabs. Chairs for other concrete adjacent to or on the ground may be pieces of concrete brick pressed into the sub-grade, or chairs set on pre-cast concrete pads pressed into the sub-grade.

C. When placed in the forms, reinforcement shall be clean and free of all loose rust, scale, dust, paint, oil, or other foreign material, and shall be accurately and securely positioned both laterally and vertically before placing concrete.

D. The rebars shall be fastened together at every intersection or at intervals not greater than 24 bar diameters by wire ties or by some alternate method acceptable to the Owner. In areas where large bars are closer together, the wire ties may be spaced not more than 30 bar diameters apart.

E. Reinforcement splices shall be held to a minimum number and shall be located at points of minimum stress. Splice lengths shall be shown on the approved shop drawings.

F. Install wire fabric in the longest practicable length. Lap adjoining pieces one full mesh minimum and tie slices with tie wire. Do not make end laps midway between supporting beams, or directly over beams of continuous structures. Offset end laps in adjacent widths to prevent continuous laps.

G. Accessories: Install as indicated on the drawings and manufacturer’s written instructions.

3.4 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.

3.5 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

C. Cold-Weather Placement: Comply with ACI 306R.

D. Hot-Weather Placement: Comply with ACI 305R.
3.6  FINISHING FORMED SURFACES

A. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete.

B. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.7  FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, re-straightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Re-straighten, cut down high spots, and fill low spots. Repeat float passes and re-straightening until surface is left with a uniform, smooth, granular texture.

C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and re-straighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Finish and measure surface so gap at any point between concrete surface and an un leveled, freestanding, 10-ft. long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.

D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

3.8  CONCRETE PROTECTING AND CURING
A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

2. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3. Flat Surface: Generally, all flat or nearly-flat surfaces, including foundations and floor slabs, shall be wet-cured by covering with burlap or equal, lapped 3 inches at joints, and by wetting this covering at least twice daily to keep it wet at all times for six days.

4. Form Tie Holes and Formed Surfaces: Form ties shall be removed immediately after form removal and the concrete surface shall be given a “rough” or “regular” finish as specified under “Concrete Finishes”, immediately after form ties have been removed.

5. The surrounding surfaces shall be kept damp during these operations by spraying with water at least once each hour, and the finished surfaces shall be sprayed with an approved curing compound within four hours after removal of forms. Only as much form work shall be removed in any one day as can be finished and sprayed with curing compound during that day.

6. Unfinished Surfaces: If forms are removed from an area, and for some acceptable reason, that particular area cannot be finished as specified during that day, the concrete curing operation shall be continued by wrapping the exposed concrete surface with burlap. The burlap shall be kept wet or the concrete surfaces shall be continuously sprinkled with a soaker hose or rotary sprinkler until the finishing operation has been complete and the curing compound applied, or until the six-day curing period is over.

7. Application of Curing Compound: The membrane curing compound shall be applied in two coats by spraying in accordance with the manufacturer’s printed instructions. The second coat shall be applied in a direction which will be at right angles to the application of the first coat. Spraying equipment shall be equipped with a wind guard on the nozzle. Runs or puddling of curing compound shall be avoided. The curing compound shall
contain a contrasting, non-permanent, coloring agent which shall make its presence obvious.

a. Curing Smooth-Rubbed Finish: All concrete to receive stucco, paint, or other similar coatings and concrete that is to receive a “smooth-rubbed finish”, as herein specified, shall be damp cured for at least six days and shall not receive curing compound.

b. Alternate Curing Method: In lieu of damp curing, except for concrete that is to receive a “smooth-rubbed finish”, the forms may be left in place for five days and thoroughly wetted at least once a day.

3.9 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Owner. Remove and replace concrete that cannot be repaired and patched to Owner approval.

PART 4 CONTRACTOR QUALITY CONTROL

A. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. The quality of the concrete is entirely the responsibility of the Contractor until accepted in place in the structure and verified by the final cylinder test.

C. Compression Test Cylinders: Standard laboratory compression test cylinders shall be made by the testing laboratory’s representative, unless otherwise approved by the Owner for each class of concrete as the concrete is discharged from the mixer. A minimum of one set of three test cylinders shall be taken each day from one representative batch of each class of the concrete furnished. Additional sets of cylinders may be taken wherever directed by the Owner. One cylinder shall be tested in seven days, one in 28 days and one held as a spare. The laboratory will keep an accurate record of the locations where the concrete was placed from which samples were taken. Slump tests will be made each time cylinders are taken, and as directed by the Owner. Test cylinders shall be made and cured in accordance with ASTM C31/C31M. Test shall be performed in accordance with ASTM C39/C39M. The laboratory will furnish copies of all test results to the Owner and Contractor.

D. Air-Entrainment Test: For air-entrained concrete, the Laboratory will make tests for the amount of air in the concrete each time cylinders are taken; except that if placements requiring cylinders are small, this may be extended to every other time. Tests will be conducted in accordance with ASTM C231/C231M.

E. Load Tests, or other special tests not covered above, if required by the Owner for any section of the structure that is compromised by quality or workmanship, shall be made by the Contractor at his own expense. Such tests shall be conducted in accordance with detailed instructions approved by the Owner.

F. Batch Truck Tickets: Accompanying each batch of concrete delivered to the site shall be a truck ticket that shall indicate the following information: (1) time mix was batched, (2) brand and type of cement (3) pounds of cement per cubic yard of concrete, (4) planned slump, (5) water available
to be added upon arrival onsite, (6) admixture, and (7) name of supplier. These tickets shall be readily available for inspection when the truck arrives on the job; they shall be kept on the job and the information on them shall be made available to the testing laboratory’s representative for inclusion in his report.

G. Tolerances:

1. Form-work: Tolerances shall conform to the permissible variations from line, grades, or dimensions as specified in ACI 347R.

2. Reinforcement: Tolerances shall conform to the tolerances as specified in ACI 301 and 304R.

3. Slabs: Floors and exterior slabs on grade shall have surfaces that are straight within a tolerance of plus or minus 1/8 inch in 10 feet. For exterior concrete slabs where slope is specified to provide for water drainage, a 1/16 inch minimum per foot uniform slope shall be provided.

END OF SECTION
PART 1  GENERAL

1.1  SUMMARY

A. This section supplements the General Requirements for Substation Structural Steel Package. The technical requirements for design and fabrication of outdoor electrical substation structures, equipment, materials and necessary incidentals, are outlined herein and indicated on the Contract Drawings.

B. The Substation Structural Steel Package shall include, but not be limited to, required steel designs and furnishing fabricated hot-dipped galvanized steel structures, anchor rods, bus conductor, bus connectors, bus support insulators, switches and switch supports, complete, with switch operator’s grounding pads, fasteners and assembly material as indicated and specified.

C. The Field St. Substation design requires the fabrication of galvanized structures and other items of equipment in accordance with the attached Contract Drawings. It is the project intent to provide new structures that conform to the existing substation structures to the greatest extent possible. Where details of the existing structures were available, they are provided as reference drawings. Where connections between existing and new structures are made all dimensions and top-of-member elevations shall match the existing structures. Different member sizes will be permitted only where required to meet the loading and deflection requirements. The use of different member types will not be permitted.

D. The Field St. Substation package requires design and fabrication of one (1) 145kV 13’ line switch support structure, one (1) 145kV Breaker, one (1) 115kV three phase capacitor bank, one (1) 115kV Resistive Potential Device 9’ support, three (3) 96kV 15’ single phase Surge Arrester supports, one (1) 115kV 8.5’ three-phase CCVT support, and one (1) 115kV 9’ CT support, all as shown on the Contract Drawings. In addition to the structural steel, the Packager shall also provide all other associated appurtenances, and the equipment and materials as listed on the Contract Drawing Bill of Materials, including but not limited to CCVT’s, PT’s, switches, switch grounding platforms, tubular bus, cable bus, bus connectors, station post insulators, surge arresters, hardware, etc., as required for a complete installation.

E. The Substation Structural Steel Package does not include field installation of structural steel structures, concrete foundation construction, installation of equipment, installation of conduits and control cables, installation of the substation ground grid, or providing equipment and material as listed as being “Owner Furnished”.

1.2  REFERENCES

A. The work shall conform to the applicable requirements of all Federal, State and local agencies and applicable provisions of the latest edition or revision of the following standards, except as modified herein.
1. Aluminum Association (AA)
   TH56 Aluminum Electrical Conductor Handbook

2. American Concrete Institute (ACI)
   318 Building Code Requirements for Structural Concrete

3. Institute of Electrical and Electronics Engineers (IEEE)
   C2 National Electrical Safety Code (NESC)
   C37.30 Requirements for High-Voltage Switches
   C37.35 High-Voltage Air Disconnecting and Load Interrupter Switches, Guide for Application, Installation, Operation and Maintenance
   80 Guide for Safety in AC Substation Grounding
   142 Recommended Practice for Grounding of Industrial and Commercial Power Systems
   605 Guide for Bus Design in Air Insulated Substations
   837 Qualifying Permanent Connections Used in Substation Grounding

   A36/A36M Carbon Structural Steel
   A123/A123M Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
   A153/A153M Zinc Coating (Hot-Dip) on Iron and Steel Hardware
   A307 Carbon Steel Bolts, Studs, and Threaded Rod
   A325M Structural Bolts, Steel, Heat Treated
   A394 Steel Transmission Tower Bolts, Zinc-Coated and Bare
   A563 Carbon and Alloy Steel Nuts
   A595/A595M Steel Tubes, Low-Carbon or High-Strength Low-Alloy, Tapered for Structural Use
   A992/A992M Structural Steel Shapes
   B8 Concentric-Lay-Stranded Copper Conductors; Hard, Medium-Hard, or Soft
   B584 Copper Alloy Sand Castings for General Applications
   F1554 Anchor Bolts, Steel
   F2329/F2329M Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

5. Federal Specifications and Standards (FSS)
   TT-P-645C Paint, Alkyd Type, Formula Number 84

6. National Fire Protection Association (NFPA)
   -- Handbook of Fire Protection Engineering
   70 National Electrical Code (NEC)
PART 2 PRODUCTS

2.1 STRUCTURAL STEEL DESIGN

A. The Substation shall be designed for nominal voltages of 115kV with 650kV BIL.

B. Steel structures shall be designed to be supported on anchor rods only. No grouting under the structure baseplate will be allowed.

C. Structures and anchor rods shall be designed to withstand the following loadings:

1. 115kV structures shall be designed to withstand the forces on conductors from a symmetrical short circuit of 63,000 amperes, minimum for 0.5 seconds.

2. The structures shall be designed to withstand wind loadings in accordance with the NESC or the ASCE MOP 113, whichever is more restrictive.

3. The structures shall be designed to withstand apparatus loads, dead loads, equipment operating dynamic loads, temporary construction loads, specified loads, and normal service conditions for the installation location.

4. Ice Loading: Allowance for ice loading will not be required in the structure design.

D. Configuration, unless noted otherwise, shall be as specified herein and indicated on the drawings.

1. The Contractor shall furnish the necessary structures, switches, switch operating handles and inter-phase operating rods, switch operator’s grounding pads, adapter plates, and other related devices necessary for complete installations as specified herein and indicated on the drawings.

2. The Contract Drawings indicate the general arrangement of the structures and components, and are furnished to serve as a guide in establishing the basic design to be followed. Details shown for the sizes of members, details of connection, location of holes, etc., are representative only. The Contractor is responsible for determining, and verifying, all final detailed designs. The structures provided shall meet the loading design requirements of the applicable standards for the area of service.

3. The design shall provide adequate capacity and space, including space required for operation and maintenance, and shall be satisfactory for the use intended. The design shall provide
electrical and mechanical clearances necessary to prevent interference with operating mechanisms or door opening on control cabinets.

E. Steel structure design and fabrication shall conform to ASCE SEI 48, ASCE MOP 113, and AISC 360. Steel structures shall meet the current design and loading requirements of the NESC.

1. For purposes of design analysis, the combinations of attachments, wind loading and unbalanced forces that provides the maximum loading on the structures shall be used.

2. Allowable stresses shall be in accordance with the NESC, AISC or local building codes, whichever are the most restrictive.

3. Deflection shall be limited to the following values on Class "A" structures and Class "B" Structures.

   a. Class "A" structures are those intended for the support of high voltage equipment (i.e. air switches, interrupter switches and circuit interrupting devices).

      1) Horizontal deflection of vertical members shall be limited to 1/100 of the vertical height of the structures.

      2) Vertical and horizontal deflection of horizontal members shall be limited to 1/200 of the span.

   b. Class "B" structures are those on which the deflections, within limits, do not affect the performance of the supported equipment (i.e. bus supports and miscellaneous equipment supports).

      1) Horizontal deflection of vertical members shall be limited to 1/50 of the vertical height of the structure.

      2) Vertical deflection of horizontal members shall be limited to 1/200 of the span.

      3) Horizontal deflection of horizontal members shall be limited to 1/100 of the span.

4. The recommended minimum clearance between conductors and grounded metal parts, conductors of different phases, vertical clearance of unguarded parts and horizontal clearance of unguarded parts shall be as follows:

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Phase to Ground</th>
<th>Phase to Phase</th>
<th>Vertical to Grade</th>
<th>Horizontal to Fence</th>
</tr>
</thead>
<tbody>
<tr>
<td>115kV</td>
<td>44</td>
<td>63</td>
<td>146</td>
<td>164</td>
</tr>
</tbody>
</table>

5. The design shall provide sufficient rigidity so that all equipment, such as air switches, interrupter switches and circuit interrupting devices will operate properly, and so that deflections of members will not exceed the limits specified by the equipment manufacturer.
Knee braces and diagonal braces shall be omitted to the maximum extent possible. When knee braces or diagonal braces must be installed, they shall be installed so that the intersection of the bottom of such brace intersects the vertical axis of the associated column no less than 5'-6" above the top of the concrete foundation and shall be installed so that the angle from the vertical does not exceed 45 degrees.

6. All connections and attachments shall develop the maximum strength of the member. Bolts shall be used for all connections to be made after fabrication and galvanizing.

2.2 STRUCTURAL STEEL FABRICATION

A. Materials and equipment shall comply with the requirements of the General Requirements, and the following.

B. The design, material, structures and workmanship shall meet or exceed current industry standards. Materials shall be new and free of defects.

C. Structural steel shall conform to ASTM A36/A36M and ASTM A992/A992M. Bolts shall be high strength, galvanized, conforming to ASTM A325M. Anchor rods shall conform to ASTM F1554 and be furnished in sufficient length to achieve the full tensile strength of the bolts.

D. Galvanizing shall be hot-dipped, conforming to the latest industry standards. All steel, including all bolts, shall be hot-dip galvanized after fabrication.

1. Nuts, bolts, washers and threaded bars/studs: ASTM F2329/F2329M

2. All other steel items: ASTM A123/A123M

E. Fabrication of the structures shall include bolt holes for equipment mounting. Any additional miscellaneous shapes, such as operating rod supports, etc., shall be furnished as required and the structure shall have holes to suit.

1. Support structures for potential transformers shall include mounting brackets to attach control wiring junction box where indicated on the drawings.

2. Additional structural support attachment brackets for various panels and boxes may be added to the approval drawings at time of approval. The Contractor may assume for purposes of this bid that up to sixteen (8) eight brackets approximately C6 channel, one foot in length, welded to the column may be required.

F. All laced or trussed members shall be shop assembled and provided with suitable connections for field erection. All pieces shall be clearly marked to facilitate field erection, and Shop Drawings shall indicate markings.

G. Each member shall be assigned a mark number and shall have this number stamped or imprinted in characters at least 1/2-inch high. All lettering or imprint painted on a member after galvanizing shall be applied with material which cannot be removed by natural washing action.

2.3 OWNER FURNISHED MATERIALS
A. The Owner has established a list of items by description, which the Owner intends to furnish for the project. Reference numbers are provided for identification on Contract Drawings. The Packager shall coordinate the listed Owner Furnished Materials into all Structural Steel designs where indicated. The Contractor will be furnished one electronic copy of Manufacturer's Drawings, where available, illustrating terminal arrangements and physical properties of equipment furnished by Owner.

2.4 CONTRACTOR FURNISHED MATERIALS

A. The Owner has established a list of items by description, which the Contractor is to furnish for the project. Reference numbers are provided for identification on Contract Drawings. For some items, manufacturer name and catalog number are provided to establish a standard of reference. The list of Contractor Furnished Materials is not intended to be comprehensive or complete, and shall be supplemented with accessory and incidental materials as necessary for a complete installation, including anchor bolts. The Contractor shall verify quantities.

B. All material shall be new, approved and labeled, where required, by UL. Only products by manufacturers regularly engaged in production of specified units will be acceptable.

C. Provide materials of suitable composition to perform satisfactorily when exposed to corrosive conditions of project site.

D. Protection from contact of dissimilar materials

1. All metal surfaces to be in contact with mortar, concrete or other masonry materials shall be painted with alkali-resistant coatings such as heavy-bodied bituminous paint.

2. Aluminum surfaces placed in contact with steel shall be given one coat of zinc chromate primer complying with FSS TT-P-645C, or equivalent. Aluminum surfaces in contact with stainless, aluminized, hot-dip galvanized or electro-galvanized steel need not be treated.

E. Structure Grounding

1. Grounding pads shall be welded, or grounding points shall be incorporated, near the base of each low profile type column leg.

2. For steel elements, provide grounding attachment points for vertical runs up, and horizontal runs across, the complete lengths of columns or trusses. Ground cable attachments shall be provided at maximum spacing of 4'-0”.

F. Miscellaneous Items

1. Switch Operator Platforms: All group operated switches shall be supplied with an operator platform. The platform shall be designed in accordance with the recommendations of IEEE-80 pertaining to touch potentials.

