TECHNICAL SPECIFICATIONS

26 05 13 – Medium Voltage Cables
26 05 19 – Control Wire Specification
26 05 26 – Grounding and Bonding for Electrical Systems
26 05 43 – Underground Ducts for Electrical Systems
26 13 13 – Medium Voltage Metal-Clad Switchgear
26 23 13 – Engine Generator Set Control and Protection Specification
337119 – Precast Concrete Electrical Manhole Specifications

CITY OF CONCORD
CODDLE CREEK WATER TREATMENT PLANT
6935 DAVIDSON HIGHWAY
CONCORD, NC 28027

Prepared by:

ELECTRICAL ENGINEERING CONSULTING & TESTING, P.C.
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NC FIRM #C-1503

MEDIUM VOLTAGE CABLES
ELECTRICAL SPECIFICATION – SECTION 26 05 13
APRIL 2019

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SECTION 26 05 13
MEDIUM VOLTAGE CABLES

PART 1 – GENERAL

1.01 DESCRIPTION

A. This section specifies the electrical and mechanical requirements, installation, and connection of medium-voltage cables, indicated as cable or cables in this section, and medium-voltage cable splices and terminations.

B. Cable insulation shall be ethylene propylene rubber.

C. The cable shall have an overall insulating jacket (PVC).

D. A certified test report shall be supplied for each reel.

1.02 RELATED WORK

A. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

1.03 QUALITY ASSURANCE

A. Each cable manufacturer shall provide adequate documentation of a Quality Assurance program that will provide reasonable assurance that cable shall be manufactured in accordance with this specification and all applicable industry standards and specifications.

B. The manufacturer shall submit to the owner copies of the AEIC Qualification Report for the proposed cable design. This report shall be furnished with the quotation. These reports shall include certified data for any test designated by AEIC or ICEA as being "FOR ENGINEERING INFORMATION ONLY" or any similar designation.

1.04 FACTORY TESTS

A. Production tests shall be performed in accordance with AEIC CS8-13 and ICEA S-93-639. The following test shall be done as a minimum requirement:

1. Continuous DC Spark testing of the nonconducting stress control layer prior to extrusion of the EP insulation.
2. Mooney Viscosity, Scorch Viscosity, and Specific Gravity of each batch of the EP insulation prior to extrusion.
3. A.C. Voltage Withstand test at 44 kV for 5 minutes on each finished cable.
4. Volume Resistivity of the nonmetallic shield.
5. D.C. Resistance of all insulated conductors and metallic shields.
6. Dimensional Verification of all extruded layers.
7. Absence of water in conductors and interfaces confirmed.
8. Insulation resistance on all completed cables.
9. Corona test on all discharge free type cable.

1.05 SUBMITTALS

A. Shop Drawings:
   1. Submit sufficient information to demonstrate compliance with drawings and specifications.
   2. Submit the following data for approval:
      i. Complete electrical ratings for medium voltage cable, splices and terminations.
      ii. Installation instructions for medium voltage cable, splices and terminations.

B. Certified copies of all production test reports for each reel shall be furnished to the owner at the time of cable delivery.

C. Field test reports.

1.06 APPLICABLE PUBLICATIONS

A. The cable assembly shall meet all applicable manufacturing and qualification testing requirements of ICEA S-93-639, AEIC CS8 and UL-1072 (Type MV-105) except where deviations are specifically noted within this specification.

B. Where references are made to specifications of the Insulated Cable Engineers Association (ICEA), the Association of Edison Illuminating Companies (AEIC), Underwriters Laboratories (UL), or the American Society for Testing and Materials (ASTM), the latest revisions of the cited specifications shall apply.

C. Institute of Electrical and Electronic Engineers (IEEE)

   1. 48-2009 Test Procedures and Requirements for Alternating Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 765 kV.

   2. 386-2016 Standard for Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 Kv.

   3. 400-2012 Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems Rated 5 kV and Above.

   4. 400.2-2013 Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF)(less than 1 Hz).

   5. 400.3-2006 Guide for Partial Discharge Testing of Shielded Power Cable Systems in a Field Environment.

   6. 404-2012 Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2.5 kV to 500 kV.

D. National Electrical Manufacturers Association(NEMA)

   1. WC 74-2006 5 – 46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.

E. Underwriters Laboratories (UL)

   1. 1072-2013 Medium Voltage Power Cables.

F. National Fire Protection Agency (NFPA)

   1. 70-2017 National Electrical Code (NEC)

1.07 SHIPMENT AND STORAGE

A. Cable shall be shipped on non-returnable wooden reels unless otherwise specified by the owner. Each reel shall carry a metal tag identifying the manufacturer, the cable type, the cable size, footage, and the order number.

B. Cable must be shipped with reels in an upright position supported by both outside flanges.

C. The cable on each reel shall be furnished with factory-installed watertight seals at each end. These seals shall be of a heat-shrink or cold-shrink design. Taped ends will not be considered acceptable.

D. Test tail shall be provided for on-reel field testing.

E. All cable reels shall be inspected for damage before unloading.

F. Forklifts shall not be used for unloading or moving reels.

G. Reels shall be stored on a level, well-drained hard surface area. Shipping lading shall be left in place. Cable ends shall be checked for waterproofing and redone if necessary.

H. Cable reels shall be moved using proper equipment and care. Cable ends shall be protected at all times from entrance of moisture. Cable ends shall be immediately sealed whenever the cable is cut.

I. The correct footage shall be marked on the cable as it is used by subtracting the cut amount from existing lengths.

PART 2 – PRODUCTS

2.01 CABLE

A. The cable shall be a single conductor, composed of a concentric stranded copper conductor, extruded conductor shield, EPR insulation, extruded semi-conducting insulation shield, metallic copper tape shield, and an overall PVC jacket. It shall be rated for continuous operation at 105º C conductor temperature, emergency overload operation at 140º C conductor temperature, and a short circuit operation at 250º C conductor temperature

B. The insulated phase conductor shall be sized as indicated on the project drawings. The insulated ground conductor shall be sized as indicated on the project drawings.

C. The conductor strands shall be annealed, bare or tin-coated, compact or compressed Class B copper. They shall meet the requirements of ICEA S-93-639, ASTM B3, B8, and 496.