2. Anchor Rods: Supply all anchor rods required to install Packager supplied structures.
3. **Terminal Pads:** All connector and switch terminal pads shall be finished on the top surface to provide a smooth connection point for terminal connectors to transfer rated current. The pads on switches shall be tin plated, 4-hole NEMA pads suitable for bolted aluminum or copper connectors with standard hole spacing of 1-3/4 inches x 1-3/4 inches.

4. All necessary connectors shall be provided to terminate or couple bus, cable, equipment, switches, etc.

5. All terminal pad connections shall be made using a suitable number of stainless steel hex bolts, hex nuts, 2 stainless steel flat washers and 1 stainless steel compression washer provided per bolt. This hardware shall be provided by the Contractor. Bolt lengths shall be sized to provide minimal projection beyond hex nut to prevent excessive noise due to corona, but the entire hex nut shall be engaged.

6. **Grease:** All grease shall be high temperature synthetic grease.

7. **Aeolian vibration damping cable** shall be provided for all horizontal bus runs of tubing with diameter of 2 inches or larger.

8. Provide electrical joint compound for all aluminum-to-aluminum and aluminum-to-copper connections. Furnish a sufficient quantity of AFL “Alnox” Electrical Joint Compound, or approved equal, for aluminum connections.

9. All copper bus connectors shall be mechanical.

10. Provide a bi-metal transition plate for any planned copper/bronze to aluminum connections. Transition plate is not required when one or both sides of the connection are tin plated.

**PART 3 EXECUTION**

3.1 **SUBMITTALS**

A. The Contractor shall submit lists of equipment and material supplemented by shop drawings, descriptive bulletins, and/or other information necessary to completely describe the equipment and material proposed. Provide submittals within 30 days from the date of Notice of Award, for review by the Owner. Submittals shall be complete and shall include, but not necessarily be limited to, the following:

B. **Structural Steel**

1. Steel structure design calculations, including complete foundation load reactions.

   a. Calculations shall be signed and sealed by a Structural Engineer with a Florida Professional Engineering License.

2. Plan, elevations and section views necessary to fully illustrate the structure layout and their assembly.
3. Complete structural steel details, including member sizes, welding requirements, fabrication and erection instructions. Include all necessary details without limitation of connections to structures.

4. Itemized Bills of Material, complete with identifying mark indications and quantities.

5. Installation and erection instructions, including weights of all preassembled components.

6. Foundation bolt (anchor rod) details and templates for structures to be furnished.

C. Equipment, Materials, and Incidentals

1. Complete switch manufacturer shop drawings including ratings, dimensions, mounting and terminal details, manual or motor operator details, and maintenance manuals.

2. Complete surge arrester manufacturer shop drawings including ratings, dimensions, mounting and terminal details, and performance characteristics.

3. Complete CCVT, RPD and CT manufacturer shop drawings including ratings, dimensions, mounting and terminal details, and performance characteristics.

4. Completely itemized Bill of Material including item Description, Manufacturer, Catalog Number, and Quantity, cross referenced to the Owner’s reference numbers.

5. Manufacturer’s literature and data as necessary to establish “Approved Equal” equivalence for any items substituted.

3.2 Shop Drawings

A. All shop drawing submittals required to be delivered to the Utilities Commission of New Smyrna Beach shall be mailed (three copies) and sent by e-mail to:

   Tad Moon  
   Electrical Engineer  
   Utilities Commission of New Smyrna Beach  
   200 Canal Street  
   New Smyrna Beach, FL 32168  
   tmoon@ucnsb.org

B. Certified physical copies of drawings (24” X 36” prints), instruction books, and operations & maintenance manuals shall be provided for each category of equipment furnished. Manufacturer descriptive bulletins and/or other information shall be complete for all components. Electronic files of drawings compatible with AutoCAD Release 2010 shall also be furnished to the Owner for record.

C. Submit test data to the Owner for review, for any applicable items.

D. Where spare parts are included in the Structural Steel Package award, submittals shall include a list of spare parts items to be furnished under the contract. The spare parts list shall provide the name and
identification number of both the Packager and the original manufacturer of the components. The parts list shall provide the list price for each item, effective as of the date of conditional Notice of Award of Contract and conditional notice to proceed.

3.3 SHOP DRAWING REVIEW

A. Failure by the Owner for reasons other than actions or omissions on the part of the Contractor to return shop drawings within 15 business days from date of receipt thereof shall constitute the basis for a day-for-day extension in the proposed delivery schedule. Failure by the Owner to return shop drawings within 15 business days due to actions or omissions on the part of the Contractor shall not constitute grounds for extension of delivery time proposed.

B. A maximum of two reviews for each submittal to establish conformance with the Specifications will be allowed. In the event an item has been determined by Owner not to be in conformance with the contract requirements after two reviews, the Contractor shall pay Owner an amount equal to the cost incurred by UCNSB to perform additional submittal reviews required to establish conformance with the Specifications. These costs will be deducted from the Contractor’s retainage prior to final payment.

C. Both the owner and the supplier shall make a good-faith effort to be available for teleconferencing upon the call of either party, and shall attempt to do so within the 15 business day approval period. All such teleconferencing shall be performed at the supplier’s expense and shall be arranged by the supplier.

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. Section includes requirements for basic electrical materials and methods applicable to sections with electrical equipment requirements except when in these individual sections requirements are otherwise specified.

1.2 QUALITY ASSURANCE

A. Electrical Work and Materials: Follow the latest edition of the National Electrical Code (NEC), which is minimum requirement for electrical work and if there is a conflict between requirements specified in Contract Documents and code, the more stringent will apply as determined and approved by Engineer.

B. Unless otherwise indicated, provide electrical materials and equipment which are the standard products of manufacturers regularly engaged in production of such materials and equipment. Except where otherwise shown on Drawings.
   1. Provide the manufacturer's latest standard design that conforms to these Specifications.
   2. When 2 or more units of same class of material and equipment are required, these units shall be products of same manufacturer.

1.3 SUBMITTALS

A. Comply with Section 01330. Include the following information:
   1. Complete list of electrical materials to be furnished, indicating manufacturer.
   2. Complete schedule and listing of system and equipment identification labels with legends.
   3. Test plan and schedule.

1.4 PROJECT CONDITIONS

A. General: Drawings indicate extent and general arrangement of principal electrical elements, outlets, and circuit layouts.

B. Connections: Properly connect electrical elements and devices provided under this and other sections, in accordance with NEC, to form workable system following Contract Documents, whether connections and interconnections are specifically specified or shown on Drawings.
C. Additional Circuits: Install where required by furnished equipment and for proper installation of work, without additional cost to the Owner.

1.5 IDENTIFICATION FOR SYSTEM AND EQUIPMENT

A. General

1. Identification: Identify and label each raceway, piece of equipment, and conductor.

2. Label Schedule: Develop schedule from legend shown on Drawings, schedules, and derived from nature of system.
   a. Lacking specific data, develop legends from nature of service or system and submit for Engineer’s approval.
   b. Arrange schedule to produce legible comprehensive identification system.

B. Raceway Identification

1. Exposed Raceways: Identify at each end within 12 inches of termination.

2. Identifying Labels: Factory manufactured with colored paper, machine printed, with identifying legend laminated between 2 sheets of vinylite plastic formed to completely encircle raceway.
   a. Sizes: Match raceway to which applied.
   b. Installation: Following manufacturer’s instructions.

3. Legends for Use in Labels:
   a. Indicate system voltage and what it serves or type of service.
   b. Letter colors and minimum sizes.
      1) Raceways 2-1/2 inch and smaller: 1 inch high white letters on black background.
      2) Raceways larger than 2-1/2-inch diameter: 2 inch high letters with same colors as above.

C. Equipment Identification

1. Nameplate: Attach to inside surfaces with adhesive and to outside surface with round head, self-tapping metal screws.
   a. Letter Colors and Minimum Sizes: Two-color laminated plastic not less than 1/16 inch thick, machine engraved to show white letters not less than 1/4 inch high on black background.
2. Legend: Identify enclosure or piece of equipment.

D. Conductor Identification

1. Location:
   a. Identify power conductors terminating in panelboards, cabinets, switchgear, and switchboards at each end and in intervening junction and pull boxes.
   b. Where feeder conductors pass through cable tray, tag feeder every 15 feet to indicate electrical characteristics, circuit number, and panelboard designation.
   c. Locate labels near conductor ends for terminals and on exposed portions of conductor within pull and junction boxes.

2. Labels: Plastic slip-on ferrule type with durable machine printed letters, numerals, and other identifying characters.

PART 2 PRODUCTS

2.1 SUBSTATION PACKAGE

A. Substation capacitor bank, CCVT’s, CT, Resistive Potential Device, bus, structures, connectors, disconnect switches, insulators and all miscellaneous equipment will be provided by the Contractor.

1. See Substation Bill of Material for Items that will be furnished by the Owner.

2. If Bill of Material lists material quantities, these should be assumed to be approximate. Contractor is responsible for providing his own material take offs and quantities.

B. Bus Fittings and Connections will be provided by the Contractor. Bus fittings and connections shall be either welded or compression as indicated by the Bill of Material.

1. Substitution of swaged type connectors for welded and/or compression connectors will be allowed. Approved vendors for swaged connectors are AFL and DMC Power. Contractor will be responsible for acquiring all tooling required for installation.

C. Insulators

1. Contractor shall furnish an additional three (3) of each size insulator to the job site as a part of the substation package. These insulators shall be maintained on site during construction and used in the event of a broken or damaged insulator so that the work is not delayed. Broken or damaged insulators shall then be replaced by the Contractor, and three (3) spares of each type shall be turned over to the Owner at the completion of the project.

D. Bolted Terminal Pad and Bus Connections:

1. Contractor shall provide hardware for bus connections.
2. Use 1/2” UNC-13 stainless steel hex head bolts and nuts, grade 316
3. Under both bolt head and nut, provide one 1-1/4” 316 stainless steel flat washer and one 1-1/8”, 2500-3500lb rated 301 stainless steel Belleville compression washer.

2.2 PROTECTIVE RELAYS

A. Contractor shall provide relay panels, protective relays, and control devices per the Contract Drawings and Specification Section 16290.

2.3 WIRE AND CABLE - 600 VOLTS AND BELOW

A. Low voltage wire and cable shall be in accordance with Section 16120, Low Voltage Conductors and Cables.

B. Wire Cable Identification: Printed at regular intervals throughout entire length.
   1. Manufacture or trade name.
   2. Size of conductor.
   3. Type of insulation.
   4. Voltage classification.

C. Color Coding of AC Distribution Circuits: Throughout entire network for service, feeder, and branch circuit conductors. Match existing conditions, where applicable.
   1. Conductor No. 10 AWG and Smaller: Factory impregnated color throughout its entire length.
   2. Conductor No. 8 AWG and Larger: Marked with color coding tape minimum of 0.004 inch in thickness.
      a. Color:
         1) Green for grounding conductors.
         2) White for neutrals.
         3) Color of conductors for different voltage systems:

<table>
<thead>
<tr>
<th>System</th>
<th>Phase A</th>
<th>Phase B</th>
<th>Phase C</th>
<th>Neutral</th>
<th>Ground</th>
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<tr>
<td>120/240</td>
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<td>red</td>
<td>--</td>
<td>white</td>
<td>green</td>
</tr>
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<tr>
<td>3 phase</td>
<td></td>
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</table>
2.4 WIRE CONNECTIONS AND CONNECTING DEVICES

A. Splice Connectors

   1. All splices shall be made using terminations. No in-line splicing of control cables will be accepted.

B. Termination Components

   1. Stranded and multiple solid conductors at connection to terminals: Solderless terminal lugs or UL listed crimp tool compression style lugs. Ring type.

2.5 CCVT, CT, and RPD JUNCTION BOXES

A. General: Terminal cabinet type following Drawings, with continuous piano hinged door(s), back panel to mount terminal blocks, and terminal blocks.

   1. Number: Furnish sufficient terminals to accommodate active and spare conductor terminations on Drawings, plus 30 percent extra except where otherwise shown on Drawings.

   2. Mounting

      a. Mount terminals and back panels from cabinet front.

      b. Do not mount with fasteners extending through cabinet back.

B. Materials

   1. Cabinets shall be Stainless Steel.

   2. NEMA 4 and 4X Cabinets: Quick release latches, padlockable.

   3. Terminal Strips: Standoff mounted and channel mounting type with marking strips.

   4. Boxes shall be sized to accommodate all wiring, devices and terminations. Contractor to verify box size prior to ordering, based upon actual devices supplied.

   5. Low voltage fused disconnects shall be interlocked to allow removal of the fuses only after the disconnect switch has been opened.

      a. Fused disconnects shall be either fully enclosed UL98 listed, or protected by removable clear plastic barriers to prevent accidental contact with live circuits.

C. Locations

   1. Panels for Damp, Wet, or Corrosive Areas: NEMA-4X, minimum 16 gauge 316 stainless steel with stainless steel accessories and hardware unless otherwise indicated

2.6 LOW VOLTAGE CIRCUIT BREAKERS
A. Applications: UL489, with interrupting capacity following Drawings and UL listed for conductor type used.

1. Type: Molded case, quick-make, quick-break, thermal magnetic trip type, trip indicating and bolted in type.

2. Rating on each breaker: Visible trip.


4. Two and Multiple pole Circuits: Common trip type having single operating handle.

   a. Single pole circuit breakers with handle ties for multiple pole breakers: Not accepted.

B. For circuit breakers to be installed in existing equipment, Contractor shall provide devices that match the ratings and manufacture of the in-place equipment.

C. Used for Service Disconnect: Same as for enclosed applications, except suitable for service entrance.

2.7 PHASE IDENTIFICATION

A. Provide phase identification on all new 115kV bus.

   1. Provide phase identification at each 115kV disconnect switch structure and line termination structure, at the base of the appropriate phase insulator.

B. Phase identification lettering shall be a minimum of 4” high. The lettering shall withstand weathering and UV exposure without fading or discoloring. Phase coloring shall be as follows:

   1. Aθ = White text on Red background
   2. Bθ = White text on Black background
   3. Cθ = White text on Blue background

2.8 DEVICE NUMBERS

A. Provide device numbers on all new circuit breakers and disconnecting switches.

   1. Circuit breaker numbers shall be installed on the exterior of the circuit breaker.

   2. Hookstick switch numbering shall be installed as close as possible to the center phase of each three phase group of switches.

   3. Gang operated switch numbers shall be installed at the switch operating handle.
B. Device numbers and letters shall be a minimum of 4” high. The lettering shall be yellow on a black background, and withstand weathering and UV exposure without fading or discoloring.

PART 3 EXECUTION

3.1 GENERAL

A. Install electrical equipment and material of size, type, and general routing following Drawings or approved Contractor's Drawings.

B. Install metallic raceway, fittings, boxes, and cabinets free from direct contact with reinforcing steel.

C. Install fasteners, anchor bolts, anchorage items, and supports as required to insure proper and rigid alignment.
   1. Attach equipment with fasteners sized according to size and weight of equipment and thickness of supporting surface.

D. Where aluminum is placed in contact with dissimilar metal or concrete, separate contact surfaces with gasket, non-absorptive tape, or coating to prevent corrosion.

E. Ground and make metallic conduit, raceways, and cable trays electrically and mechanically continuous.
   1. Conduits: Continuous between outlets, boxes, cabinets, and panels, and secured to each box.
   2. Ground Conductor: For each conduit run.

3.2 TESTING

A. Contractor shall engage an independent third party testing agency to perform the required testing of the substation equipment and materials.
   1. The testing agency shall demonstrate a minimum of 5 years’ experience with utility substation equipment acceptance testing.
   2. Qualifications of the testing agency shall be submitted to the Owner for review.

B. Submit a testing plan and schedule to the Owner.

C. Contractor shall perform all final testing and commissioning of the equipment supplied in the Substation package. Testing shall be per the NETA Acceptance Testing Standard (ANSI/NETA ATS-2013) and per manufacturer’s recommendations. The equipment to be tested includes:
   1. 145kV Breakers
   2. Cables, Low Voltage, 600V
   3. Cutout Switches
4. Protective Relays
5. CCVTs
6. CTs
7. RPDs
8. 31.2MVAR Capacitor Bank
9. Arrestors
10. Air Break Disconnect Switches
11. Surge Arresters
12. Outdoor Bus Structures
13. System Functional Testing

D. Equipment shall be put into service only after receiving Owner’s written approval of the test report.

3.3 CIRCUIT BREAKERS

A. Owner will furnish, one (1) 145kV circuit breaker at the project site. Coordinate with Owner for the delivery of the circuit breaker. All preliminary work to prepare for the installation shall be completed by the Contractor prior to agreed upon delivery date.

B. Contractor shall be responsible for receiving, rigging and offloading the circuit breaker. Contractor shall be responsible for supervising the placement of the circuit breaker on the foundation. Equipment not immediately installed shall be stored in accordance with Specification 01600, Material Delivery, Storage and Handling, as well as the manufacturer’s instructions.

Install the circuit breaker per the manufacturer’s written instructions. Secure the circuit breaker to the anchor bolts, and make all connections to circuit breaker bushings, ground grid, and controls circuits.

1. Pressurize the 145kV circuit breaker with SF6 gas per the manufacturer’s instructions. Gas will be provided by the Owner.

C. Contractor shall perform all final testing and commissioning of the circuit breaker.

1. Testing shall be per the NETA Acceptance Testing Standard (ANSI/NETA ATS-2013), including all testing listed as “Optional”.
2. Record the results of all testing and provide a final report to the Owner for review.
3. Equipment shall be put into service only after receiving Owner’s written approval of the test report.

3.4 SUBSTATION BUS

A. General: Install substation bus such that it is secure and braced against magnetic forces due to short circuit currents.

B. Tube Bus:
   1. Install as shown on Contract Drawings
   2. Tube bus runs over nine (9) feet in length shall have a vibration damper installed.
      a. Install a length of 4/0 ACSR cable within the aluminum tube prior to installing the end fittings. The weight of the cable damper shall be 15%-25% of the weight of the associated tube bus segment.
   3. Support tube bus as shown with insulator support clamps at the support insulators.
   4. Rigid tube bus shall have expansion fittings as shown on the Contract Drawings.
   5. Drill a 5/16” weep hole at the low point of all bus runs.

C. Bare Cable Bus
   1. Install flexible cable bus as shown on the Contract Drawings.
   2. Cable shall be routed, as nearly as is possible, directly from one termination pad to the next.
   3. Cable shall be installed considering possible expansion and contraction due to temperature variations, but shall not excessively bow or sag.
   4. Installation shall conform to NESC required phase to phase and phase to ground clearances.

D. Fittings and Connections
   1. Install connectors per the manufacturer’s recommendations.
   2. Apply oxide inhibiting, electrical joint compound before installing conductor into standard compression connectors.
      a. Use Alcoa AFC grit compound for installing cable fittings.
      b. Use non-gritted Alcoa #2 EJC for all others.

E. Bolted Connections:
1. Clean surfaces with emery cloth and wire brush to remove oxide layer
2. Use non-grit oxide inhibitor between the two surfaces (Alcoa #2 EJC or equal)

3.5 PROTECTIVE RELAYS

A. Install new relay panels as shown on the Contract Drawings and defined in the Specifications.
B. Contractor shall install new control cable from the substation to the control panel terminations.
C. Contractor shall connect the panel wiring to the control devices.
D. When all other work is complete, Contractor shall identify and remove all existing control wiring made obsolete by this project.
E. Contractor shall perform all final testing and commissioning of the protective relays.

1. Testing shall be per the NETA Acceptance Testing Standard (ANSI/NETA ATS-2013), including all testing listed as “Optional”.
2. Record the results of all testing and provide a final report to the Owner for review.
3. Equipment shall be put into service only after receiving Owner’s written approval of the test report.

3.6 CABLE AND CONDUCTORS

A. Install complete raceway system and clear debris and moisture before conductor installation.
B. Install conductors in raceways with no splices between boxes following Drawings.
C. Pull conductors using proper equipment without exceeding manufacturer's recommendation for maximum pulling tension.
D. Protect conductor insulation jacket at all times from kinks, scrapes, punctures, and other damage.
   1. Replace damaged conductors.
   2. Use UL listed lubricating compound compatible with conductor insulated jacket and with raceway to reduce pulling force.
E. Support conductors in vertical risers with woven grips to prevent loading on conductor connectors.
F. For conduits entering buildings or from areas where temperature change may cause condensation or moisture, seal between conductors and conduit after conductors are in place.
G. When using color coding tape, apply with overlapping turns for minimum length of 2 inches starting 2 inches back from termination point.
H. Connect circuit conductors of same color to same phase throughout installation.

I. Contractor shall perform all final testing and commissioning of the control cable.

1. Testing shall be per the NETA Acceptance Testing Standard (ANSI/NETA ATS-2013), including all testing listed as “Optional”.

2. Record the results of all testing and provide a final report to the Owner for review.

3. Equipment shall be put into service only after receiving Owner’s written approval of the test report.

3.7 CABINETS AND ENCLOSURES

A. Mount cabinets and enclosures with minimum of 1-1/2 inch air space all around.

B. Arrange conductors in cabinets, panels, and enclosures neatly, cut to proper length and with surplus conductor removed.

C. Identify each circuit in enclosure.

D. Provide terminals and connectors for type of material used.

3.8 GROUNDING

A. Ground exposed noncurrent carrying metallic parts of electrical equipment, raceway systems, and neutral of all wiring systems following NESC, NEC and other applicable codes.

B. Bond all substation structures and equipment to station ground grid using 4/0 stranded bare copper conductor.

1. All circuit breakers and multi-leg steel structures shall be bonded to ground using two independent grounds.

2. All lightning arrestors, voltage transformers, and single leg structures shall be bonded to the ground grid using one ground.

3. All switch operators (swing handle or motor operators) shall be bonded to the switch structure, ground conductor, and the switch operator platform.

C. Contractor shall perform all final testing and of the substation ground system.

3.9 FIELD QUALITY CONTROL

A. Contractor shall retain the services of a NETA certified independent testing agency to perform all final testing per the NETA Acceptance Testing Standard (ANSI/NETA ATS-2013). Record the results of all testing and provide a report to the Owner for review.
1. Correct defects and failures to Engineer’s acceptance.

END OF SECTION
SPECIFICATIONS
SECTION 16050.1
BILL OF MATERIAL

PART 1 GENERAL

1.1 SUMMARY

A. Provide, transport, handle, store and protect material and equipment used on this project as specified in Specification Section 01600.

B. Conform to the Contract Specifications and all applicable technical specifications, codes, and standards.

C. Packager’s materialman shall review the contract documents and create their own counts of the materials required prior to submitting a bid.
END OF SECTION
NOTES:

1. MANUFACTURERS AND PART NUMBERS LISTED ARE THE BASIS OF DESIGN ONLY. CONTRACTOR SHALL PROCURE MATERIALS THAT CONFORM TO THE SPECIFICATIONS AND THE DESIGN DRAWINGS. IF NO SPECIFICATION EXISTS FOR A MATERIAL, PROVIDE THE LISTED EQUIPMENT OR AN APPROVED EQUAL BASED ON THE ITEM DESCRIPTION.

2. MATERIAL QUANTITIES ARE APPROXIMATE. CONTRACTOR SHALL PERFORM THEIR OWN TAKEOFF (MATERIAL COUNT) PRIOR TO BIDDING.
<table>
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<tr>
<th>ITEM #</th>
<th>APROX. QTY</th>
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PART 1 GENERAL

1.1 SUMMARY

A. Provide electrical identification products and components for identification of electrical materials, equipment and installation, including but not limited to the following:

1. Buried electrical line warnings.
2. Conduits, raceways, cables, and conductors.
3. Operational instruction signs.
4. Warning and caution signs.
5. Equipment labels and signs.

1.2 QUALITY ASSURANCE

A. Comply with applicable portions of Section 16050, Basic Electrical Materials and Methods.
B. Provide components that are the standard product of a manufacturer regularly engaged in the product of the required materials and equipment.
C. Comply with applicable codes and standards including, but not limited to the most recent edition of the following.

D. Design to provide satisfactory performance under the specified operating conditions.

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01330, Submittal Procedures.

1. Product data.
2. Schedule of identification nomenclature to be used for identification signs and labels.
3. Samples of each color, lettering style, and other graphic representation required for identification materials; samples of labels and signs.
PART 2 PRODUCTS

2.1 ELECTRICAL IDENTIFICATION PRODUCTS

A. Provide Adhesive Marking Labels for Raceway and Metal-Clad Cable:
   1. Pre-printed.
   2. Flexible.
   3. Self-adhesive labels with legend indicating voltage and service (emergency, lighting, power, light, power dc, air conditioning, communications, control, and fire).

B. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Provide self-adhesive vinyl tape not less than 3 mils thick by 1 inch to 2 inches in width.

C. Pre-tensioned Flexible Wraparound Colored Plastic Sleeves for Raceway and Cable Identification: Provide flexible acrylic band, sized to suit the raceway diameter and arranged to stay in place by pre-tensioned gripping action when coiled around the raceway or cable.

D. Underground Line Marking Tape:
   1. Provide permanent, bright-colored, continuous-printed, plastic tape compounded for direct-burial service not less than 6 inches wide by 4 mils thick.
   2. Provide printed legend, indicative of general type of underground line below.

E. Wire/Cable Designation Tape Markers: Provide vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with preprinted numbers and letters.

F. Aluminum, Wraparound, Cable Marker Bands:
   1. Provide bands cut from 0.014-inch thick, aluminum sheet, fitted with slots or ears for securing permanently around wire or cable jacks or around groups of conductors.
   2. Make arrangement for applying legend with stamped letters or numbers.

G. Plasticized Card Stock Tags:
   1. Provide vinyl cloth with preprinted and field-printed legends to suit the application.
   2. Use orange background, except as otherwise indicated, with eyelet for fastener.

H. Brass or Stainless Steel Tags:
   1. Provide metal tags with stamped legend punched for fastener.
   2. Dimensions: 2 inches by 2 inches by 19 gauge.
I. Engraved, Plastic-Laminated Labels, Signs, and Instruction Plates:
   1. Provide engraving stock melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8-inch thick for larger sizes.
   2. Provide engraved legend in white letters on black face and punched for mechanical fasteners.

J. Baked-Enamel Warning and Caution Signs for Interior Use: Provide preprinted aluminum signs, punched for fasteners, with colors, legend, and size appropriate to the location.

K. Fasteners for Plastic-Laminated and Metal Signs: Provide self-tapping stainless steel screws or number 10/32 stainless steel machine screws with nuts and flat and lock washers.

L. Cable Ties:
   1. Provide fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18-inch minimum width, 50-pound minimum tensile strength, and suitable for a temperature range from minus 50 to 350 degrees F.
   2. Provide ties of specified colors when used for color coding.

PART 3 EXECUTION

3.1 INSTALLATION

A. Lettering and Graphics:
   1. Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated.
   2. Install numbers, lettering, and colors as approved in submittals and as required by code and according to applicable portions of Section 16050 Basic Electrical requirements

B. Install identification devices in accordance with manufacturer’s written instructions and requirements of NEC.

C. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

D. Conduit Identification.
   1. Identify Raceways of Certain Systems with Color Banding:
      a. Provide bands for exposed or accessible raceways for identification.
      b. Provide pre-tensioned bands, snap-around colored plastic sleeves, colored adhesive marking tape, or a combination of the two.
c. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.

d. Install bands at changes in direction, at penetrations of walls and floors, and at 40-foot maximum intervals in straight runs.

E. Identify Junction, Pull, and Connection Boxes

1. Provide code-required caution sign for boxes, with pressure-sensitive, self-adhesive type label, indicating system voltage in black, preprinted on orange background.

   a. Install label on outside of box cover.

   b. Label box covers with identity of contained circuits.

   c. Use pressure-sensitive plastic labels at exposed locations.

   d. Provide similar labels or plasticized card stock tags at concealed boxes.

F. Underground Electrical Line Identification:

1. During trench backfilling, for exterior underground power, signal, and communications lines, install continuous underground plastic line marker, located directly above line at 6 to 8 inches below finished grade.

2. Where multiple lines are installed in a common trench or concrete envelope, do not exceed an overall width of 16 inches; install a single line marker.

G. High Voltage Overhead Bus:

1. Provide phase identification at each disconnect switch and support structure. Identification shall be mounted to the grounded steel structure directly underneath the high voltage bus being identified.

2. Identification shall consist of 4”x4” non-reflective, non-corrosive phase markers.

   a. Markers shall denote A, B or C phase and clearly legible from ground level.

   b. Markers shall attach to the structures using solid mounting hardware or wire ties. Adhesive attachment is not acceptable.

H. Install line marker for underground wiring, both direct-buried and in raceways.

I. Use conductors with factory-applied color on the entire length of the conductors except as follows:

1. Use following field-applied color-coding methods in lieu of factory-coded wire for sizes larger than No. 10 AWG.
a. Apply colored, pressure-sensitive plastic tape.
   1) Provide half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made.
   2) Apply the last two laps of tape with no tension to prevent possible unwinding.
   3) Use 1-inch-wide tape in colors as specified.
   4) Do not obliterate cable identification markings by taping.
   5) Adjust tape locations slightly to prevent obliteration.

b. Use of colored cable ties in lieu of pressure-sensitive tape.
   1) Apply three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3 inches apart.
   2) Apply with a special tool or pliers, tighten for snug fit, and cut off excess length.

2. Power Circuit Identification:
   a. Securely fasten identifying metal tags or aluminum wraparound marker bands to cables, feeders, and power circuits in vaults, pull boxes, junction boxes, manholes, and switchboard rooms.
   b. Use 1/4-inch steel letter and number stamps with legend to correspond with designations on drawings.
   c. Where metal tags are provided, attach them with approximately 55-pound test monofilament line or one-piece self-locking nylon cable ties.

J. Tag or label conductors as follows.
   1. Future connections: Indicate cable for future connection or connection under another contract, with identification indicating source and circuit numbers.
   2. Multiple Circuits: Where multiple branch circuits or control wiring or communications/signal conductors are present in the same box or enclosure (except for three-circuit, four-wire home runs):
      a. Label each conductor or cable.
      b. Provide legend indicating source, voltage, circuit number, and phase for branch circuit wiring.
c. Indicate phase and voltage of branch circuit wiring by means of coded color of conductor insulation.

d. For control and communications/signal wiring, use color coding or wire/cable marking tape at terminations and at intermediate locations where conductors appear in wiring boxes, troughs, and control cabinets.

e. Use consistent letter/number conductor designations throughout on wire/cable marking tapes.

3. Match identification markings with designation used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facility’s electrical installations.

K. Apply warning, caution, and instruction signs and stencils as follows:

1. Install warning, caution, or instruction signs where required by NEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect.

2. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation.

3. Install butyrate signs with metal backing for outdoor items.

4. Emergency Operating Signs: Install engraved laminate signs with white legend on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding, or other emergency operations.

L. Install equipment/system circuit/device identification as follows:

1. Apply equipment identification labels of engraved plastic-laminate on each major unit of electrical equipment in building, including central or master unit of each electrical system. This includes communication/signal/alarm systems, unless unit is specified with its own self-explanatory identification.

2. Except as otherwise indicated, provide single line of text, with 1/2-inch-high lettering on 1-1/2-inch-high label (1-inch-high where two lines are required), white lettering in black field.

3. Text shall match terminology and numbering of the Contract Documents and shop drawings.

4. Apply labels for each unit of the following categories of electrical equipment.

   a. Panelboards, electrical cabinets, and enclosures.

   b. Access doors and panels for concealed electrical items.
c. Circuit Breakers.
d. Capacitor Banks.
e. High voltage disconnect switches.
f. Control devices.
g. CCVT’s
h. CT’s
i. Resistive Potential Devices

M. Apply circuit/control/item designation labels of engraved plastic laminate for disconnect switches, breakers, pushbuttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components, where labeling is specified elsewhere.

N. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.

O. Install labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

END OF SECTION
PART I  GENERAL

1.1  SUMMARY

A. Provide all wires and cables as indicated on drawings and as specified herein, for a complete electrical system.

1.2  QUALITY ASSURANCE

A. Comply with applicable portions of Section 16050 Basic Electrical Materials and Methods.

B. Provide components that are the standard product of a manufacturer regularly engaged in the production of the required materials and equipment.

1. The manufacturer shall be responsible for the design, construction and proper operation of all components.

C. Comply with applicable standards, codes and regulations including but not limited to the most recent edition of the following:

1. Association of Edison Illuminating Companies (AEIC).

2. ASTM International (ASTM):

   a. B3, Soft or Annealed Copper Wire.

   b. B8, Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft.

   c. B29, Refined Lead.

   d. B33, Tinned Soft or Annealed Copper Wire for Electrical Purposes.

3. Insulated Cable Engineers Association, Inc. (ICEA):

   a. S-19-81, Rubber-Insulated Wire and Cable.

   b. S-61-402, Thermoplastic-Insulated Wire and Cable.

   c. S-66-524, Cross-linked Thermosetting Polyethylene-Insulated Wire and Cable.
d. S-68-516, Ethylene-Propylene-Rubber Insulated Wire and Cable.

4. National Electrical Manufacturer’s Association (NEMA):
   a. W 3, Rubber Insulated Wire and Cable.
   b. WC 5, Thermoplastic Insulated Wire and Cable.
   c. WC 7, Cross-Linked-Thermosetting Polyethylene-Insulated Wire and Cable.
   d. WC 30, Color Coding of Wires and Cable.


6. Underwriters Laboratory Inc. (UL):
   a. UL 44, Wires and Cables Rubber/Thermoset Insulated.
   b. UL 83, Wires Thermoplastic Insulated.
   c. UL 854, Cables, Service Entrance.
   d. UL 1277, Tray Cable.
   e. UL 1581/IEEE 383, Vertical Tray 70,000 BTU Flame Test.


1.3 SUBMITTALS
   A. Submit the following in accordance with Section 01330, Submittal Procedures.
      1. Product data.
      2. Drawings.

PART 2 PRODUCTS

2.1 MATERIALS
   A. 600V Cable for Low Voltage Power Circuits:
      1. Southwire Company.
      2. Belden Corporation.
3. Prysmian Cable Systems.

B. Control and Metering Wire:
   1. Southwire Company.
   2. Houston Wire and Cable.

C. Instrumentation Cable:
   1. Belden Company.
   2. Okonite Corporation.
   3. Houston Wire and Cable.

D. Ethernet Cable:
   1. Houston Wire and Cable.
   2. Belden Corporation.

2.2 WIRES AND CABLES

A. Provide copper conductors unless otherwise indicated. Material and stranding of conductors shall conform to ASTM B33, ASTM B3, and to ASTM B8, for the appropriate class No. 12 AWG minimum wire size unless otherwise noted.

B. Tinned Wire used with Natural Rubber Insulation: Conforms to ASTM B33. Uncoated, soft or annealed copper wire conforms to ASTM B3.

C. All wire and cable shall be UL listed.

D. Conductor color coding shall be provided per the contract drawings.

E. Wires and Cables for Maximum 600-Volt Power Circuits: Type XHHW/XHHW-2 rated 600-volt, single conductor, stranded copper with XLP insulation and PVC or CPE jacket or equivalent.