D. Voltage Rating:

1. 15kV, 60Hz

E. Insulation:

1. Insulation level shall be 133%.

2. The conductor insulation shall be a discharge free or a discharge resistant, flexible, thermosetting dielectric based on an ethylene propylene elastomer. The insulation shall comply with the referenced standards.

F. The extruded conductor shield shall be either a semi-conducting EPR material or a non-conducting thermoset material. The conductor shield shall be inseparably bonded to the insulation but readily removable from the conductor. The conductor shield material shall not chemically interact with the conductor and it shall be compatible with the insulating material. It shall meet the requirements of ICEA S-93-639 and AEIC CS8-13.

G. The insulation shield shall be an extruded material either semi-conducting ethylene propylene rubber compound or a nonmetallic conducting material complying with ICEA S-93-639 and shall be clean stripping.

H. The peel strength from the insulation shall be tested in accordance with AEIC CS8.

I. The outer screen for the insulated core shall be covered with a flat copper tape applied helically with a minimum of 12.5 % nominal overlap.

J. The outer jacket of the cable shall be extruded directly over the metallic insulation shield and be made of polyvinyl chloride (PVC) in accordance with ICEA S-93-639.

K. The outer jacket shall have clear and durable indented markings on the outer surface of the jacket to identify the name of the manufacturer, the conductor size, type and thickness of insulation, type of conductor, voltage rating, and year of manufacture. The jacket shall also be marked to show that the jacket is insulating. The cable markings shall contain the universal symbol for an electric supply cable as required by the National Electrical Safety Code. Electric supply cable symbols required by the NESC shall appear at a spacing of not more than forty (40) inches.

2.02 SPLICES AND TERMINATIONS

A. Splices shall be made in conjunction with the splice kit manufacturer's recommendations. 3M Brand QS-III type kits shall be used. Kits shall be adequate for the size cable being spliced. Long barrel compression type connectors with two compression indents per cable shall be used. The proper size hydraulic compression tool shall be used per manufacturer's recommendation. The compression indents shall be filled with solder or semi-conducting tape per the splice kit manufacturer's recommendation.

B. Terminations shall be made in accordance with the manufacturer's recommendations. 3M Brand Quick-Term III HI-K, Series 7690-T for indoor equipment shall be used. Kits shall be adequate for the size cable being terminated. Long barrel compression type minimum of two-hole lugs with a minimum of two compression indents per cable shall be used. The proper size hydraulic compression tool shall be used per manufacturer's recommendation.

C. The cable shield shall be properly terminated to a grounding braid or wire and attached to the ground grid in a proper manner.

2.03 FIREPROOFING

A. Fireproofing tape shall be Scotch brand 77 Fire and Electric Arc Proofing Tape. Securing tape shall be glass cloth electrical tape not less than 0.18 mm (7 mils) thick, and 19 mm (0.75 inch) wide.

PART 3 – EXECUTION

3.01 GENERAL

A. Installation shall be in accordance with the NEC, as shown on the drawings, and per manufacturer's instructions.

B. Cable shall be installed in conduit above grade and duct bank below grade.

C. All cables of a feeder shall be pulled simultaneously.

D. Splice the cables only in manholes and pullboxes and where shown on the drawings, unless otherwise approved by the Engineer.

E. Ground shields in accordance with Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS and the project drawings.

F. Cable maximum pull length, maximum pulling tension, and minimum bend radius shall conform with the recommendations of the manufacturer.

3.02 PROTECTION DURING SPLICING OPERATIONS

A. Blowers shall be provided to force fresh air into manholes where free movement or circulation of air is obstructed. Waterproof protective coverings shall be available on the work site to provide protection against moisture while a splice is being made. Pumps shall be used to keep manholes dry during splicing operations. Under no conditions shall a splice or termination be made that exposes the interior of a cable to moisture. A manhole ring at least 150 mm (6 inches) above ground shall be used around the manhole entrance to keep surface water from entering the manhole. Unused ducts shall be plugged and water seepage through ducts in use shall be stopped before splicing.

3.03 PULLING CABLES IN DUCTS AND MANHOLES

A. Cable reels shall be mounted on reel jacks or other approved methods during cable pulling. Brakes or other suitable means shall be used to control payout of cable and to prevent over spin of excess cable from the reel when cable pulling slows or stops.

B. Cable shall only be pulled from reels. Pre-cutting and laying the cable on the ground is not permitted.

C. Cable shall only be pulled from the assigned point and in the assigned direction as noted in the cable pulling calculation documents and/or the drawings.

D. Cable pulling tension shall not exceed the maximum amount specified in the manufacturer's technical data.

E. A cable-pulling machine equal to Greenlee type 6800 Ultra Tugger Cable Puller with Standard Force Gauge shall be used to pull all cable. The Optional Strip Chart attachment shall be used and a permanent chart recording of all pulls shall be maintained for review. Required information shall include date, time, weather condition, problems, tension, and foreman's name.

F. Proper accessories to the above shall be used to maintain proper bending radii, feed cable into conduits properly, keep cable off ground or other obstructions.

G. A swivel of the proper rating shall be used between the cable and pull rope to eliminate twisting, winding, and tangling of cable and rope during pull.

H. A wire duct brush and flexible mandrel of the proper size shall be used on all ducts before pulling cable to clean and size the ducts.

I. A lube spreader swab shall be pulled through the duct immediately before pulling the cable. This is done to lubricate the duct.

J. A cable pulling lubricant shall be used in sufficient quantities to ensure a duct coefficient of friction of 0.20 or less. The lubricant must be approved by the cable manufacturer as suitable for the type cable being pulled.

K. A set screw clamp pulling grip of the proper rating shall be used to attach the copper conductor(s) of the cable to the pulling rope. *Basket type grips shall not be used.*

L. Proper amount of slack shall be pulled into all manholes, equipment, or pole tops to allow for proper training and fastening of cable. Minimum bending radius of 12 times the cable outside diameter shall be maintained. The intent is to form the cable along the wall of the manholes as close as feasible to maintain maximum cable slack to allow for possible future splicing of faulted

cable or splice kits.