F. Wires and Cables for panel interior control wiring and control wiring between panels: Type SIS, rated 600-volt single conductor.

G. Wires and Cables for Control, Indication, Signal and Alarm Circuits: Single and multi-conductor control cable, Class B or C stranding.
1. Use Type XHHW/XHHW-2 insulation, 600-volt, abrasion, moisture, and heat resistant thermoset cross-linked polyethylene (XLP) insulation with PVC or CPE conductor jacket.

2. Multi-conductor cable to have sunlight resistant PVC jacket, rated flame retardant type TC for use in cable trays.

H. Analog wiring shall be shielded single pair, instrumentation cable designed for noise rejection for process control, computer, or data log applications and meeting NEMA WC 55 requirements.

   1. Outer jacket shall be 45 mil nominal thickness.
   2. Individual pair shield shall be 1.35 mil, double-faced aluminum/synthetic polymer overlapped to provide 100 percent coverage.
   3. Dimension shall be 0.31-inch nominal OD.
   4. Conductors shall be:
      a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.
      b. No. 20 AWG, 7-strand tinned copper drain wire
      c. Insulation of 15 mil nominal PVC.
      d. Jacket of 4 mil nominal nylon.
      e. Pair conductors, color-code black and red.

   5. Cables: Rated 600 volts and 90˚C. Flame retardant type TC rated for cable trays.

I. Copper Ethernet Cable for communication shall be CAT 6. Conductor shall be 23 AWG solid bare copper, color coded, to form 4-pair UTP.

PART 3 EXECUTION

3.1 INSTALLATION

   A. Install wiring in accordance with applicable provisions of NEC, and as indicated.

   B. Wire and cable sizes are indicated; however, in no case use smaller cable sizes than required by the NEC.

   C. Unless otherwise indicated, use no conductor smaller than No. 12 AWG for power.

   D. Use minimum size No. 12 AWG stranded wire for interior panel control wiring and control wiring between panels.
E. Use minimum size No. 10 AWG stranded wire for control wiring to remote locations (circuit breakers, CCVTs, etc.).

F. Conductors for Branch Lighting Circuits: Install conductors of sizes such that greatest voltage drop between lighting panel and center of load will not exceed 2 percent at rated load.

G. Number and sizes of wires and conduits indicated are based upon selected standard components of electrical equipment.
   1. Modifications approved by the Engineer may be made by the Contractor at his expense to accommodate equipment actually purchased.
   2. The basic sequence and method of control must be maintained as indicated on the drawings and specifications.

H. Install conductors continuous from outlet to outlet and make no splices except within outlet, junction, or terminal boxes.

I. Draw all conductors contained within single conduit at same time. Cut-off section subject to mechanical pulling means, provide maximum slack at all connection, pull, and terminal points.

J. Apply wire pulling compound as recommended by the cable manufacturer to conductors, if required.

K. Use no cable bend with radius of less than eight times its diameter.

L. Wires and cables installed without prior submittal review and Engineer’s approval are subject to removal at no additional expense to the Owner.

M. Support cables in riser raceways at intervals as required by NEC.

3.2 CONDUCTOR IDENTIFICATION

A. Label each wire at all termination points. Label to denote the terminal block designation of the remote end of the cable.

B. Identify each wire in junction boxes, cabinets, and terminal boxes where total number of control, indicating, and metering wires is three or more and no terminal board is provided, including all power wires, by means of plastic split-sleeve, no adhesive, wire marker.

C. In cases similar to above where terminal boards are provided for the control, indicating, and metering wires, identify all wires including motor leads and other power wires too large for connection to terminal boards, by wire markers as specified above.

D. Provide cable and wire identification in accordance 16075, Electrical Identification.
3.3 CONNECTORS, TERMINAL LUGS AND BOARDS

A. Terminate all wires connected to terminal boards, terminal blocks, or to other similar terminals by means of ring tongue, nylon self-insulated, tin-plated copper pressure terminals.

B. Fabricated terminal boards, installed where indicated, of type 600 volts, 30 amperes, screw terminals, with white marking strips for wire identification, of the 4-, 6-, 8-, or 12-hole type, as necessary.

C. Clearly and permanently mark terminal strips with ink or indelible pencil. Mark each wire consistently throughout entire system, using notation of wires given on manufacturer’s wiring diagrams wherever possible.

3.4 FIELD QUALITY CONTROL

A. Contractor shall retain the services of a NETA certified independent testing agency to perform all final testing per the NETA Acceptance Testing Standard (ANSI/NETA ATS-2013). Record the results of all testing and provide a final report to the Owner for review.

1. Contractor shall correct all deficiencies found.

END OF SECTION
PART 1       GENERAL

1.1   SCOPE

A. This specification includes the minimum design requirements for an indoor protective relay panel. The proposal shall include freight on board final destination. The relay panel shall be furnished with all accessories as indicated in the drawings, Technical Data Sheet and in this specification.

1.2   STANDARDS

A. The equipment shall be designed, manufactured and tested in accordance with the latest applicable standards to include, but not be limited to:

1. ANSI – American National Standards Institutes
2. NEMA – National Electrical Manufacturers Association
4. NEC – National Electric Code
5. NFPA – National Fire Protection Association
6. ASTM – American Society of Testing and Materials

1.3   SERVICE USE

A. The protective relay panel will be installed inside a control building in an existing substation owned by the Utilities Commission City of New Smyrna Beach, FL (UCNSB; a.k.a. OWNER). The location is in the City of New Smyrna Beach, located in Volusia County, Florida. The address of the substation is 3019 State Rd 44, New Smyrna Beach, FL 32168.

1.4   GENERAL REQUIREMENTS

A. The CONTRACTOR shall determine required materials and quantities from the drawings, the Technical Data Sheet and this specification.
1.5 SUBMITTALS

A. All submittals shall be sent to the OWNER and ENGINEER for review and approval. Electronic copies of material submittals and preliminary drawings for approval are accepted, distribution shall be as follows (see below for requirements of the Operations and Maintenance Manuals and the Record Drawings submittals):

B. Review of shop drawings by Engineer does not relieve the CONTRACTOR of responsibility for errors, correctness of details or conformance with the specifications.

C. Provide a Drawing List with the drawing submissions.

D. Shop drawings: Indicate outline dimensions, weight, materials and anchoring details. Include the following drawings as a minimum:

1. Equipment outline plan and elevation drawings.

2. Panel wiring diagrams with all internal wiring completed by the MANUFACTURER. The drawings will be modified by the owner at a later date to include external wiring to field devices, power, SCADA, etc. Wiring diagrams shall be of the point-to-point type; terminal point tabulations are not acceptable.

3. The panel wiring diagrams shall locate each piece of equipment and terminal blocks mounted thereon and indicate the individual wiring between each item.

4. Interconnection wiring diagrams as required.

E. Bill of materials with manufacturer, model/type, description and catalog number for standard components and accessories.

F. Technical Data Sheet: completed Technical Data Sheets must be submitted with the proposal. Blank spaces or “unknown” responses are not acceptable. MANUFACTURER’s engineer’s best estimates may be acceptable for some responses for the proposal. If that is the case, accurately completed Technical Data Sheets must be resubmitted with correct data after award of contract.

G. Schedule for the manufacture and delivery of equipment furnished under this specification.

H. MANUFACTURER’s standard method for finishing, including surface preparation and type of finish applied.

I. MANUFACTURER’s recommended methods for handling and storage.

J. Test Reports:

The MANUFACTURER shall perform the following tests:

1. The panel shall be connected to the appropriate control voltage and all equipment shall be verified for proper operation. Relays and meters shall be checked to insure they power up.

2. All wiring shall be verified and functionally tested to be correct per the drawings.
3. A report showing verification of these tests will be submitted for approval prior to shipment and will be included in the O&M Manuals.

K. Record Drawings: Submit two (2) hard copies to the OWNER and one (1) hard copy to the ENGINEER.

L. Operation and Maintenance Manuals: submit five (5) copies to the OWNER and one (1) copy to the ENGINEER of the following information in book form before shipment of the equipment, with one additional copy accompanying the relay panels:

1. Parts illustrations, including parts lists adequate for the purpose of identifying and ordering replacement parts and designation of the number required per component.

2. Complete drawing set.

3. Test reports

4. Material Data Sheets for hazardous materials.

5. AutoCAD™ R2010 DWG or DXF formatted files for all project drawings. Provide files on DVD or CD.

1.6 WARRANTY

A. The MANUFACTURER shall guarantee the equipment furnished under this contract to be free from material and manufacturing defects for the MANUFACTURER’s standard warranty period, which shall be not less than five (5) years. The CONTRACTOR shall include warranty information with the bid proposal.

1.7 DELIVERY, STORAGE AND HANDLING

A. The equipment shall be handled and stored in accordance with the MANUFACTURER’s recommendations until received by the OWNER.

B. Prior to shipping the panels, remove all temporary wiring installed in the factory for equipment testing.

C. Block and support the equipment mounted on the panels as required to avoid damage during shipping.

D. The relay panels shall be shipped fully assembled. The crate/bracing shall be clearly labeled with the MANUFACTURER’s control number, project name, purchase order number and equipment destination.

E. The MANUFACTURER shall provide detailed instructions for checking for shipping damage and unloading the equipment.

F. The CONTRACTOR shall be responsible for receiving and storing.
PART 2  PRODUCTS

2.1  PROTECTIVE RELAY PANELS

A. The equipment to be furnished is protective relay panels. The protective relay panels shall be of high commercial quality in material, workmanship and design. The material and design shall be such as has been proved to be satisfactory for the application by past experience of the MANUFACTURER. The CONTRACTOR shall show, in his bid proposal, that the MANUFACTURER has previously made equipment of the same type and that it is providing satisfactory service under similar conditions.

B. All incoming and outgoing cables shall enter the equipment from above by means of a cable tray above the equipment.

C. Protective Relay Panel Wiring

1. Wiring shall be performed with switchboard type stranded wire with gray SIS insulation rated for 600-volt service and which passes the VW-1 vertical flame test. The stranding for general switchboard wiring shall be Class K stranded.

2. Current transformer circuits shall use No. 10 AWG copper conductor.

3. All other circuits shall use No. 12 AWG copper conductor.

4. All terminations of wire shall be made with pre-insulated pressure-crimp type ring-tongue terminal connectors, applied with a compression tool that requires full compression before relieving.

5. Crimped pin terminals shall be used on all control wiring to the SEL-700 series relays.

6. To insure positive electrical connections and avoid damage to the ferrule, it is mandatory that the proper crimping tool be used in accordance with the instructions for its use. The proper terminal and crimping tool shall be used for each wire size.

7. Origin:Destination style labeling shall be used. See Contract Drawings for details.

8. Ring-tongue terminal connectors shall equal to the pre-insulated PLASTI-GRIP terminal, as manufactured by AMP Incorporated, Harrisburg, PA or equal.

9. The crimping tool used to apply these terminal connectors shall be equal to the TETRA-CRIMP Tooling as manufactured by AMP Incorporated, and as recommended by the manufacturer of the ring-tongue terminal connectors being furnished and installed by the MANUFACTURER.

10. A wireway duct system, consisting of overhead horizontal wireways and vertical wireways, with removable covers shall be provided for the wiring within the panel. These wireways shall allow cabling from panel to panel and vertically from the top to the floor of each protective relay panel section.
11. All wiring within the wireways shall be completely accessible for operations, maintenance, removal, and replacement. The wireway system shall be designed with capacity for wire for all devices, present and future, that can practicably be mounted on the panel.

12. The removable covers shall be completely accessible for removal and replacement. No wiring within or external to the wire-ways shall be attached to the covers.

13. Exposed wiring shall be kept to a minimum. Where used, exposed wiring shall be formed into compact groups bound together and firmly supported. Exposed wiring shall be run straight, horizontally, or vertically with short-radius right-angle bends.

14. Hinge wiring shall be twisted around the longitudinal axis of the wire, wherever possible, instead of being bent laterally.

15. Each wire shall be protected from abrasion where it leaves a channel or wireway. Grommets shall be provided at all holes and all elliptical slots furnished for wires and cables, including holes provided for OWNER-furnished wires and cables.

16. Splices are not permitted in the wiring.

17. All connections shall be made at device studs or terminal blocks. A maximum of two connections per terminal stud will be used where possible. All wiring between various devices shall be performed by the most direct method rather than looping back and forth across the protective relay panel.

18. Wiring from the protective relay panel(s) to outdoor equipment shall be made using multi-conductor control cables per Specification Section 16120.

19. The MANUFACTURER shall provide labeled and pre-terminated jumpers for the connections between protective relay panels as required.

20. Circuit/conductor designations as shown on the schematic and wiring diagrams shall be machine lettered, stamped, engraved, or neatly marked with permanent black ink on a white heat shrink marking sleeve at every wire termination.

21. The heat shrink sleeves shall be suitable for being slipped onto each conductor, over solderless-type lugs or connectors which have already been applied to the conductor, and heat shrunk to fit the conductor using a heat gun.

22. After shrinking, the marker sleeve shall be tight enough to stay in place regardless of conductor position and loose enough to permit the marker to be slid and twisted so it can be read after the conductor is terminated.

23. The lettering shall be machine printed or neatly hand printed with indelible ink, black on white background, and shall be in accordance with the designations shown on the wiring diagrams.

24. The heat shrink tubing shall be suitable for being "printed" in a typewriter or printer with a multiple strike inked textile ribbon.
25. The heat shrink marking sleeves shall be equivalent to:
   1) Critchley, E-Z Mark Type I HS.
   2) Raychem RNF-100 heat shrink tubing.

D. Terminal Blocks

1. The MANUFACTURER shall be responsible for designation of terminal blocks and panel designators.

2. The MANUFACTURER shall be responsible for development of the panel wiring diagrams.

3. Arrangement and location of the blocks shall be such that incoming and outgoing cables can be supported and all wiring to the blocks shall be completely accessible without having to remove other devices for accessibility. The terminal blocks shall be mounted on angled spacers or some other device such that they are oriented at approximately 45° towards the rear of the protective relay panel. Adjacent rows of terminal blocks shall be separated at least six inches edge to edge.

4. Terminal blocks shall be provided for each protective relay panel section to facilitate interconnections of wiring between adjacent protective relay panel sections, power sources, SCADA connections, and field equipment. These blocks shall be mounted on the side sheets and be grouped according to the interconnecting cable destination.

5. Circuit/conductor designations as shown on the schematic and wiring diagrams shall be machine lettered, stamped, engraved, or neatly marked with permanent black ink on the white marking strip on the terminal block.

6. The terminals shall be arranged so that the conductors in each cable are grouped together to the fullest extent possible. Terminals for common circuits shall be jumpered and one conductor run to adjacent protective relay panels to reduce the number of conductors. Adjacent terminals on the same terminal block shall be used for the three-phase leads and neutral from each set of current transformers.

7. Each set of current transformer cables shall be terminated on 4-point shorting terminal blocks.

8. The terminal blocks shall be Marathon Special Products 1700 series terminal blocks or approved equal.

E. Nameplates

1. Nameplates shall be furnished per the included nameplate schedule and details.

2. The protective relay panel designation shall also be placed on the inside of each protective relay panel, using a nameplate identical to that located at top of the exterior side of the panel.
3. Nameplates, stencils, KRPY-type labels, or neat lettering giving the device function number and wiring diagram location designation shall also be placed on the back of the panels adjacent to each device.

4. Nameplates shall meet the following requirements:
   a. All engraving shall be centered, unless otherwise specified.
   b. Nameplate material shall be laminated phenolic resin sheet either 1/16 or 3/32 inch thick (as specified or required) cut to size with square edges.
   c. Nameplate material shall have semi-matte, buffed, or satin finish black surfaces, except for nameplates specified to have red surfaces.
   d. All nameplate material shall be suitable for exposure to direct sunlight without fading.
   e. Nameplate material shall have a white center.
   f. All lettering shall be flat groove type cut through the black surface to military specification MIL-P-78A and Federal Specification L-P-509A.
   g. The Contractor shall use gothic lettering.
   h. All mounting holes shall be 1/8 inch diameter.
   i. All edges shall be beveled.

F. Protective Relay Panel Construction

1. General

2. The protective relay panels shall be numbered per the drawings.

3. The protective relay panels shall have the following structural and mechanical features:
   1) Rigid, self-supporting, sheet-steel enclosed.
   2) Top closure and necessary framing, bracing, and brackets. The individual panels shall have an overall height of 7 feet 6 inches (90 inches) not including the base. Panel widths shall be 30 inches and depth shall be 24 inches as specified in the drawings.
   3) Refer to the panel arrangement and layout as shown on the drawings.
   4) Panels shall be of especially leveled sheet steel no lighter than No. 11 United States Standard Gage.

4. Electrical Features
5. One fixture with two 20-watt fluorescent lamps controlled by a two-way switch per panel for rear lighting. The lamp assemblies shall be furnished with removable, translucent, durable covers.

6. One ground-type, with Ground Fault Circuit Interrupter (GFCI), convenience outlet for each protective relay panel. The outlets shall be 2-pole, 3-wire, 20 amperes, 125 volts (NEMA type 5-20R). Separate 120-volt, single-phase, alternating-current (AC) circuits shall be provided for interior lighting and convenience outlets located within the panel. These circuits shall be wired to outgoing terminal block points.

7. Ground bus shall be copper and in accordance with Paragraph 6.1.2 of ANSI C37.20. The ground bus, complete with solderless lugs or terminals for connecting a No. 4/0 AWG grounding cable, shall be located at the bottom rear of each protective relay panel. A minimum of 24 drilled and tapped holes with 10-32 screws shall be provided in the ground bus for each panel. Refer to the wiring diagrams for the actual number used. Copper jumper straps shall be provided for connecting the ground bus to the ground bus on adjacent protective relay panels.

G. Panel Devices

1. Provide each panel with the devices as shown on the Drawings and described herein with nameplates on both the front and back of the panels. The equipment shall be mounted in the positions shown. The panel layout drawings are diagrammatic and are intended to convey the desired device layout. Should physical constraints or device dimensions require a layout that differs from that shown on the Contract Drawings, indicate an alternate arrangement in the shop drawings and state reasons for the alternate arrangement.

2. Refer to the drawings for name of manufacturer and catalog number of the major metering, control, and relay equipment to be furnished and installed in each protective relay panel. Quote protective relays and meters on a "no substitute" basis.

3. All relays and meters mounted on the front of the panels shall be flush or semi-flush mounted.

H. Small Parts

1. Provide assorted equipment, such as fuses, test blocks, nameplates, or other identification means as shown on the Contract Drawings or specified herein.

2.2 MISCELLANEOUS

A. Furnish 100% spare bulbs and fuses.

PART 3 EXECUTION

3.1 INSTALLATION

A. The CONTRACTOR shall be responsible for final placement of the panels in the existing control building.
B. The CONTRACTOR shall be responsible for all external connections, to include power, control power, and field devices.

C. The CONTRACTOR shall provide the services of an independent, approved relay testing agency to test and provide testing certification stickers for all relays during substation commissioning.
   1. CONTRACTOR’s testing agency shall test for proper relay operation as well as proper operation of all programmed protective functions and logic.
   2. CONTRACTOR shall submit a test plan for approval by the Owner 2 weeks in advance of testing.

D. The CONTRACTOR shall perform final checkout and commissioning of panels after installation.

END OF SECTION
PART 1   GENERAL

1.1   SUMMARY

A. This specification covers the design, engineering, manufacture and testing of high voltage instrument transformers

1.2   QUALITY ASSURANCE

A. Comply with applicable portions of Section 16050, Basic Electrical Materials and Methods

B. Provide components that are the standard product of a manufacturer regularly engaged in the production of the required materials and equipment.

   1. The manufacturer shall be responsible for the design, construction, and proper operation of all components.

C. Comply with applicable standards including, but not limited to the most recent edition of the following:


D. Design to provide satisfactory performance under the specified operating conditions.

   1. Suitable for outdoor unsheltered service and standard service conditions

1.3   SUBMITTALS

A. Submit the following in accordance with Section 01330, Submittal Procedures.

   1. Approval documentation shall include the following:

      a. Outline drawing, showing dimensions and base drilling details; valves and other auxiliary devices clearly identified with catalog numbers and purpose

      b. Nameplate drawing

      c. Schematic and wiring diagram

      d. Drawings (Outline, Nameplate, Schematic, Wiring Diagram)
2. One bound instruction book shall be furnished with the equipment, containing the following information:
   a. List of all equipment furnished
   b. Storage and handling instructions
   c. Installation instructions
   d. Operation and Maintenance instructions

3. Final documentation shall include above items, plus
   a. Instruction book
   b. Test report

PART 2 PRODUCTS

2.1 COUPLING CAPACITOR VOLTAGE TRANSFORMERS

A. MANUFACTURERS

1. Provide CCVT's from one of the following:
   a. GE/Alstom
   b. ABB
   c. Trench
   d. or approved equal

B. COUPLING CAPACITOR VOLTAGE TRANSFORMERS

1. Provide voltage transformers meeting the following requirements:
   a. Nominal System Voltage: 115kV line-to-line
   b. Maximum System Voltage: 121kV line-to-line
   c. System Frequency: 60Hz
   d. Dual-Wound Secondaries
   e. Secondary Voltage: 120V with 67V tap.
   f. Connection: Single phase, line-to-ground.
g. Burden: WXYZ-burden at 0.3 accuracy.

h. BIL: 550kV

C. WINDINGS

1. The transformer windings shall be high conductivity electrolytic copper.

2. The high voltage capacitive divider shall be connected phase to ground.

3. The CCVT shall have secondary windings as shown on the Contract Drawings for independent metering and synchronization circuits.

4. Each coupling capacitor voltage transformer shall have two electrically separate secondaries, each capable of supplying voltage at both marked ratios.

2.2 CURRENT TRANSFORMERS

A. MANUFACTURERS

1. Provide current transformers from one of the following:

   a. GE/Alstom

   b. ABB

   c. Trench

   d. or approved equal

B. NEUTRAL CURRENT TRANSFORMERS

1. Provide metering accuracy current transformers meeting the following requirements.

   a. Nominal System Voltage: 115kV line-to-line

   b. Maximum System Voltage: 145kV line-to-line

   c. System Frequency: 60Hz

   d. Current Ratio: Dual Ratio 40:5A.

   e. Accuracy: C200

   f. Thermal Rating Factor: 1.5.

   g. Voltage Factor: 1.9 for 30 seconds.
2. Current transformer shall be designed for installation on the neutral of an ungrounded wye shunt capacitor bank. Transformer will measure neutral unbalance current.

2.3 RESISTIVE POTENTIAL DEVICES

A. MANUFACTURERS

1. Provide Resistive Potential devices (RPD) from one of the following:
   a. S & C Electric Model 81346R6
   b. or approved equal

B. RESISTIVE POTENTIAL DEVICE

1. Provide a Resistive Potential Device meeting the following requirements.
   a. Nominal System Voltage: 69kV line-to-ground
   b. Volt-Ampere Output Rating: 15VA
   c. System Frequency: 60Hz
   d. Voltage Ratio: 332:1
   e. BIL: 350kV

2. The RPD shall be constructed of an oil insulated high voltage resistor assembly with a series output transformer.

3. RPD shall include a pressure relief valve for the tank.

4. RPD shall include a spark gap to protect the transformer from over voltages.

5. The device shall be designed for monitoring neutral to ground voltage on an ungrounded wye-connected shunt capacitor bank.

6. Resistive potential device shall be supplied with a minimum 9'-0” high galvanized steel mounting pedestal. S&C part number 92431R1-G or approved equal.

2.4 VOLTAGE TRANSFORMER LINE TERMINAL

A. The line terminal shall be located at the top of the transformer. This terminal shall consist of a NEMA four-hole connection, with a minimum of 3” x 3” surface area.
B. The terminal pad shall be oriented to allow the high voltage connection to be made either in line with the transformer axis or perpendicular to it.

2.5 CURRENT TRANSFORMER LINE TERMINALS

A. The line terminals shall be located at the top of the transformer perpendicular to the transformer post and on opposite sides. These terminals shall consist of a NEMA four-hole connection, with a minimum of 3” x 3” surface area.

B. The terminal pad shall be oriented to allow the high voltage connection to be made perpendicular to the transformer axis as shown on the contract drawings.

2.6 BASE HOUSING

A. The base housing of all equipment defined herein shall be made of cast aluminum or painted steel.

B. The oil-filled part of oil-filled type equipment shall be completely factory sealed to prevent breathing and absorption of moisture. The base housing shall be of weatherproof construction.

C. The base shall contain insulating mineral oil that is free of PCB contamination.

D. Provide a ground pad welded to the base housing. Pad shall be drilled and tapped to accept a NEMA standard terminal pad, with two ½” diameter stainless steel bolts.

E. If the base requires painting, the color shall be ANSI #70 – Sky Gray.

F. Provide a potential grounding switch on all CCVTs between the capacitor divider intermediate voltage circuit and ground. The switch shall be operable by a hook stick from ground elevation without opening the base housing of the coupling capacitor voltage transformer.

2.7 SECONDARY TERMINAL BOX

A. The secondary terminal boxes shall be weatherproof design to keep moisture out and have a minimum of two 1 ½-inch NPT conduit hubs to allow installation of conduit to a junction box.

2.8 INSULATING OIL

A. The insulating oil shall be certified free of PCBs.

1. The transformer nameplates shall include a statement that the oil is PCB free.

2.9 PORCELAIN HOUSING

A. All equipment line to ground insulation shall be porcelain, with the dimensions and characteristics required to meet the above ratings.
B. The porcelain exterior shall be glazed and ANSI #70 - Sky Gray in color.

2.10 NAMEPLATE

A. All devices shall be provided with a nameplate attached to the base of the device, easily visible from the ground after installation.

B. Nameplate shall be stainless steel with engraved lettering.

C. Shall be permanently attached using non-corrosive hardware.

PART 3 EXECUTION

3.1 TESTING

A. The manufacturer’s standard design and production tests shall be performed to verify conformance with ANSI C57.13 and the herein specified ratings.

B. The Contractor shall employ an independent testing agency to perform acceptance testing of all new instrument transformers prior to energization.

3.2 INSTALLATION

A. Installation shall be completed by the Contractor.

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. The work consists of furnishing Outdoor SF6 Gas Circuit Breaker equipment as herein specified, delivering the Equipment to the substation site, receipt, offloading, installation, and testing. Equipment shall be designed, built and delivered completely wired, tested and ready for installation.

B. This specification covers the design, rating, features, construction, testing, shipment, documentation of 123kV, 2000A, Zero Crossing Circuit Breakers to be used by the Utilities Commission of New Smyrna Beach (UCNSB).

C. As used herein, “Manufacturer” shall mean the firm with facilities and expertise, regularly engaged in the design, production, assembly and testing of high-voltage outdoor gas circuit breakers for electric utilities.

D. As used herein, “Equipment Contractor” or “Contractor” shall mean the person, firm, or Corporation whose bid is accepted and to whom the Owner has issued a Purchase Order or Contract to supply one or more items of Equipment.

E. It is the intent of these specifications for the Contractor to furnish the standard outdoor circuit breaker design of a Manufacturer, complete with standard accessories, but with modifications as detailed in these specifications.

1.2 REFERENCES

The Equipment described by these specifications shall, as a minimum, be built in accordance with applicable standards of the American National Standards Institute, the Institute of Electrical and Electronics Engineers, the American Society for Testing and Materials and the National Electrical Manufacturer's Association as to ratings, characteristics and tests. The work shall conform to applicable provisions of the latest edition or revision of the following publications and standards, except as otherwise specifically stated herein:

A. Institute of Electrical and Electronics Engineers (IEEE):

<table>
<thead>
<tr>
<th>IEEE Specification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEEE C37.04</td>
<td>Rating Structure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis</td>
</tr>
<tr>
<td>IEEE C37.06</td>
<td>High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis - Preferred Ratings and Related Required Capabilities for AC Voltages Above 1000V</td>
</tr>
<tr>
<td>IEEE C37.09</td>
<td>Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis</td>
</tr>
</tbody>
</table>
IEEE C37.010 Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis

IEEE C37.011 Guide for the Application of Transient Recovery Voltage for AC High-Voltage Circuit Breakers

IEEE C37.012 Guide for the Application of Capacitance Current Switching for AC High-Voltage Circuit Breakers Above 1000V

IEEE C37.081 Guide for Synthetic Fault Testing of AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis

IEEE C37.13 Requirements for Instrument Transformers

B. American Society for Testing and Materials (ASTM):

A 123 Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

C. National Electrical Manufacturers Association (NEMA):

SG 4 Alternating Current High-Voltage Circuit Breakers

1.3 DESIGN AND PERFORMANCE REQUIREMENTS

The workmanship, design and materials shall be of the highest quality and the most suitable for the application. The materials and equipment shall be new, of proven manufacture and free from defects. The design shall provide maximum mechanical and electrical strength and shall include ample safety factors to cover the maximum voltage rating and interrupting capacity rating of the Equipment. The Equipment shall be of dead tank design and environmentally protected.

1.4 SUBMITTALS

The Contractor shall provide a complete Schedule of data submittals within ten days of the receipt of Purchase Order.

The Contractor shall submit Adobe PDF copy of the required Submittals by e-mail for review and approval by the Owner. Review by the Owner or their representative is for determining conformance with this Section and related documents. It does not relieve the Manufacturer of responsibility for quantities and compatibility of components.

Submittals will be marked with any comments and returned to the Contractor by e-mail within ten business days after receipt, if possible. Manufacturing shall not begin until the required Shop Drawings are reviewed and approved with “No exceptions noted” or “Approved as noted”.

A. Shop Drawings
Shop drawings shall be submitted in time to meet the project schedule and overall in-service date.

1. Circuit Breaker submittals shall include:
   a. Equipment outline and assembly showing: total weight, all principal features and dimensions, bushing numbering plan, and required foundation bolt sizes and locations
   b. Breaker Nameplate
   c. Bushing data
   d. Ratio curves for bushing current transformers for each ratio and at various volt-ampere burdens
   e. Diagrams of bushing current transformer connections, showing number of turns, polarity, ratios and connections to terminal blocks
   f. Detailed views of control cabinet, CT junction box or other enclosures, including equipment layout, nameplates, conduit entrance, and terminal block orientation and numbering
   g. Separate AC and DC schematic diagrams.
   h. Full size control wiring and interconnection diagrams, based on actual physical arrangement of terminal blocks
   i. Bill of Material / Parts bulletin.
   j. Description of Manufacturer’s paint process
   k. Manufacturer’s recommended installation tests.

2. Drawing title block shall include the Owner’s name, purchase order number, and the name of the substation.

B. Factory Tests

1. All production tests included in IEEE C37.09 shall be made on each Circuit Breaker. In addition, an operation recording test shall be made at the factory and copies of the charts shall be furnished to the Owner as record information.

2. Certified test reports for tests performed by the Manufacturer shall be submitted for review prior to shipment.

C. Instruction Manual

The Contractor shall provide one bound paper copy of an instruction manual, conveniently mounted inside the door of each circuit breaker or circuit switcher, plus three additional copies. The cover
sheet shall reference the applicable serial number(s), date of manufacture, and the Owner’s name and purchase order number. The instruction (operation and maintenance) manual shall contain, as a minimum:

a. Instructions for receiving, storing and installing the Equipment; including recommended installation procedures and tests

b. Operating instructions

c. Maintenance instructions; including preventive maintenance schedule, required lubricants, adjustment values, and recommended periodic testing

d. Final approval drawings and assembly drawings; full size, or reduced to 11”x17” if legible

e. Test data and curves

f. Original manufacturer's catalog or part numbers for all components, including, without limitation, relays, switches, coils, fuses, mechanism components and all other parts which might require maintenance or replacement in the normal operation of the device.

D. Final "as-built" submittals shall be furnished on a USB drive in a format compatible with AutoCAD 2013 (two copies).

1.5 DELIVERY, STORAGE AND HANDLING

Deliver the Equipment with all manufacturers' tags and labels intact. Handle and store the Equipment in such a manner so as to avoid damage to the units.

1.6 WARRANTY

A. The equipment Manufacturer's warranty period shall extend a minimum of two years from date of delivery.

B. The equipment Manufacturer's extended warranty shall include all parts of the Equipment regardless of original manufacturer.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. All material and equipment shall be new, approved and labeled, where required, by UL. Only products by manufacturers regularly engaged in production of specified units will be acceptable.

B. Where two or more units of the same class of equipment or materials are required, provide all units from a single manufacturer.

C. Provide materials and equipment of suitable material to perform satisfactorily when exposed to conditions of project site.
2.2 CIRCUIT BREAKER

A. The breaker shall have the following ratings:

1. Maximum kV RMS      123
2. Range Factor (K)      1.0
3. Frequency       60 HZ
4. Continuous Current at 60 HZ 2,000 Amps RMS
5. Low-Frequency 1 Minute Dry RMS kV  260
6. Impulse Full Wave Withstand kV Crest 550
7. Rated Interrupting Time Maximum 3 Cycles
8. Rated Permissible Tripping Delay (Y) 1 Second
9. Short Circuit Current at Rated Max. kV 63 kA RMS
10. Maximum Symmetrical Interrupting Capability 63 kA RMS
11. Closing and Latching Capability 164 kA RMS
12. 3-Second Short Time Current Carrying Capability 63 kA RMS
13. Power Requirements:
    Control Voltage Close and Trip 125 VDC
    Motors and Heaters Voltage as designated with order

B. Breakers shall pass all tests outlined in ANSI/IEEE C37.04, and meet the ratings outlined in ANSI/IEEE C37.06 when tested per the procedure in ANSI/IEEE C37.09.

C. The breaker shall meet the requirements of a Class C2 rating as defined in the latest IEEE std C37.09.

D. The breaker shall be independent-pole operated.

2.3 OPERATING MECHANISM

A. The operating mechanism shall be spring-operated. One mechanism per phase shall be provided. The maximum interrupting time shall be as specified above.

B. The operating mechanism charging motor shall be a universal type rated 120VAC/125VDC, 500W or less. The motor will operate at 125VDC unless otherwise specified.

C. The closing mechanism shall be stored energy type. Closing of the circuit breaker shall completely charge all stored energy devices so that the circuit breaker is ready for all subsequent operations that may be required.

D. The circuit breaker shall provide local and remote alarms for failure of the stored energy devices to fully charge subsequent to a close operation of the circuit breaker. Alarm must activate when stored energy devices fail to charge, regardless of whether the breaker contacts are open or closed.

E. The operating mechanism shall be designed for both local and remote control. Local control shall be via the use of a Manufacturer provided control switch located in the circuit breaker control cabinet.
F. A manually operated tripping device mounted on the exterior of the breaker is not required.

G. The discharge of the closing spring shall automatically charge the tripping spring.

H. Redundant trip circuits shall be provided (dual trips, independently wired, independently fused).

I. The mechanism shall have a means of indicating breaker position. This indicator shall be visible without having to open a cabinet door.

J. A minimum of ten "52a" and twelve "52b" auxiliary contacts shall be wired out to terminal blocks for the customer use. Any unused auxiliary contacts shall also be wired out to terminal blocks for customer use.