M. Scotch brand 77 Fire and Electric Arc Proofing Tape shall be used on all conductors in manholes, pullboxes, equipment, and substation steel structures to prevent a fire or arc on one cable from spreading to other cables. At the end of each taped cable section, secure the fireproof tape in place with glass cloth tape.

N. Cable shall not be pulled when the temperature has been below 15° F in the previous 24 hours.

3.04 SPLICES AND TERMINATIONS

A. Splices shall only be made in a manhole or pull box and where shown on the drawings, unless otherwise approved by the Engineer. The splice shall be made in the center of the wall that is opposite to the duct entry wall and on the cable rack.

B. Install the materials as recommended by the manufacturer, including precautions pertaining to air temperature and humidity during installation.

C. A journeyman electrician who has been certified as a 15 kV cable splicer through training from a suitable authority such as a cable manufacturer, kit manufacturer, or industry trade association shall be used to make all terminations and splices. Certification papers must be presented to the owner before work begins.

D. Splices in manholes shall be located midway between cable racks on walls of manholes, and supported with cable arms at approximately the same elevation as the enclosing duct.

E. The finished splice shall be treated with a waterproofing compound in accordance with manufacturer's instructions to ensure the splice is suitable for direct immersion in water.

F. Terminations shall be made at the supply point and at receiving equipment as required.

G. Proper protection from the weather shall be provided as required when making a splice or termination.

3.05 CIRCUIT IDENTIFICATION OF FEEDERS

A. In each manhole or pullbox, the circuit identification shall be painted in stencil above the incoming and outgoing ducts. Circuit identifications shall be per the project drawings.

B. In each switchgear and junction box, the circuit identification shall be either painted in stencil beside the conduit or permanent identification tags shall be installed on the cables themselves. If tags are used, the tags shall be embossed brass and attached with black nylon cable ties. Tags shall be positioned so that they are legible.

C. Identify medium voltage conduits within buildings and electrical rooms by stenciling in 2-inch black letters at a minimum of every 50 feet. Stencil to include voltage, source equipment name, and load equipment name (i.e. 4160V US20_F1-US5). Place where convenient for tracing.

D. Medium voltage conductor wire, cable, and buses shall be properly phased and identified throughout. Individual conductors shall be color coded as noted below.

Conductor	4160V	12470V
Phase A	Black (1 Stripe)	Black (2 Stripes)
Phase B	Red (1 Stripe)	Red (2 Stipes)
Phase C	Blue (1 Stripe)	Blue (2 Stripes)
Neutral	White (1 Stripe)	White (2 Stripes)
Ground	Green	Green

3.06 ACCEPTANCE CHECKS AND TESTS

A. After installation and prior to a very low frequency (VLF) alternating voltage withstand test, a simple continuity test shall be performed on all cable to verify shield continuity.

B. A VLF alternating voltage withstand test shall be performed on all cable lengths after termination or splicing. If the entire run of cable is new, the test shall be performed at the acceptance test voltage levels defined in IEEE 400.2. If new cable has been spliced into existing cable, or existing cable is being reused for an entire run, the test shall be performed at the maintenance test voltage level defined in IEEE 400.2. The test duration shall be for one hour per cable.

C. A VLF alternating voltage with tan delta tests and differential tan delta measurements shall be performed on all cables in accordance with IEEE 400.2.

D. The cable system shall not be connected to any equipment during the test.

E. Test results shall be provided to the Owner.

END OF SECTION

GENERAL SPECIFICATIONS FOR INTERCONNECTING CONTROL WIRE AND CABLE ELECTRICAL SPECIFICATION – SECTION 26 05 19 APRIL 2019

CITY OF CONCORD

CODDLE CREEK WATER TREATMENT PLANT

6935 DAVIDSON HIGHWAY

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1.0 SCOPE

1.1 The specification covers the control wire and cable used for interconnecting switchgear with equipment, 600V or less.

2.0 GENERAL REQUIREMENTS

2.1 All conductors shall be stranded, tinned copper.

2.2 All control wire and cable must pass the vertical flame test requirements of IEEE-383 and shall be UL rated VW-1.

2.3 All circuits #6 AWG and smaller shall be wired with multi-conductor Type TC cable (THHN/THWN), 600V insulation. The insulation of the individual conductors shall be heat and moisture resistant, polyvinyl chloride (PVC). The overall jacket shall be PVC. Conductor sizes shall be per the project drawings. The color code shall be as follows.

1. Black
2. Red
3. Blue
4. Orange
5. Yellow
6. Brown
7. Red/Black
8. Blue/Black
9. Orange/Black
10. Yellow/Black
11. Brown/Black
12. Black/Red

2.4 All control wire and cable shall be suitable for use in wet and damp locations and shall have a minimum rating of 75°C when used in wet locations.

2.5 Each conductor in a multi-conductor cable shall have a unique insulation color for conductor identification. Markings printed on conductor insulation shall not be permitted.

2.6 With the exception of multi-conductor AC power cables, the colors WHITE and GREEN shall not be permitted insulation colors.

2.7 Multi-conductor AC power cables may contain one conductor colored white (for neutral) and one colored green (for ground). Multi-conductor AC power cables that have no white and green conductors shall have the conductors used for neutral and ground permanently marked as required by the NEC. A bare copper ground conductor shall be permitted in cables used for AC power circuits.

2.8 All DC control circuits shall be multi-conductor tray cable containing an overall shield with drain wire.

3.0 INSTALLATION

3.1 All interconnecting control wire and cable shall be installed in conduit, switchgear, and equipment as shown on project drawings.

3.2 Pull all conductors into raceway at same time.

3.3 Use suitable wire pulling lubricant.

3.4 Neatly train and lace wiring inside switchgear sections, handholes, equipment, and panelboards.

3.5 Clean conductor surfaces before installing lugs and connectors.

3.6 Control wire and cable routed into and through the switchgear shall be fastened securely to avoid any moving equipment such as medium voltage circuit breakers, PT and CPT trunnions, and switchgear cell doors.

3.7 AC and DC circuits shall be routed separately. The only exception permitted is when AC and DC circuits are routed in common wire trough in equipment control cabinets or bundled in switchgear cells.