K. The standard operating duty shall be O-0.3 sec.-CO-15 sec.-CO.

L. Spring-operated mechanisms shall be so arranged that a closing operation cannot be started before the spring is in its fully charged position.

M. The operating mechanism shall be constructed using all steel parts. No phenolic parts are to be used in any part of the operating mechanism.

N. A non-resettable mechanical operation counter and a spring position indicator shall be provided and visible with the cabinet doors closed.

O. All alarm contacts shall close to alarm.

P. The control power and mechanism power shall be designed to be fed by separate sources. The circuits shall be such that the customer can easily jumper both to one source, if desired.

Q. The spring charging motor shall be easily accessible for replacement through the cabinet door.

R. The operating mechanism shall be adequate to perform the operating duty specified above between maximum SF6 operating pressure and lockout pressure.

S. The operating mechanism and linkage shall be totally enclosed so as to protect the mechanism from the environment and access by rodents, birds, snakes and other creatures.

2.4 BUSHINGS

A. Bushings shall conform to the latest NEMA and ANSI / IEEE standards.

B. All bushings shall be made of porcelain. The bushings color shall be “sky gray”. The internal surface of the bushing shall be glazed.

C. Utilities Commission of New Smyrna Beach may consider alternatives to porcelain such as composite bushings. The Manufacturer shall supply any and all necessary information required to evaluate the use of the alternative material with his bid. The information shall include factory test reports, material composition information and users list with names and phone numbers.
D. The bushings shall be equipped with 4-hole NEMA pad terminals.

E. The bushings' BIL shall be as follows:
   123 kV Circuit Breakers - 550 KV

F. Each bushing shall be furnished with a nameplate permanently mounted on the flange such that it can be easily read with the bushing installed, or nameplate shall be mounted inside the cabinet door. The nameplate shall be made of stainless steel and the following information should be stamped:
   Manufacturer
   Type
   Serial Number
   Catalog and or Drawing Number
   Year of manufacture
   Rated Voltage
   Rated Current
   Basic Impulse Level (BIL)
   Weight

G. The Manufacturer shall ship the breaker with the bushings installed when possible.

2.5 CURRENT TRANSFORMERS

A. The current transformers shall be designed, built and shall be expected to perform as per the latest version of ANSI/IEEE C57.13.

B. The CT’s shall be multi-ratio with a maximum ratio of 2000/5 and thermal rating factor of 2.0.

C. Multi-ratio bushing current transformers shall be provided in the power circuit breaker bushings. Each CT shall have a single turn primary with separate core. The accuracy class and primary current rating shall be C800 at 2000/5 TAP.

D. Each bushing shall have two (2) each CTs. On each bushing the “X” designation shall be the farthest from the interrupter and the “Y” designation shall be the closest to the interrupter.

E. The secondary tap leads of the current transformer shall be copper wire, No. 12 AWG minimum, 600 V insulation class and shall be brought out to shorting type terminal blocks complete with engraved white phenolic type marking strips (tape type labels are not acceptable) having the wire identities in black.

F. There shall be no cable splices in the current transformer wiring circuits.

G. Proper protection shall be provided between current transformers and mounting plates. Bolts and hardware shall be made to prevent rubbing or chafing of the current transformer insulation.

H. Current transformer terminal blocks shall have engraved phenolic type labels identifying bushing CT and CT lead numbers.
I. All the secondary leads shall be connected to the terminal blocks using ring type compression connectors.

J. All taps from the multi-ratio current transformers brought to the shorting type terminal blocks shall retain a logical physical orientation. Individual sets of current transformer terminations shall not be mixed with other sets of terminations (e.g. 1X-3X-5X and 2X-4X-6X CTs are grouped together).

K. Current transformers shall have a stainless-steel nameplate affixed to the inside of the cabinet door and shall contain the following information, as per ANSI/IEEE C57.13:
   - Manufacturer
   - Type
   - Serial Number
   - Date of manufacture
   - Rated Frequency
   - Rated Primary Current
   - Rated Secondary Current
   - Rated Continuous Thermal Current Factor
   - Accuracy Rating
   - Instruction Book Number

2.6 SF6 GAS SYSTEM

A. The Manufacturer shall furnish a complete SF6 gas system for each circuit breaker.

B. The gas system shall include pressure alarms, valves, dryers, filters and all accessories for filling, operation and maintenance of the circuit breakers.

C. The gas system shall be designed to automatically maintain the moisture content of the SF6 at an adequate level for proper operation.

D. The monitoring system shall be temperature compensated.

E. In addition to the regular gasket or “O” ring seal between the bushing and the dead tank, an RTV (silicon based) sealant shall be put along and between bushing flanges. This is to preserve the O-ring gasket and minimize SF6 leaks.

F. The Manufacturer shall furnish temperature compensated gas pressure gauges and gas density monitors.

G. The Manufacturer shall provide a ¼” tube fitting - a 37 degree AN male 7/16-20 flare type - for each circuit breaker.

H. The Manufacturer shall provide for filling the breaker, with the SF6 pressure gauge/density monitor in place and for testing the setting of the alarm contacts of the gauge/density monitor.

I. The SF6 normal operating pressure as well as the minimum SF6 pressure to interrupt full rated load and full rated fault current shall be stamped in the nameplate of each breaker.
J. The Manufacturer shall provide a valve arrangement to permit that any individual pole could be serviced without affecting the other two poles.

K. **SF6/Nitrogen mixtures are not acceptable.**

L. Each breaker shall be furnished with sufficient SF6 gas to maintain positive pressure and to provide for safe transport under pressure.

M. SF6 gas shall be new and shall conform to the latest version of ASTM D 2472, Standard Specification for Sulfur Hexafluoride.

N. The Manufacturer shall furnish the necessary insulating SF6 gas to fill the breaker to operating pressure.

O. All the SF6 gas lines, as well as all the valves used in the SF6 gas system shall be stainless steel 316 and should be manufactured specifically for SF6 handling.

P. All fittings shall be manufactured by welded brazing and/or compression fittings with o-ring seals.

Q. All valves shall be manufactured by Qualitrol or approved equal.

R. Where gas pipelines are exposed to possible damage, conduit, enclosed tray, or other mechanical protective means shall be furnished to adequately protect them from damage.

S. Moisture tests shall be performed on the SF6 gas for each circuit breaker before they leave the Manufacturer’s facility. The results of these tests shall be included in the test report of each breaker.

T. The Manufacturer shall provide gas-sampling valves in places that will be safe to take samples while the breaker is energized. Furthermore, the location of these sampling valves should be in a way that will not cause false trips to occur.

U. Isolating valves for the SF6 pressure switches, gauges, density monitor, etc., shall be provided to be able to replace any one of the subject components without having to remove the SF6 gas from the breaker.

V. The circuit breakers shall be designed to operate on decreasing SF6 pressure as follows:

1. **1st Stage - Alarm (Annunciator)**
   The pressure setting of this 1st stage alarm shall be the pressure where the Manufacturer believes the drop in pressure is caused by a SF6 leak.
   The pressure setting shall be determined by the Manufacturer.

2. **2nd Stage - Block Close and Trip**
   The pressure setting of this 2nd stage shall be the minimum safe pressure required to operate the breaker (open and close). This pressure setting shall be determined by the Manufacturer.

3. **3rd Stage - Breaker Failure Emergency Alarm (RTU)**
The pressure setting of this 3rd stage alarm is to inform the System Operator that the breaker SF6 pressure is reaching a critical point.

4. 4th Stage - Automatic Breaker Failure
The pressure setting of this 4th stage shall be the pressure at which the dielectric strength of the breaker is compromised.

W. The Manufacturer shall provide a cut-off switch which disables the breaker failure pressure switch during the gas filling or removal process. The cut-off switch shall be physically located adjacent to the gas filling sampling valve. The cut-off switch shall be readily identifiable with labels and provide on/off position indication.

X. Two pressure switches shall be provided for redundancy.

Y. The pressure switches can be installed in the same SF6 gas line or on separate lines.

Z. The contacts of these pressure switches shall be wired such as either one of the contacts intended for a specific function shall trigger the event without depending on the other contact.

AA. The Manufacturer should consider the pressure range between the 1st stage and the 4th stage operations, listed above, to determine if that could be accomplish with one pressure switch. If the pressure range is beyond the operational range of the pressure switch, the Manufacturer shall provide additional pressure switches, two or more as required, to accomplish the requirement of stated above. In this case, the total amount of SF6 pressure switches required will be four (4) with the requirement as stated above.

2.7 CONTROL CABINET AND ENCLOSURES
Enclosures for operating mechanism, compressors or pumps, wiring terminations, and relays and controls shall be weatherproof stainless steel or aluminum, mounted on the supporting framework.

A. All enclosures shall be mounted not less than 18 inches above the framework baseplate.

B. The control cabinet, besides the operating mechanism, shall include all connections, wiring and linkages for a complete installation along with at least the following conditions and or items:

1. One (1) auxiliary switch:
   With at least ten (10) spare ‘a’ contacts and ten (10) spare ‘b’ contacts for owner’s use, in addition to what the Manufacturer uses for circuit breaker control. The auxiliary switch contacts shall be wired out to terminal blocks, which shall be grouped together.

2. One (1) universal type spring-charging motor (125 VAC/VDC).

3. Dual 125 VDC trip coils per pole (magnetically and electrically independent) with disconnecting knife switches. Primary trip coil circuits for all three poles may be fused together, but shall be separately fused from secondary trip coils.

4. One (1) 125 VDC close coil per pole, separately fused.
5. One (1) 120 VAC GFI convenience receptacle to be mounted in an accessible location, separately protected by a circuit breaker.

6. SF6 gas pressure gauge calibrated in pounds per square inch.

7. An operation counter that shall be located in the mechanism housing and conveniently read from ground level.

8. An external mechanical pull emergency trip device shall be provided. This device shall not bypass the circuit breaker safety and block features.

9. Besides the alarm points specified above, a “Loss of DC Power” alarm point shall also be provided.

10. In a separately fused circuit, indicating lights at the breaker shall be provided for each separate alarm function. The Manufacturer shall supply push button switches to test the indicating lamps.

11. The Manufacturer shall provide one (1) spare contact for remote indication of each of the alarmed points.

12. A control switch with red and green flags shall be used for local close and trip.

13. One (1) hand closing lever for manually closing the circuit breaker per breaker.

14. The Manufacturer shall provide knife blade fuses for the close and trip circuits only.

15. These fuses shall be labeled with circuit name and amp rating. **Tape type labels are not acceptable.**

16. The Manufacturer shall supply a spare fuse block, which shall be modular type with Bakelite frame and reinforced retaining clips to prevent accidental removal or dropping out due to vibration.

17. The spare fuse block shall contain two (2) spare fuses for the close circuit and two (2) spare fuses for the trip circuit.

18. All other circuits shall be protected by circuit breakers.

19. The wiring of the closing circuit shall be such that the closing motor is separately protected by a circuit breaker from the closing control circuits.

20. The Manufacturer shall install double-pole single throw switches for the trip and close circuit isolation.

21. All surge protection devices shall be accessible and provide visual indication upon failure.
22. Two (2) copper-faced or stainless steel 2-hole ground pads shall be provided on diagonally opposite corners of the structural frame of the high voltage compartment to provide convenient connection of ground grid lead with routing adjacent to breaker leg. Provide two (2) bolted bronze type grounding terminals for #4/0 copper conductor, Hubbell/Anderson Cat. No. SWL-025B or equal.

C. All enclosures shall be sufficiently rigid to prevent warping of doors and to ensure positive operation of doors and latches. Design of the enclosures shall be such that overlapping metal surfaces are sealed to prevent corrosion. Welds, if used, shall be full-penetration throughout.

D. Doors shall be hinged and shall have heavy duty 3-point latches. Hinges and pins shall be stainless steel. Each door latch shall be lockable in the latched position with a padlock having up to a 3/8-inch shackle and a one-inch clear opening when locked closed. Devices shall be provided on the hinge end of doors and swing panels to hold them in the open position while work is being performed in the cabinet.

E. A conduit entrance with removable cover plate shall be located in the bottom of each enclosure. Location of the entrance(s) in the mechanism housing(s) shall be such that remote cables can be easily terminated on terminal blocks without routing through the operating mechanism(s).

F. Suitable ventilating holes shall be provided and located in each enclosure to permit proper air circulation. The vents shall be durable, maintenance free, and designed to prevent entry of water and insects.

G. One or more space heaters shall be furnished and mounted in each enclosure to prevent condensation.

H. All enclosures shall be securely grounded to the equipment frame.

I. Provide breather and drain fittings in all raceways between enclosures, if applicable, to prevent condensation or trapping of moisture.

J. One bronze ground bar or copper grounding bus bar, with minimum of 10 connection points for CT and control wiring circuit grounds.

1. The ground bar shall be bonded to the cabinet ground, which is in turn bonded to the frame ground.

2. Ground conductor terminations shall be limited to one conductor per opening or lug. Set screw type ground bar shall have hex (Allen) heads.

2.8 TERMINAL BLOCKS AND CONTROL WIRING

A. Wires to be terminated and individual termination points on terminal blocks shall be clearly marked for circuit identification and shall be terminated on terminal blocks, which are also to be marked for circuit identification (device codes etc.). Labels to be engraved plastic, or phenolic type labels; tape, paper, composition, etc. will not be acceptable.
B. The terminal block arrangement and location shall be such that incoming and outgoing cables can be supported. Adjacent rows of terminal blocks shall be separated at least 6” edge to edge, and at least 6” from sides, top or bottom of the cabinet for all wiring which will be done in the field by a contractor furnished by UCNSB. Wiring done at the factory may be made in a space, which is less than 3”.

C. If terminal blocks are located within 6” of corners, top or bottom, the Manufacturer shall offset them at a 45-degree angle so as to facilitate easy termination.

D. Terminal blocks shall have an engraved phenolic type white marker strip having the wire identities in black as shown on the Manufacturer’s certified drawings and shall be supplied for the following:
   1. Control circuits
   2. Current transformer leads
   3. Motor leads
   4. Heater leads
   5. Any other equipment controls, instruments, meters, and relays requiring external connections.

E. Penn Union, G.E. or Westinghouse heavy duty shorting blocks shall be used for terminating the CT secondary.

F. For easy removal by the customer, terminal blocks shall be secured to permanently mounted brackets with tapped holes or to a welded nut with which block mounting screws are threaded into.

G. The Manufacturer shall provide a 24-pole terminal strip. This terminal strip shall be for the customer’s use to interconnect for remote breaker control. One side shall be left open for customer use; the other side will be for Manufacturer’s connections. The terminal blocks for remote breaker control shall be grouped together.

H. All control wiring shall be terminated in the operating mechanism housing with the terminal strip designation in accordance with the coding shown on the wiring diagrams.

I. All terminal and device codes shall be shown and properly labeled on the schematic drawings. The device codes shall be permanently labeled on the panel inside of the breaker control cabinet.

J. All wiring diagrams shall be drawn with all the devices indicated in their relative physical locations and shall represent the equipment and terminals arranged, as they would appear to the person wiring the equipment.

K. All control wiring shall be identified at both ends with wrap around markers carrying the same wire marks as shown on the Manufacturer’s certified drawings and shall be supported in such a manner as to permit visual tracing of all the wires. Wiring marking shall be performed by the use of T & B “E-Z Code” self laminating adhesive material or equal.
L. Circuit code labels are not to be installed over crimped connections, as a visual inspection of the crimp is required.

M. Wiring ductwork shall be of such design to provide access to all wiring. Otherwise, grouping of wires to be exposed and tie-wrapped for neatness.

N. All Manufacturer’s connections to the interconnecting terminal blocks shall be made on one side only, leaving space on the other side for the customers connections.

O. The Manufacturer shall mount two (2) twelve-point terminal blocks as spares for the customer’s use.

P. All cabinet wiring other than AC and or DC buses shall be AWG #12, tinned copper, 65 strand, G.E. type Vulkene switchboard wire SI-57275, 600 V, gray insulation.

Q. The Manufacturer shall have no more than three (3) conductor terminations per terminal strip pole nor more than two (2) conductor terminations per relay or component terminal point.

R. Non-insulating ring-type compression terminal connectors shall be used on all terminals.

S. Ring type, solderless, barrel type compression connectors such as Burndy hylug or approved equivalent shall be used for all terminations and connections within the breaker.

T. All terminal block individual termination point studs shall utilize 3/32” thick nuts.

U. The Manufacturer shall furnish all conduits necessary for inter-connecting all electrical control systems within the breaker.

V. Conduit joints and fittings shall be dust tight and watertight.

W. Conduits shall not be filled to more than 50% capacity.

2.9 SYNCHRONOUS SWITCHING (POINT-ON-WAVE) DEVICE

A. The circuit breaker and synchronous switching device shall be configured to provide pole closing at zero phase voltage based on a reference voltage input for energizing a three-phase, grounded wye or ungrounded wye connected capacitor bank. Bus orientation and voltage rotation shall be provided when the order is placed.

B. The synchronous switching device shall be capable of performing both synchronous closing and opening without requiring reprogramming of the synchronous switching device or rewiring of the breaker. All wiring and programming shall be completed prior to shipment of the breaker.

C. The synchronous switching device shall record up to 200 operations. The most recent 40 operations shall also display the operation waveform. All operations and waveforms shall be downloadable via a local communication port. A cursor function shall be available to determine time deviation for detailed analysis of synchronous switching operation.
D. The synchronous switching device shall be micro-processor based and allow for future software and firmware upgrades as necessary.

E. The synchronous switching device shall have a self diagnostic feature that will automatically run if the power to the controller is cycled.