3.8 All shielded cables shall be grounded at one end only.

3.9 All wiring shall be landed on the devices or terminal blocks with ring-tongue terminals having insulated compression barrels. Fork terminals are unacceptable. No more than two wires may be terminated at any one connection point. The only permitted exception is where devices have compression connectors as a part of their integral design (i.e. circuit breakers in panelboards).

3.10 There shall be no splices in the wiring. All connections shall be made on terminal studs or devices.

3.11 All wires shall be marked with the opposite end destination at each end except jumpers to points on the same device or terminal block which are shorter than 12 inches in length. Such jumpers need not be marked.

3.12 All cables shall be clearly labeled at each end with a permanent means of marking.

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
ELECTRICAL SPECIFICATION – SECTION 26 05 26
APRIL 2019

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SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Grounding and bonding components.

B. Provide all components necessary to complete the grounding system as shown on the project drawings.

1.02 RELATED SECTIONS

A. Section 26 05 13 – MEDIUM VOLTAGE CABLES

B. Section 26 05 43 – UNDERGROUND DUCTS FOR ELECTRICAL SYSTEMS

C. Section 26 13 13 – MEDIUM VOLTAGE METAL CLAD SWITCHGEAR

D. Section 33 71 19 – PRECAST CONCRETE ELECTRICAL MANHOLES

1.03 REFERENCES

A. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; 2017.

B. NFPA 70-2017 – National Electrical Code; National Fire Protection Association

1.04 SUBMITTALS

A. Product Data: Provide for grounding electrodes and connections.

B. Project Record Documents: Record actual locations of components and grounding electrodes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Erico

B. Anderson (Hubbell Power Systems)

2.02 ELECTRODES

A. Manufacturers:

1. Erico - Eritech

B. Rod Electrodes: Copper, per project drawings

2.03 CONNECTORS AND ACCESSORIES

A. Mechanical Connectors: per project drawings

B. Exothermic Connections: per project drawings. All underground connectors shall be exothermic.

C. Wire: Stranded copper: sizes and placement per project drawings

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify existing conditions prior to beginning work.

B. Verify locations of existing underground utilities. If necessary dig by hand in those areas.

C. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.02 INSTALLATION

A. Install ground electrodes at locations indicated on project drawings.

B. Provide grounding electrode conductor and connect to reinforcing steel in foundation footing where indicated.

C. Bond medium voltage metal-clad switchgear as indicated on the project drawings.

G. Conductor sizes shall not be less than shown on drawings.

H. Connect lightning arresters to the equipment ground bus or ground rods as applicable.

I. Bolts shall be torqued to the values recommended by the manufacturer.

3.03 FIELD QUALITY CONTROL

A. Contractor shall engage the services of a NETA accredited testing firm to perform inspections and testing of the grounding system.

B. Grid resistance shall be measured by the fall of potential method in accordance with IEEE 81 and NETA ATS.

C. If grid resistance measured exceeds 25 ohms notify Engineer.

END OF SECTION

UNDERGROUND DUCT FOR ELECTRICAL SYSTEMS
ELECTRICAL SPECIFICATION – SECTION 26 05 43
APRIL 2019

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SECTION 26 05 43

UNDERGROUND DUCTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. This section includes concrete-encased nonmetallic duct.

B. This section prescribes the minimum criteria to be applied when constructing concrete-encased, nonmetallic ducts for electrical systems.

1.02 RELATED SECTIONS

A. Section 33 71 19 – Precast Electrical Manholes.

1.03 REFERENCES

A. IEEE C2 - National Electrical Safety Code; Institute of Electrical and Electronic Engineers; 2017.

B. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit, National Electrical Manufacturers Association; 2013.

C. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing; National Electrical Manufacturers Association; 2013.

D. NEMA TC 6&8 - PVC Plastic Utilities Duct for Underground Installation; National Electrical Manufacturers Association; 2013.

E. NEMA TC 9 - Fittings for PVC Plastic Utilities Duct for Underground Installation; National Electrical Manufacturers Association; 2004.

F. NFPA 70 – National Electrical Code; 2017.

G. UL 651 – Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.

H. UL 514b – Conduit, Tubing, and Cable Fittings.

1.04 SUBMITTALS

A. Product Data: Provide for nonmetallic conduit and accessories.

B. Project Record Documents: Record actual routing and elevations of underground conduit and duct, and locations and sizes of manholes.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. All construction work shall be accomplished in a thorough and workmanlike manner in accordance with drawings and specifications.

C. The underground installation shall be in accordance with all applicable sections of the National Electrical Safety Code (NESC) and the National Electrical Code.

D. All material and equipment used in the construction must be stored to be protected from deteriorating effects of the elements. If outdoor storage cannot be avoided, the material and equipment must be stacked on supports well above the ground line and protected from the elements as appropriate, with due regard for public safety.

E. Concrete test cylinders shall be prepared in the presence of the Owner or Owner's representative. The Owner shall be notified 24 hours prior to each concrete placement. The Owner may, at its discretion, waive the representation requirement during the preparation of test cylinders. Any waiver of representation does not relieve the Contractor of the responsibility for preparing concrete test cylinders in accordance with these specifications. Three copies of cylinder test reports shall be submitted to the Owner for approval. The Contractor shall be responsible for all costs incurred for cylinder preparation and testing. Should the Contractor fail to prepare and test cylinders, the Owner may require that samples be secured and tested in accordance with the "Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete" – ASTM C42, 2013. The number and locations of such tests shall be determined by the Owner.

F. Test cylinders shall be prepared from each 20 yd^3 of concrete in accordance with the "Sampling Practice for Sampling Freshly Mixed Concrete" – ASTM C172 and the "Standard Practice for Making and Curing Concrete Test Specimens in the Field" – ASTM C31. One cylinder shall be tested at 7 days and two cylinders shall be tested at 28 days in accordance with the "Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens" – ASTM C39. One cylinder shall be provided to the Owner to hold in reserve. A minimum of three cylinders shall be prepared and tested for pours of less than 50 yd^3. In the event that a pour takes several days, the number of cylinders required shall be determined by the Owner.

G. Concrete cylinders shall be tested by a laboratory approved by the Owner.

H. When cylinder breaks do not meet the specifications, the Contractor can seek approval from the Owner for alternate strength tests to be made in accordance with ASTM C42 (cored test). Alternate tests shall be made at the Contractor's expense. Concrete which does not meet the specifications, even after the alternate tests have been performed, shall be removed and replaced at the Contractor's expense.

1.06 WARRANTY

A. Submit manufacturer's standard warranty.

PART 2 PRODUCTS

2.01 DUCTS AND ACCESSORIES

A. Ducts:
   1. Carlon Plus 40; PVC rigid nonmetallic conduit, rated for use with 90C conductors. Products equal in all aspects from other manufacturers will be considered if there is a cost savings to the Owner.

B. Conduit, fittings and cement shall be produced by the same manufacturer to ensure system compatibility and integrity.

C. Duct Spacers
   1. Underground Devices, Inc: Wunpeece Spacers
      a. 5W30-2 for 5” duct with two horizontal duct positions
      b. 6W30-2 for 6” duct with two horizontal duct positions
      c. 6W30-3 for 6” duct with three horizontal duct positions

   2. Carlon Snap-N-Stac Combo Spacers (for use in reinforced duct bank sections)
      a. SP5W30-2 for 5” duct with two horizontal duct positions
      b. SP6W30-2 for 6” duct with two horizontal duct positions
      c. SP6W30-2 for 6” duct with three horizontal duct positions (overlap placement to accommodate three horizontal duct banks with this item).

   3. Products equal in all aspects from other manufacturers will be considered if there is a cost savings to the Owner.

2.02 DUCT BANK CONCRETE

A. Concrete used in the construction of the underground duct bank shall have a 28-day compressive strength of 3000 psi. Concrete shall have a slump of 7 – 8 inches and a maximum aggregate size of 3/8 inch to ensure that the concrete flows evenly into all voids between each duct and between ducts and trench walls.

2.03 DETECTABLE WARNING TAPE

A. 3M Scotch detectable buried barricade tape, 3M product number 406. 5-mil thick by 3 inches wide, solid aluminum foil backing with clear film laminate, detectable tape, red with black letters, printed with wording “CAUTION BURIED ELECTRICAL CABLE BELOW”.

B. Products equal in all aspects from other manufacturers will be considered if there is a cost savings to the Owner.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify routing and termination locations of duct bank prior to excavation for rough-in.

C. Verify locations of manholes prior to excavating for installation.

D. Interface installation of underground warning tape with backfilling. Install tape 6 inches (150 mm) below finished surface.

E. Verify all, if any, unstable trench bottom areas have been properly excavated and correctly filled with compacted course of CABC stone.

3.02 DUCT BANK INSTALLATION

A. See drawings for specific depths and cross sections of duct banks. Where specific depths are not provided on drawings, install duct to locate top of duct bank minimum 18 inches below finished grade in non-traffic areas or a minimum of 24 inches below grade in traffic areas.

B. The Contractor shall prepare the duct bank trench to the depth specified. The routing must be as shown on the plans and specifications unless conditions encountered are such that changes are necessary to accomplish the work. In such event the Owner should be promptly notified.

C. The trench widths specified are a minimum and should be increased as necessary to obtain the required depths in loose soils.

D. Care shall be exercised to minimize the likelihood of water flow since this may cause trench damage and reduction in duct bank depth. If this occurs, the trench must be cleared to the specified depth before installing the duct bank.

E. All trenches shall follow straight lines between staked points to the greatest extent possible. The trenches must be dug so that the bottom has a smooth grade. Large rocks, stones and gravel in excess of 1-inch diameter must be removed from the bottom of the trench.

F. A four (4) inch bed of well compacted fill shall be placed in the bottom of the trench.

G. Where an unstable trench bottom is encountered, it must be stabilized before laying the duct. The Contractor shall excavate the unstable material and replace with a compacted course of CABC stone with a depth as necessary to prevent settling.

G. Construction shall be arranged so that trenches are left open for the shortest practical time to avoid creating a hazard to the public and to minimize the likelihood of collapse of the trench due to construction activity, rain or accumulation of water in the trench.

H. Duct ends shall not be left open. Keep ducts clean of earth, sand, or gravel, and seal with tapered plugs upon completion of each portion of the work.

I. Install duct with minimum slope of 4 inches per 100 feet (100 mm per 25.4 m) (0.33 percent). Slope duct away from building entrances. Pitch the duct uniformly between manholes or both ways from high points between manholes for the required duct bank drainage.

J. Cut duct square using saw or pipe cutter; de-burr cut ends.

K. Insert duct to shoulder of fittings; fasten securely.

L. Join nonmetallic duct using adhesive as recommended by manufacturer.

M. Wipe nonmetallic duct dry and clean before joining. Apply full even coat of adhesive to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.

N. Install no more than equivalent of three 90-degree bends between pull points.

O. Provide suitable fittings to accommodate expansion and deflection where required.

P. Stagger duct joints vertically in concrete encasement 6 inches (150 mm) minimum.

Q. Use specified duct spacers installed not greater than 5 feet (1525 mm) on centers.

R. Band ducts together before backfilling.

S. Securely anchor duct to prevent movement during concrete placement.

T. Provide minimum 3 inch (75 mm) concrete cover at bottom, top, and sides of duct bank.

U. Install reinforcing bars as shown on the project drawings.

V. Provide two No. 6 steel reinforcing bars in top of bank under paved areas. Bars should extend 36 inches beyond edge of pavement where duct bank crosses perpendicular to pavement.

W. Connect to manhole wall using one No. 4 steel reinforcing bar 36 inches long per duct.

X. Pour each run of concrete between manholes or other terminations in one continuous pour. If more than one pour is necessary, terminate each pour in the vertical plane and install four No. 6 steel reinforcing bars, one near each corner of the duct bank section and extending 18 inches into the concrete on both sides of the joint.

Y. Should trench walls begin to collapse during concrete placement, all concrete placement shall stop until collapsed walls are adequately shored up and deposited soil is removed.