F. The synchronous switching device shall have a bypass mode allowing the breaker to operate even if the synchronous switching device has an error alarm. All alarms shall be logged in the controller and able to be downloaded. A description of each alarm/error shall be available within the controller software.

G. The synchronous switching device shall operate a capacitive circuit minimizing the network transient under 10%.

H. Pole disagreement shall cause a tripping signal to be sent to the closed poles of the circuit breaker after an adjustable time delay of 0 to 5 seconds. Other time ranges, which may be required by the operating characteristics of the circuit breaker, may be acceptable. The pole disagreement circuit is preferred to be in trip circuit #1.

I. The anti-pump circuit shall be fully operative for all three poles.

J. The mechanical scatter shall not be greater than +/- 1 ms from the target make point.

K. The synchronous switching device shall require no periodic adjustments over its life.

L. The breaker shall not be required to operate periodically to maintain its synchronous switching accuracy.

M. The synchronous switching device shall adapt for:

1. Environmental Conditions
2. Control Voltage
3. Temperature
4. Mechanical Conditions
5. Mechanism Scatter
6. Mechanism hysteresis over time

2.10 METAL PREPARATION AND PAINTING

A. Galvanized parts furnished on the equipment shall be hot dip galvanized in accordance with ASTM A123.

B. Prior to painting, all surfaces shall be cleaned by sandblasting, shot-blasting, or be solvent-, steam- or pressure-washed to remove all dirt, grease, rust or mill scale.
C. After cleaning, all surfaces shall be degreased using an appropriate commercially available degreasing solution and rinsed with clean water and dried prior to application of the primer coats.

D. After the metal has been cleaned and pretreated, it shall be primed and painted by the Manufacturer’s best quality paint process suitable for the environment of the equipment installation. Color shall be ANSI 61 or ANSI 70 gray.

E. Complete painting procedures must be submitted to the Owner for review. Written acceptance must be received prior to paint application.

F. For a spray-type process, two coats of an epoxy primer shall be applied to a minimum thickness of 1 mil per coat. Adequate drying time shall be allowed between coats to insure proper bonding. The primed material surface shall be sprayed with three finish coats of the manufacturer's best quality paint. Each coat shall have a minimum dry thickness of 1 mil for an overall dry film thickness of 5 mil, including finish and prime coats.

G. The interior surfaces of the equipment cabinets and control compartments shall be treated and finished to prevent rust and corrosion.

2.11 NAMEPLATES

Stainless steel nameplates shall be furnished in accordance with IEEE C37.04, mounted at a height for easy reading. All pertinent data of the circuit breaker or circuit switcher, operating mechanism, current transformers and accessories shall be marked on the associated equipment nameplate. The Owner’s purchase order number shall be added to the equipment nameplate. Appropriate instructions and warning signs shall be located at essential locations.

PART 3 EXECUTION

3.1 SHIPMENT, DELIVERY AND INSTALLATION

A. The Equipment shall be completely assembled, wired and tested at the factory. All necessary provisions shall be made to insure that Equipment is maintained in a dry condition.

B. Circuit Breakers shall be shipped in the position (open or closed) as recommended by the Manufacturer. The Equipment shall be shipped to its destination upright and as complete as possible consistent with shipment limitations and protection of the Equipment.

C. The Equipment Contractor shall advise the Owner not less than ten days in advance of the method of shipment and anticipated date of arrival. Delivery shall be scheduled on normal business days during normal business hours. Final notice of at least 48 hours (not counting weekends and holidays) must be given prior to delivery to enable the Owner to make necessary arrangements.

1. Notice shall be given to:
   Louis Benishek
   Electric Substation Supervisor
   Utilities Commission, City of New Smyrna Beach
   200 Canal Street
D. The Equipment furnished hereunder shall be delivered to the site complete and ready for installation. The Contractor shall furnish any special tools required for assembly and installation, and shall furnish touch-up paint to match any painted surfaces.

1. If spare parts are included in the Purchase Order, they shall be furnished along with the shipment of the equipment. Spare parts which are sensitive to humidity shall be sealed in appropriate airtight containers complete with desiccant.

E. The Contractor shall make all necessary provisions required for the assembly, handling, and transportation of the Equipment.

F. The Contractor shall assume responsibility and handle all claims if there is damage in transit.

G. The substation Contractor shall place, level and secure the Equipment on the foundations. Connections to source, load, and ground terminals, and connections of low voltage power, CT, and control circuits to incoming terminals will also be provided by others.

3.2 INSTALLATION TESTS

A. Upon the Owner's request and with separate authorization, the Equipment Contractor shall make available a fully qualified factory-trained service engineer to instruct Owner's personnel in the proper operation, adjustment, test, and maintenance of the Circuit Breakers.

B. All acceptance testing and commissioning of the Equipment shall be performed by the Contractor per the NETA-ATS standards.

C. The testing procedure shall include the following elements.

1. A complete outline of the testing procedures will be reviewed by the Engineer, and comments will be incorporated before installation testing commences at the site.

2. The circuit breaker shall receive and pass all production tests as per ANSI C37.09. In addition, a test of contact alignment, a Ductor Resistance Test, and a Hi-Pot Test will be performed.

3. All current transformers will be checked for ratio, saturation excitation, and polarization. The correct location and polarity as per identification marking will be verified.

4. Copies of a complete written report will be submitted to the Engineer, identifying test equipment, the test procedures followed, and the “as-found” and “as left” condition of equipment tested.

5. The Engineer will receive final field test results, including the technician’s field copied test sheets, before the Equipment is considered ready to be put into service.
3.03 FIELD SERVICES

The services of a fully qualified factory-trained service engineer shall be made available in accordance with the following schedule:

A. A fully qualified manufacturer’s service engineer must be available upon 24-hours notice.
PART 1  GENERAL

1.1  SUMMARY

A. The work consists of furnishing a Shunt Capacitor Bank as herein specified, delivering the Equipment to the substation site, installation, testing, and commissioning. Equipment shall be designed, built and delivered completely wired, tested and ready for installation.

B. This specification covers the design, rating, features, construction, testing, shipment, documentation of High Voltage Shunt Capacitor Banks to be used by the Utilities Commission of New Smyrna Beach (UCNSB).

C. As used herein, “Manufacturer” shall mean the firm with facilities and expertise, regularly engaged in the design, production, assembly and testing of high-voltage shunt capacitor banks.

D. As used herein, “Equipment Contractor” or “Contractor” shall mean the person, firm, or Corporation whose bid is accepted and to whom the Owner has issued a Purchase Order or Contract.

1.2  REFERENCES

The Capacitor Bank, accessories, and equipment shall be of a design accepted as standard except as otherwise specifically stated herein. The work shall as a minimum conform to applicable provisions of the latest edition of the following standards, except as modified herein.

A. Institute of Electrical and Electronics Engineers
   IEEE 18-2012    Standard for Shunt Power Capacitors
   IEEE 1036-2010  Guide for Application of Shunt Power Capacitors
   IEEE 60871-2    Shunt Capacitors Endurance Testing
   IEEE C37.99-2012 Guide for Protection of Shunt Capacitor Banks
   IEEE 693-2005   IEEE Recommended Practices for Seismic Design of Substations

B. American Society for Testing and Materials (ASTM):
   A 123    Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

1.3  DESIGN AND PERFORMANCE REQUIREMENTS

The workmanship, design and materials shall be of the highest quality and the most suitable for the application. The materials and equipment shall be new, of proven manufacture and free from defects. The design shall provide maximum mechanical and electrical strength and shall include ample safety factors to cover the maximum voltage rating and current rating of the Equipment.
1.4 SUBMITTALS

The Contractor shall provide a complete Schedule of data submittals within ten days of the receipt of Purchase Order.

The Contractor shall submit Adobe PDF copy of the required Submittals by e-mail for review and approval by the Owner. Review by the Owner or their representative is for determining conformance with this Section and related documents. It does not relieve the Manufacturer of responsibility for quantities and compatibility of components.

Submittals will be marked with any comments and returned to the Contractor by e-mail within ten business days after receipt, if possible. Manufacturing shall not begin until the required Shop Drawings are reviewed and approved with “No exceptions noted” or “Approved as noted”.

A. Shop Drawings

Shop drawings shall be submitted within 60 days of the receipt of Purchase Order.

1. Capacitor Bank submittals shall include:
   
a. Equipment outline and assembly showing: total weight, all principal features and dimensions.
   
b. Capacitor Bank Nameplate
   
c. Insulator data
   
d. 3-Line diagram of capacitor unit configuration and ratings.
   
e. Bill of Material / Parts bulletin.
   
f. Description of Manufacturer’s paint process
   
g. Manufacturer’s recommended installation tests.
   
h. Certified reports of type tests to demonstrate compliance of capacitor design with industry standards and published data.

2. Drawing title block shall include the Owner’s name, purchase order number, and the name of the substation.

B. Factory Tests

1. Each capacitor design shall have successfully passed design tests described in ANSI/IEEE 18-2012 with the following additional test requirements:

2. Aging test: During this test, the test unit shall be placed in a chamber with ambient temperature adjusted to achieve the required dielectric temperature. This dielectric temperature shall be at least 50 °C. Testing time shall depend on test voltage applied, i.e. 1.4 x Un for 1000 hours, or 1.25 x Un for 3000 hours. (refer to IEC 60871-2)
3. Production tests: Terminal-to-terminal test per IEEE, STD 18™-2012 section 7.2.1 but must withstand for at least 10 seconds, ONE of the following two tests:
   a. A direct current (DC) test voltage at 4.5 times rated (rms) voltage
   b. An alternating sinusoidal voltage (AC) of 2.3 times rated (rms) Voltage.

C. Instruction Manual

   The Contractor shall provide one bound paper copy of an instruction manual, plus three additional copies. The cover sheet shall reference the applicable serial number(s), date of manufacture, and the Owner’s name and purchase order number. The instruction (operation and maintenance) manual shall contain, as a minimum:
   1. Instructions for receiving, storing and installing the Equipment; including recommended installation procedures and tests
   2. Maintenance instructions; including preventive maintenance schedule and recommended periodic testing
   3. Final approval drawings and assembly drawings; full size, or reduced to 11”x17” if legible
   4. Test data
   5. Original manufacturer's catalog or part numbers for all components and all parts which might require maintenance or replacement in the normal operation of the device.

D. As-Built

   Final "as-built" submittals shall be furnished on a USB drive in a format compatible with AutoCAD 2013 (two copies).

1.5 DELIVERY, STORAGE AND HANDLING

   Deliver the Equipment with all manufacturers' tags and labels intact. Handle and store the Equipment in such a manner so as to avoid damage to the units.

1.6 WARRANTY

   A. The equipment Manufacturer's warranty period shall extend a minimum of two years from date of delivery.

   C. The equipment Manufacturer's extended warranty shall include all parts of the Equipment regardless of original manufacturer.
PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. All material and equipment shall be new, approved and labeled, where required, by UL. Only products by manufacturers regularly engaged in production of specified units will be acceptable.

B. Where two or more units of the same class of equipment or materials are required, provide all units from a single manufacturer.

C. Provide materials and equipment of suitable material to perform satisfactorily when exposed to conditions of project site.

D. MATERIAL OR DESIGN CHANGES: Approval as Supplier of equipment covered by this Specification includes approval of the specific design(s) and materials last submitted for approval by CITY OF NEW SMYRNA BEACH's Electrical Engineering Department. Following approval, Supplier shall not make changes in the design or materials without prior approval of CITY OF NEW SMYRNA BEACH's Electrical Engineering Department. Failure to comply with this requirement may result in withdrawal of approval.

E. RESPONSIBILITY OF CONTRACTOR: Furnishing and delivering materials in accordance with this Specification is the sole responsibility of Contractor. This responsibility is not relieved by waiving of inspection, routine release by Engineer or acceptance of delivery at a CITY OF NEW SMYRNA BEACH materials facility.

2.2 SHUNT CAPACITOR BANK

A. The Shunt Capacitor Bank shall be an outdoor type 3-Phase ungrounded wye-wye assembly, shunt connected and used for kVAR control.

B. The 3-phase capacitor bank shall have the following ratings:

1. Maximum voltage 123.3 kV
2. Nominal voltage 115 kV
3. Rated Frequency 60 Hz
4. Basic Impulse Insulation Level 550 kV BIL
5. Rate Reactive Power 31.2 MVAR
6. Capacitors per series group 4
7. Parallel series groups per phase 4

C. The capacitor bank(s), outdoor type, shall be suited to operate in an ambient temperature range of -50°C to +50°C.

D. The capacitor bank structure, units and hardware shall be suitable for use in a seacoast marine environment.

E. Each phase shall consist of two (2) parallel wye-wye connected groups. The Phase groups shall consist of one (1) string in parallel with three (3) strings with provisions to connect at CT in between the parallel groups, see Figure 1. Each string shall consist of four (4) 650kVAR, single phase, 17.8kV capacitors.
F. One (1) string of each phase shall have three (3) 40kA, 600A Fused hookstick shorting switches connected as shown in Figure 1.

![Figure 1 – 3-Line Diagram]

2.3 CAPACITOR UNITS

A. The capacitor units shall be fuseless, extra heavy duty with the ratings and requirements as follows:

1. Rated voltage 17.8 kV
2. Nominal voltage 16.6 kV
3. Rated Reactive Power 650 kVAR
4. Basic Impulse Insulation Level 150 kV BIL
5. Number of internal series groups 9
6. Rated Frequency 60 Hz
7. Minimum External Creep Distance 23.6 in
8. Nominal Capacitance 5.44 μF
9. Tolerance at 25° C -0/+5 %
10. Number of Bushings 2
11. Stud Size and Thread M16

B. Standard case material shall be AISI 304 stainless steel with a 59 mil minimum thickness. All hardware shall be AISI 316 stainless steel (corrosion resistance).

C. Case design, including bushing seals, shall be such as to ensure that the capacitor will remain hermetically sealed throughout its life.

D. Color shall be No. 70 Light Gray per ANSI Standard No. 255.1.
E. Location of the mounting bracket may be varied slightly at the choice of Supplier provided that the point of lift is above the center of gravity. The underside of the mounting brackets shall be unpainted to provide for good electrical contact when bolted to the capacitor bank frame.

F. Capacitors shall have two bushings of glazed wet-process porcelain or an approved equivalent attached by solder-sealing or other approved method.

G. The bushings shall be equipped with a tinned solid bronze stud and parallel groove bolted terminal connector suitable to accommodate a minimum range of conductor sized from #8 solid through #2/0 AWG stranded CU/AL. The bushing flange shall be welded to the capacitor case.

H. Capacitors shall have a decal affixed to the narrow side of the case advising that the fluid does not contain PCB. The decal shall have a blue background with white or silver lettering.

I. Paint: ANSI #70, 2 part epoxy process, 2 coats, sky gray color. Prior to applying paint finish, capacitor case should be sandblasted to allow for proper adhesion. Minimum dry paint thickness of 3.2 mils (corrosion resistance).

J. Bushing seals shall have adequate mechanical strength and flexibility to withstand reasonable cantilever moment or impact without damage, for seismic concerns.

K. SOLID INSULATION: The internal elements shall be the all-film type and shall contain no craft paper. The solid dielectric material shall consist of a minimum of 2 sheets of polypropylene film. The dielectric fluid shall be a biodegradable non PCB fluid (as defined by the EPA), with high dielectric strength and temperature stability. The aluminum foil electrodes shall be folded at the edges and the element connections shall be soldered. Laser cut foil is not acceptable. The series groups should be completely insulated (full length of the elements) from other series groups.

L. Capacitor losses (stabilized) shall not exceed 0.12 watts per kVAR when the capacitor is energized at rated voltage in an ambient temperature of 40°C.

2.4 CONSTRUCTION

A. All rack and bus insulators shall be apparatus station post in accordance with ANSI C29.9.

B. All insulators shall be porcelain and ANSI Z55.1 No. 70, light gray.

C. Centerline-to-centerline spacing of each stack shall be 180 inches

D. Rack material shall be Galvanized steel conforming to ASTM A36 with hot-dipped galvanized finish (ASTM A123).

2.5 METAL PREPARATION AND PAINTING

A. Galvanized parts furnished on the equipment shall be hot dip galvanized in accordance with ASTM A123.

B. Prior to painting, all surfaces shall be cleaned by sandblasting, shot-blasting, or be solvent-, steam- or pressure-washed to remove all dirt, grease, rust or mill scale.
C. After cleaning, all surfaces shall be degreased using an appropriate commercially available degreasing solution and rinsed with clean water and dried prior to application of the primer coats.

D. After the metal has been cleaned and pretreated, it shall be primed and painted by the Manufacturer’s best quality paint process suitable for the environment of the equipment installation. Color shall be ANSI 61 or ANSI 70 gray.

E. Complete painting procedures must be submitted to the Owner for review. Written acceptance must be received prior to paint application.

F. For a spray-type process, two coats of an epoxy primer shall be applied to a minimum thickness of 1 mil per coat. Adequate drying time shall be allowed between coats to insure proper bonding. The primed material surface shall be sprayed with three finish coats of the manufacturer's best quality paint. Each coat shall have a minimum dry thickness of 1 mil for an overall dry film thickness of 5 mil, including finish and prime coats.

G. The interior surfaces of the equipment cabinets and control compartments shall be treated and finished to prevent rust and corrosion.

2.6 NAMEPLATES

Stainless steel nameplates shall be furnished in accordance with IEEE C37.04, mounted at a height for easy reading. All pertinent data of the circuit breaker or circuit switcher, operating mechanism, current transformers and accessories shall be marked on the associated equipment nameplate. The Owner’s purchase order number shall be added to the equipment nameplate. Appropriate instructions and warning signs shall be located at essential locations.