Z. Provide suitable pull string in each empty duct except sleeves and nipples.

AA. Swab duct. Use suitable caps to protect installed duct against entrance of dirt and moisture.

BB. Backfilling shall be completed in a manner that voids will not be present. Backfill shall not be replaced until concrete has properly cured.

CC. Backfill shall not contain any large stones or broken pavement that may damage the duct structure.

DD. Backfill shall be thoroughly tamped using lightweight mechanical tampers.

EE. Interface installation of detectable underground warning tape with backfilling. Install tape 6 inches (150 mm) below finished surface.

3.03 ACCEPTANCE TESTS AND CHECKS

A. After the duct has been concrete encased, a standard flexible mandrel shall be pulled through each duct to loosen foreign particles and to test for out-of-round and duct deflection conditions.

B. The mandrel shall be not less than 12 inches long and shall have a diameter not less than 0.5 inch less than the inside diameter of the duct.

C. After the mandrel has been successfully pulled through each duct, a brush with stiff bristles shall then be pulled through each duct to remove foreign particles loosened by the mandrel. The diameter of the brush shall be the same as, or slightly larger than, the diameter of the duct.

D. If the mandrel test reveals out-of-round or duct deflection conditions, the Contractor shall replace the affected section(s) of duct and retest to the satisfaction of the Owner.

END OF SECTION

MEDIUM VOLTAGE METAL-CLAD SWITCHGEAR
ELECTRICAL SPECIFICATION – SECTION 26 13 13
JULY 2019

CITY OF CONCORD
CODDLE CREEK WATER TREATMENT PLANT
6935 DAVIDSON HIGHWAY
CONCORD, NC 28027

Prepared by:

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NC FIRM #C-1503

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This document originally issued and sealed by Barry Wayne Tyndall, license number 015897, on 07/31/2019. This medium shall not be considered a certified document.

SECTION 26 13 13
MEDIUM VOLTAGE METAL-CLAD SWITCHGEAR SPECIFICATION

PART 1 – GENERAL

1.01 DESCRIPTION

A. Furnish an outdoor, protected-aisle medium voltage metal-clad switchgear lineup complete from the incoming line terminals to the outgoing feeder terminals including all auxiliary equipment and controls specified herein to be delivered FOB to the City of Concord, Coddle Creek Water Treatment Plant, 6935 Davidson Highway, Concord, NC.

B. It is the intent of these specifications that the supplier shall furnish their standard switchgear sections complete with all standard accessories as modified by and/or detailed in these specifications.

C. Any exceptions to these requirements must be approved in writing by the purchaser before fabrication.

D. The following drawings are to be used in conjunction with this specification:

P1711178CS	Cover Sheet and Drawing Index
P1711178E101	Electrical Site Plan
P1711178E102	Electrical Site Plan Detail
P1711178E300	Partial Medium Voltage System One-line Diagram
P1711178E301	Switchgear M One-line Diagram – Bus 1
P1711178E302	Switchgear M One-line Diagram – Bus 2
P1711178E310	52-1AL Panel Layout and Bill of Material – Upper Section
P1711178E311	52-1AL Panel Layout and Bill of Material – Lower Section
P1711178E312	52-2AL Panel Layout and Bill of Material – Upper Section
P1711178E313	52-T Tie Breaker Panel Layout and Bill of Material
P1711178E314	Typical Top Feeder Panel Layout and Bill of Material
P1711178E315	Typical Bottom Feeder Panel Layout and Bill of Material
P1711178E320	Switchgear M Contact Development
P1711178E321	Switchgear M Contact Development
P1711178E510	Switchgear M Typical Feeder AC Elementary Diagram
P1711178E511	Switchgear M Feeders 1BL and 2BL AC Elementary Diagram
P1711178E512	Switchgear M 1AL AC Elementary Diagram
P1711178E513	Switchgear M 2AL AC Elementary Diagram
P1711178E514	Switchgear M Tie Breaker AC Elementary Diagram
P1711178E520	Switchgear M 1AL DC Elementary Diagram
P1711178E521	Switchgear M 2AL DC Elementary Diagram
P1711178E522	Switchgear M Tie Breaker DC Elementary Diagram
P1711178E523	Switchgear M Feeder 1BU DC Elementary Diagram
P1711178E524	Switchgear M Feeder 1BL DC Elementary Diagram
P1711178E525	Switchgear M Feeder 1CU DC Elementary Diagram
P1711178E526	Switchgear M Feeder 1CL DC Elementary Diagram
P1711178E527	Switchgear M Feeder 2CU DC Elementary Diagram
P1711178E528	Switchgear M Feeder 2CL DC Elementary Diagram
P1711178E529	Switchgear M Feeder 2BU DC Elementary Diagram
P1711178E530	Switchgear M Feeder 2BL DC Elementary Diagram
P1711178E540	Communications Schematic

1.02 RELATED WORK

A Section 26 05 13, MEDIUM-VOLTAGE CABLES: Medium-voltage cables and terminations.

B. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.

C. Section 26 23 13, ENGINE GENERATOR SET CONTROL AND PROTECTION UPGRADE: Requirements for replacing existing engine generator controls, PLC controls, protective relaying, and metering of existing plant generator.

1.03 APPLICABLE PUBLICATIONS

A. The equipment covered in these specifications shall be designed, built and tested in accordance with the latest applicable standards of IEEE, ANSI, NEMA, ASME, AISI, UBC, AISC, SSPC, ASHRAE, ASTM, OSHA, AWS, NEC, and NFPA. All references to codes, standards and/or material specifications shall be to the latest revision as of the effective contract date for the medium voltage switchgear specified herein.

1.04 SUBMITTALS

A. Provide outline drawings and other information with proposal.

B. Shop Drawings: Indicate outline dimensions, enclosure construction, shipping splits, lifting and supporting points, electrical single line diagram, schematics, and equipment electrical ratings.

C. Product Data: Provide data for components and accessories.

D. Test Reports: Indicate findings of field quality control procedures.

E. Submit manufacturer's installation and operation instructions.

F. Maintenance Data.

1.05 QUALITY ASSURANCE

A. Conform to requirements of the latest NFPA 70E edition.

B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

1.06 FACTORY TESTS

A. The switchgear equipment shall receive the following factory tests.
   1. Low frequency dielectric withstand test
   2. Grounding of instrument cases
   3. Control wiring and device functional test
   4. Polarity test
   5. Control sequence test
   6. Low frequency withstand test

B. The circuit breakers shall receive the following factory tests:
   1. Coil check test
   2. Clearance and mechanical adjustment
   3. Timing test
   4. Conductivity of current path
   5. Hi potential test
   6. Vacuum bottle integrity test
   7. Electrical and mechanical operation (300 operations minimum)

C. The manufacturer shall provide test reports and documentation verifying completion of factory tests.

1.07 SERVICE CONDITIONS

A. Site conditions
   1. Site location: Concord, North Carolina
   2. Site elevation: Approximately 700'
   3. Seismic Zone: Submit equipment data to Purchaser's structural engineer for determination of equipment suitability for seismic zone.
   4. Ambient temperatures: Maximum of 105°F. Minimum 0°F.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Structure shall be delivered in shipping splits for ease of handling.

B. Equipment shall be shipped and handled with proper precautions being taken to protect equipment from damage.

C. The equipment shall be delivered FOB to the City of Concord, Coddle Creek Water Treatment Plant, 6935 Davidson Highway, Concord, NC.

D. The Seller shall confirm that the Purchaser's is ready to receive the switchgear prior to shipment.

PART 2 – PRODUCTS

2.01 GENERAL REQUIREMENTS

A. The following vendors are approved vendors for the switchgear lineup:
   1. General Electric
   2. Cutler-Hammer
   3. Siemens
   4. Square D

B. Vendors not on this list must be approved in writing by the purchaser.

C The Seller has the sole responsibility for the performance of this specification. The responsibility shall not be divided among the individual component manufacturers.

D. The medium voltage metal-clad switchgear lineup shall consist of ten (10) 15 kV sections.

E. The switchgear sections shall be arranged as follows (left to right when viewed from front):
   1. Minimum 72" wide work space including mounting space for batteries and battery charger.
   2. A 15 kV main section consisting of a circuit breaker and main bus. Provide bus, circuit breaker, circuit breaker compartment, potential transformers, current transformers, protective relays, lockout relay, meter, control power transformer, and surge arresters as shown on the one-line diagram and as specified herein. The main breaker shall be located in the lower section and bus stabs shall be provided for connecting the incoming utility source to the line side of the circuit breaker. The source side potential transformers and control power transformer shall be located in the upper section. All protective relays and controls shall be located in the upper section, excluding 51BU and its two (2) test switches which shall be located in the lower section. Section shall be provided complete with controls and wiring.
   3. A 15 kV section consisting of main bus and two (2) circuit breakers. Provide bus, (2) circuit breakers, circuit breaker compartments, current transformers, protective relays, lockout relays, meters, and surge arresters as shown on the one-line diagram and as specified herein. The feeder breakers shall be located in the upper and lower sections. Sections shall be provided complete with controls and wiring.

4. A 15 kV section consisting of main bus, one (1) circuit breaker, and provision for one (1) future circuit breaker. Provide bus, (1) circuit breaker, circuit breaker compartments, current transformers, protective relays, lockout relays, meters, and surge arresters as shown on the one-line diagram and as specified herein. The feeder breaker shall be located in the upper section. Sections shall be provided complete with controls and wiring.
5. A 15 kV section consisting of a tie circuit breaker and main bus. Provide bus, circuit breaker, circuit breaker compartment, and potential transformers as shown on the one-line diagram and as specified herein. The tie breaker shall be located in the lower section. The bus side potential transformer shall be located in the upper section. There shall be a 15" touch smart display that shall be integrated as HMI with the generator PLC located in the upper section. There shall also be an ammeter, volt meter for bus 1, and volt meter for bus 2 located in the upper section. Section shall be provided complete with controls and wiring.
6. A 15 kV transition section with bus side potential transformers and auxiliary compartment as shown on the one-line diagram and as specified herein. The bus side potential transformers shall be located in the upper section. Sections shall be provided complete with controls, wiring and a control power throw-over scheme.
7. A 15 kV section consisting of main bus and provisions for two (2) future circuit breakers. Provide bus, circuit breaker compartments, current transformers, protective relays, lockout relays, meters, and surge arresters as shown on the one-line diagram and as specified herein. Sections shall be provided complete with controls and wiring.
8. A 15 kV section consisting of main bus and two (2) circuit breakers. Provide bus, (2) circuit breakers, circuit breaker compartments, current transformers, protective relays, lockout relays, meters, and surge arresters as shown on the one-line diagram and as specified herein. The feeder breakers shall be located in the upper and lower sections. Sections shall be provided complete with controls and wiring.
9. A 15 kV section consisting of a circuit breaker and main bus. Provide bus, circuit breaker, circuit breaker compartment, potential transformers, current transformers, protective relays, lockout relay, meter, control power transformer, and surge arresters as shown on the one-line diagram and as specified herein. The breaker shall be located in the lower section and bus stabs shall be provided for connecting the incoming source to the line side of the circuit breaker. The source side potential transformers and control power transformer shall be located in the upper section. All protective relays and controls shall be located in the upper section. Section shall be provided complete with controls and wiring.

F. The switchgear shall be an outdoor switchgear assembly with metal housing and walk-in protected aisle that is NEMA 3R rated for outdoor use and shall include suitable weatherproof access doors, doors with provision for padlocking; protected ventilation openings as required; interior lighting, utility outlets with protective devices; and equipment heaters with protective devices. The ventilation shall be thermostatically controlled. There shall be adequate aisle width for breaker removal.

G. Workmanship and materials utilized in the construction of the medium voltage switchgear shall be of the highest quality. All materials shall be new and adequate to provide long life and reliable operation. Equipment shall not have been in prior service except as required by factory tests.

H. The switchgear shall be delivered FOB the City of Concord, Coddle Creek Water Treatment Plant, 6935 Davidson Highway, Concord, NC. The Seller's responsibility for the delivery of the switchgear shall end when the switchgear is fully assembled, set on the Purchaser's foundation and certified by the Seller to be ready for energization.