2.7 ACCESSORIES

A. PORTABLE CAPACITANCE METER:
A handheld portable capacitance meter and software shall be supplied to facilitate the measurement of a capacitor unit’s capacitance without disconnection of any capacitor leads. The meter shall have a capacitance range of 0 to 1000 microfarads. All capacitance measurements shall be stored and time stamped including the temperature. The data shall be easily downloadable to a PC for storage and analysis. The ABB type CB2000 is the only acceptable model.

B. LIFTING DEVICE:
The manufacturer shall supply a capacitor lifting device per substation to facilitate the safe removal and installation of a capacitor unit without the use of chains, hooks or pulley system. The device shall connect directly to the bank rack structure above the unit being removed or installed. It shall be constructed of lightweight aluminum (less than 50 lbs) and be capable of handling capacitors weighing up to 200 lbs. The device shall consist of a rail assembly retaining support, trolley and winch. The device must be operable by a single crew member and suitable for the installation of any of the approved manufacturer’s units.

2.8 PROTECTION SCHEME

A. The Capacitor bank shall have provisions for connection and mounting of a neutral CT and Resistive Protection Device (RPD) as shown in Figure 1.

B. The neutral CT and RPD will be provided by the Contractor per the design drawings.
PART 3   EXECUTION

3.1 SHIPMENT, DELIVERY AND INSTALLATION

A. The Equipment shall be completely assembled and tested at the factory. All necessary provisions shall be made to insure that Equipment is maintained in a dry condition.

B. The Equipment shall be shipped to its destination upright and as complete as possible consistent with shipment limitations and protection of the Equipment.

C. The Contractor shall advise the Owner not less than ten days in advance of the method of shipment and anticipated date of arrival. Delivery shall be scheduled on normal business days during normal business hours. Final notice of at least 48 hours (not counting weekends and holidays) must be given prior to delivery to enable the Owner to make necessary arrangements.

1. Notice shall be given to:
   Louis Benishek
   Electric Substation Supervisor
   Utilities Commission, City of New Smyrna Beach
   200 Canal Street
   New Smyrna Beach, FL 32168
   (386) 424-3167

D. The Equipment furnished hereunder shall be delivered to the site complete and ready for installation. The Contractor shall furnish any special tools required for assembly and installation, and shall furnish touch-up paint to match any painted surfaces.

1. If spare parts are included in the Purchase Order, they shall be furnished along with the shipment of the equipment. Spare parts which are sensitive to humidity shall be sealed in appropriate airtight containers complete with desiccant.

E. The Contractor shall make all necessary provisions required for the assembly, handling, transportation, installation, and testing of the Equipment

F. The Contractor shall assume responsibility and handle all claims if there is damage in transit.

G. The equipment foundations will be provided by the Contractor per the design drawings. The Contractor will place, level and secure the Equipment on the foundations. Connections to source, load, and ground terminals, and connections CT circuits to incoming terminals will also be provided by the Contractor.

3.2 FIELD SERVICES

The services of a fully qualified factory-trained service engineer shall be made available in accordance with the following schedule:

A. A fully qualified service engineer must be available upon 24-hours notice.

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. This specification covers the design, engineering, manufacture and testing of high voltage station class metal oxide lightning arresters.

1.2 QUALITY ASSURANCE

A. Comply with applicable portions of Section 16050, Basic Electrical Materials and Methods

B. Provide components that are the standard product of a manufacturer regularly engaged in the production of the required materials and equipment.

   1. The manufacturer shall be responsible for the design, construction, and proper operation of all components.

C. Comply with applicable standards including, but not limited to the most recent edition of the following:


   2. ANSI/IEEE C62.11

   3. ANSI/IEEE C62.22

   4. NEMA LA1

D. Design to provide satisfactory performance under the specified operating conditions.

   1. Suitable for outdoor unsheltered service and standard service conditions per IEEE C62.11.

   2. Suitable for grounded wye system configuration.

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01330, Submittal Procedures.

   1. Approval documentation shall include the following:

      a. Product datasheet including all ratings

      b. Outline drawing, showing dimensions and base drilling details.
c. Nameplate drawing

2. One bound instruction book shall be furnished with the equipment, containing the following information:
   a. List of all equipment furnished
   b. Storage and handling instructions
   c. Installation instructions
   d. Operation and Maintenance instructions

3. Final documentation shall include above items, plus
   a. Instruction book
   b. Test reports

PART 2 PRODUCTS

2.1 MANUFACTURERS
   A. Provide arresters from one of the following:
      1. Ohio Brass (Hubbell Power Systems)
      2. MacLean Power Systems
      3. ABB

2.2 GENERAL REQUIREMENTS
   A. Provide 115kV station class surge arresters as follows:
      1. Nominal System Voltage: 115kV line-to-line
      2. Maximum System Voltage: 121kV line-to-line
      3. System Frequency: 60Hz
      4. Energy Rating: 10 kJ/kV of MCOV, minimum
      5. MCOV: 76kV
      6. Duty Cycle: 96kV
   B. Provide 27kV station class surge arresters as follows:
1. Nominal System Voltage: 23kV line-to-line
2. Maximum System Voltage: 27kV line-to-line
3. System Frequency: 60Hz
4. MCOV: 15.3kV
5. Duty Cycle: 18kV

C. Provide polymer type arresters. There shall be no polymer to polymer joints.

D. Minimum cantilever strength shall be 6,000 in-lbs (for polymer arresters).

E. Arresters shall be furnished with a 4-hole NEMA terminal pad on the line side for mounting of a standard terminal connector.

F. Arresters shall have a ground clamp at the base to accept a 4/0 stranded copper ground riser.

G. Provide for vertical installation, surface mounting. Arrester shall have a 3 hole mounting base using a bolt circle diameter between 8.75” and 10.0”. Mounting bolts shall be ½” diameter, stainless steel.

H. All hardware shall be stainless steel.

I. Color shall be ANSI #70 – Sky Gray.

2.3 NAMEPLATE

A. Nameplate shall be stainless steel with engraved lettering.

B. Shall be permanently attached using non-corrosive hardware.

PART 3 EXECUTION

3.1 TESTING

A. The manufacturer’s standard design and production tests shall be performed to verify conformance with ANSI standards and the herein specified ratings.

3.2 INSTALLATION

A. Installation shall be by the Contractor.

END OF SECTION
Subsurface Soil Exploration and Geotechnical Engineering Evaluation
New Substation Equipment
UCNSB Field Street Substation
New Smyrna Beach, Florida

Ardaman & Associates, Inc.

CORPORATE HEADQUARTERS
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Branch Office Locations
Florida: Bartow, Cocoa, Fort Myers, Miami, Orlando, Port St. Lucie, Sarasota, Tallahassee, Tampa, West Palm Beach
Louisiana: Baton Rouge, Monroe, New Orleans, Shreveport

MEMBERS:
ASTM International
American Concrete Institute
Geoprofessional Business Association
Society of American Military Engineers
American Council of Engineering Companies
Dear Mr. Gardner:

As requested and authorized, we have completed a shallow subsurface soil exploration for the subject project. The purposes of performing this exploration were to evaluate the general subsurface conditions within the proposed equipment area and to provide recommendations for site preparation and foundation support. This report documents our findings and presents our engineering recommendations.

SITE LOCATION AND SITE DESCRIPTION

The site for the proposed improvements is located at the Field Street substation on the south side of the Utilities Commission of New Smyrna Beach at 350 Slaton Street, New Smyrna Beach, Volusia County, Florida (Section 45, Township 17 South, Range 34 East). The general site location is shown superimposed on the New Smyrna Beach, Florida U.S.G.S. quadrangle map presented on Figure 1.

The site is currently developed with the existing Field Street substation and associated equipment.

PROPOSED CONSTRUCTION AND GRADING

It is our understanding that the proposed construction includes a 115kV breaker and capacitor bank on flat slab foundations and a switch structure likely installed on a drilled shaft/pier.

For the purposes of our analysis, we have assumed the maximum loading condition for the structures to be less than 75 kips. Grading plans are not complete at this time, but we understand that 0 to 2 feet of fill may be required to raise the structure areas to final elevations. If actual loads or fill height exceed our assumptions, then the recommendations in this report may not be valid.
REVIEW OF SOIL SURVEY MAPS

Based on the 1980 Soil Survey for Volusia County, Florida, as prepared by the U.S. Department of Agriculture Soil Conservation Service, the site is located in an area mapped as the “Riviera fine sand” soil series.

The internal drainage of the “Riviera fine sand” soil series is poorly drained, and the soil permeability is rapid to a depth of about 36 inches, moderately rapid to 42 inches and rapid below. According to the Soil Survey, the seasonal high water table for the “Riviera fine sand” soil series is typically within 10 inches of the natural ground surface.

FIELD EXPLORATION PROGRAM

SPT Boring

The field exploration program included performing 1 Standard Penetration Test (SPT) boring. The SPT boring was advanced to a depth of 40 feet below the ground surface using the methodology outlined in ASTM D-1586. A summary of this field procedure is included in the Appendix. Split-spoon soil samples recovered during performance of the boring were visually classified in the field and representative portions of the samples were transported to our laboratory in sealed sample jars.

The groundwater level at the boring location was measured during drilling. The boring was backfilled with cement grout upon completion.

Test Location

The approximate location of the boring is schematically illustrated on a site plan shown on Figure 2. This location was determined in the field by tape measuring/estimating distances from existing site features and should be considered accurate only to the degree implied by the method of measurement used.

LABORATORY PROGRAM

Representative soil samples obtained during our field sampling operation were packaged and transferred to our laboratory for further visual examination and classification. The soil samples were visually classified in general accordance with the Unified Soil Classification System (ASTM D-2488). The resulting soil descriptions are shown on the soil boring profile presented on Figure 3.

In addition, we conducted 1 natural moisture content test (ASTM D2216), 2 percent fines analyses (ASTM D1140), and soil conductivity testing (FM5 - 551) including pH on selected soil samples obtained from the boring. The results of the natural moisture content test and percent fines
analyses are presented adjacent to the sample depth on the boring profile on Figure 3. The results of the soil conductivity and pH tests are presented in the following section.

**Soil Conductivity Testing**

Soil samples obtained from Boring TH-1 at approximately at 5 feet and 20 feet deep were tested for soil conductivity (FM5-551) and pH. The soil resistivity was calculated from the results of the conductivity tests. Results of the tests are presented in the following table.

<table>
<thead>
<tr>
<th>Boring</th>
<th>Approximate Depth (feet)</th>
<th>pH</th>
<th>Resistivity (ohm-cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TH-1</td>
<td>5</td>
<td>8.5</td>
<td>2,434</td>
</tr>
<tr>
<td>TH-1</td>
<td>20</td>
<td>9.0</td>
<td>654</td>
</tr>
</tbody>
</table>

**GENERAL SUBSURFACE CONDITIONS**

**General Soil Profile**

The results of the field exploration and laboratory programs are graphically summarized on the soil boring profile presented on Figure 3. The stratification of the boring profile represents our interpretation of the field boring log and the results of laboratory examinations of the recovered samples. The stratification lines represent the approximate boundary between soil types. The actual transitions may be more gradual than implied.

The results of the boring indicate the following general soil profile:

<table>
<thead>
<tr>
<th>Depth Below Ground Surface (feet)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>From 0</td>
<td>To 6</td>
</tr>
<tr>
<td>6</td>
<td>22½</td>
</tr>
<tr>
<td>22½</td>
<td>27½</td>
</tr>
<tr>
<td>27½</td>
<td>32½</td>
</tr>
<tr>
<td>32½</td>
<td>40</td>
</tr>
</tbody>
</table>

Loose fine sand (SP) with varying amounts of shell fragments

Medium dense fine sand (SP) with varying amounts of shell fragments

Loose silty fine sand (SM)

Very loose clayey fine sand (SC)

Medium dense to dense fine sand (SP) with trace shell

The above soil profile is outlined in general terms only. Please refer to Figure 3 for soil profile details.
Groundwater Level

The groundwater level was measured in the borehole during drilling. As shown on Figure 3, groundwater was encountered at a depth of approximately 4½ feet below the existing ground surface on the date indicated. Fluctuation in groundwater levels should be anticipated throughout the year primarily due to seasonal variations in rainfall and other factors that may vary from the time the boring was conducted.

ENGINEERING EVALUATION AND RECOMMENDATIONS

General

The results of our exploration indicate that, with proper site preparation as recommended in this report, the existing soils are suitable for supporting the proposed 115kV breaker and capacitor bank on mat foundation(s) and the switch structure on a drilled shaft/pier foundation.

The following are our recommendations for overall site preparation and foundation support which we feel are best suited for the proposed structures and existing soil conditions. The recommendations are made as a guide for the design engineer, parts of which should be incorporated into the project's specifications.

Stripping

The "footprints" of the proposed equipment slab areas, plus a minimum margin of five feet, should be stripped of all gravel, surface vegetation, stumps, debris, organic topsoil or other deleterious materials, as encountered.

All existing foundations, slabs, asphalt, and any other underground structures should be removed from the proposed construction area. If pipes or any collapsible or leak prone utilities are not removed or completely filled (with grout or concrete), they might serve as conduits for subsurface erosion resulting in excessive settlements. Over-excavated areas resulting from the removal of underground structures and unsuitable materials should be backfilled in accordance with the fill soils section of this report.

Suitable Fill Material and Compaction of Fill Soils

All fill materials should be free of organic materials, such as roots and vegetation. We recommend using fill with less than 12 percent by dry weight of material passing the U.S. Standard No. 200 sieve size. The fine sand (Stratum No. 1 without roots, as shown on Figure 3) is suitable for use as fill materials and, with proper moisture control, should densify using conventional compaction methods. Soils with more than 12 percent passing the No. 200 sieve will be more difficult to compact due to their inherent nature to retain soil moisture. Soil removed from below the water table will need time to dry and to moisture condition prior to compacting.
All structural fill should be placed in level lifts not to exceed 12 inches in uncompacted thickness. Each lift should be compacted to at least 95 percent of the modified Proctor (ASTM D-1557) maximum dry density value. The filling and compaction operations should continue in lifts until the desired elevation(s) is achieved. If hand-held compaction equipment is used, the lift thickness should be reduced to no more than 6 inches.

**Foundation Support by Mat Foundation and Foundation Compaction Criteria – Breaker and Capacitor Bank**

Excavate the foundation(s) to the proposed bottom of slab elevation(s) and, thereafter, verify the in-place compaction for a depth of 2 feet below the slab bottom(s). If necessary, compact the soils at the bottom of the excavations to at least 95 percent of the modified Proctor maximum dry density (ASTM D-1557) for a depth of 2 feet below the foundation bottoms. Based on the existing soil conditions and, assuming the above outlined proof-rolling and compaction criteria are implemented, an allowable soil bearing pressure of up to 1,500 pounds per square foot (psf) may be used in the foundation design. This bearing pressure should result in total settlement on the order of 1-inch or less and differential settlement of less than ¾ inch.

For the design of the slab(s), a modulus of subgrade reaction of 100 pounds per cubic inch (pci) may be used for the soils encountered in the boring and prepared as recommended herein. We note that this modulus of subgrade reaction is based on empirical correlation to the results expected from an 18-inch plate load test. In addition, precautions should be taken during the slab construction to reduce moisture entry from the underlying subgrade soils. Moisture entry can be reduced by installing a membrane between the subgrade soils and floor slab. Care should be exercised when placing the reinforcing steel (or mesh) and slab concrete such that the membrane is not punctured. We note that the membrane alone does not prevent moisture from occurring beneath or on top of the slab.

**Dewatering**

Based on the groundwater conditions encountered, the control of the groundwater may be required to achieve the necessary stripping and subsequent construction, backfilling, and compaction requirements presented in the preceding sections. The requirement for control of groundwater should particularly be anticipated for footing and utility excavations. The actual method(s) of dewatering should be determined by the contractor. However, regardless of the method(s) used, we suggest drawing down the water table sufficiently, say 2 to 3 feet, below the bottom of any excavation or compaction surface to preclude "pumping" and/or compaction-related problems with the foundation soils.
ENGINEERING EVALUATION AND RECOMMENDATIONS – SOIL PARAMETERS FOR
DEEP FOUNDATION DESIGN

We understand that a drilled shaft/pier foundation may be designed for this project. For this purpose, classification in accordance with the Unified Soil Classification System, along with estimates of the unit weights, the angle of internal friction, moduli of lateral subgrade reaction cohesion, Young’s Modulus, Shear Modulus, and Poisson’s Ratio for the types of soil encountered in the borings are presented in Table 1.

The following should be noted when reviewing Table 1:

• $\gamma_{Buoyant} = \gamma_{Sat} - \gamma_{Water}$
• Values given in Table 1 were based on empirical correlations with the average soil conditions encountered in the referenced borings. Appropriate safety factors should be used with these values.

We caution that the soil layers shown in Table 1 are very generalized and should be used for design purposes only. The soil stratigraphy on the boring log (Figure 3) is more detailed than presented in Table 1. The information in Table 1 should not be used for assessing the constructability of the structure foundations.

QUALITY ASSURANCE

We recommend establishing a comprehensive quality assurance program to verify that all site preparation and foundation construction is conducted in accordance with the appropriate plans and specifications. Materials testing and inspection services should be provided by Ardaman & Associates.

As a minimum, an on-site engineering technician should monitor all stripping to verify that deleterious materials have been removed and should observe the proof-rolling operation to verify that the appropriate number of passes are applied to the subgrade. In-situ density tests should be conducted during filling activities and below the foundation(s) to verify that the required densities have been achieved. In-situ density values should be compared to laboratory Proctor moisture-density results for each of the different natural and fill soils encountered.

Finally, we recommend inspecting and testing the construction materials for the foundations and other structural components.