I. There shall be a late delivery charge incurred by the Seller for each week that the switchgear is not delivered to the site per the scheduled date specified in the Seller's proposal. The amount of the charge shall be $500 per day and will be deducted from the contract price as quoted in the Seller's bid.

J. The Purchaser reserves the right to reject any bids. The Purchaser will evaluate the successful bid based on conformance to the specifications, delivery schedule, overall design and cost based on initial cost plus life cycle costs.

K. The Seller's warranty shall apply for a period of not less than one (1) year after manufacturer's service has been completed. All warranties shall apply to the switchgear set FOB Purchaser's foundation. The successful bidder shall furnish a written warranty that the switchgear and its fabrication and components shall be according to these specifications and with the latest recognized industry standards.

L. The Seller's base bid shall include the standard warranty.

M. An alternate cost shall be quoted for extending the standard warranty to three years and five years.

N. Each bidder shall submit with each copy of his bid complete specifications and drawings describing and illustrating the proposed equipment.

O. The successful bidder shall furnish the following information.
   1. Drawings showing overall switchgear lineup measurements, center of gravity, weights, and mounting locations.
   2. Foundation requirements including loading and anchoring locations.
   3. Drawings showing the layout, dimensioning and wiring of all instrumentation and controls.
   4. Instructions and test reports as necessary for the installation, operation and maintenance of the equipment and for demonstrating that it complies with these specifications.
   5. Before manufacture, three (3) copies of each drawing shall be submitted to the Purchaser for approval as soon as possible after notice of award of contract.
   6. The Purchaser will, within 10 business days after receipt of prints of drawings for approval, forward one copy to the vendor marked "Approved", "Approved as Noted", or "Returned for Correction." Time involved in drawing approval will be considered as having been included in delivery time.
   7. Prints marked "Approved" authorizes the Seller to continue with the fabrication of the equipment covered by such drawings.
   8. Prints marked "Approved as Noted" authorize the Seller to proceed with the fabrication of the equipment covered by such drawings with corrections indicated thereon. Upon receipt of these prints, the Seller shall make the necessary revisions to the drawings. Additional approval by the Purchaser of such revised drawings will not be required unless changes are made other than those requested by the Purchaser.
   9. Prints marked "Returned for Correction" require the Seller to make the necessary correction(s) and resubmit prints for approval in the same routine as before. Correction of drawings and the resubmission of prints will not entitle the Seller to any extension of time, but the Purchaser will examine and return such prints within 10 business days of receipt of prints.
   10. After final approval, the Seller shall submit six (6) final prints and six (6) final instruction books as soon as practical but in no case subsequent to the shipping date of the equipment. In addition, a full set of drawings shall be furnished electronically (AutoCAD 2018 or earlier).
   11. Work done or materials ordered prior to receipt of "Approved" drawings or drawing marked "Approved as Noted" will be at Seller's risk.
   12. Approval by the Purchaser shall not relieve the Seller of the responsibility for the correctness of the drawings furnished by the Seller nor for their compliance with the specification unless so stated at the time of approval. If, at any time before the completion of the work, changes are made necessitating major revisions of approved drawings, the Seller shall make revisions and shall proceed in the same routine as for the original approval.

P The Seller shall provide on-site start-up and testing by an authorized manufacturer's agent. These services shall be adequate to ensure the proper operation of the switchgear and controls.

2.02 SWITCHGEAR CONSTRUCTION

A. The switchgear sections shall have a BIL of 95 kV.

B. The nominal insulation class shall be 15 kV, system voltage is 12.47 kV.

C. Provide an outdoor, weatherproof, protected walk-in aisle enclosure, fabricated and coordinated with the switchgear to form an integral enclosure.

D. The entire length of the protected aisle shall be wide enough to permit two circuit breakers to pass side by side conveniently.

E. Adequate space shall be provided for convenient installation, operation and maintenance of the batteries, battery charger, and circuit breaker test equipment.

F. The roof of the enclosure shall slope to allow for adequate run-off of moisture.

G. The enclosure shall include proper air conditioning, heating, and/or ventilation equipment as recommended by the manufacturer. All ventilation openings shall be provided with suitable filters and rodent screens.

H. The switchgear sections shall be constructed of electrically welded structural and sheet steel in accordance with the latest revision of ANSI C37.20. Where required, non-magnetic steel shall be used. Edges shall be bent on 1/4 radius, seam welded on corners, and ground smooth. Flat surfaces on the face of each panel shall not deviate more than 1/16 inch from a true plane.

I. Surfaces to be painted shall be thoroughly cleaned by sandblasting, pickling and rinsing and then treated with a rust inhibitive wash process. Primer coats shall be applied and the surfaces, sanded, and filled where necessary. A minimum of two (2) coats of undercoat and (1) one coat of finish paint shall be applied. Color of finish will be light gray, ANSI-61. Powder coat shall be acceptable.

J. The switchgear sections shall be bolted at the bottom to anchor bolts and suitable bracing, brackets, and straps shall be provided to prevent warping of the section.

K. Provisions, such as lifting eyes, shall be made for lifting the structure at the top.

L. Asbestos or products containing asbestos shall not be used in the equipment furnished.

M. The rear door of each compartment shall be hinged on one side. The non-hinged side shall be bolted.

N. The front doors shall be hinged on the left side and utilize a three-point latching system on the right side. The latch handle shall have provisions for padlocking.

O. Front and rear doors shall be fabricated and secured such that the circuit breakers can safely be racked into and out of the compartment with the doors closed and secured. Doors shall be designed such that racking with the doors closed and latched shall conform to the appropriate hazard/risk category of NFPA 70E for racking of circuit breakers with doors closed.

P. Doors shall be mounted such that adjacent panels will not interfere with door opening to at least 90°.

Q. No primary live parts shall be exposed when the circuit breaker is removed from the compartment. Grounded metal shutters shall automatically cover primary disconnect stabs when the breaker is racked into the test or disconnected position.

R. Shutters shall be positively driven by linkages connected to the racking mechanism.

S. The main bus compartment shall be located within the main structure and shall contain the main bus with necessary connections to bus stabs.

T. The main bus shall be arranged in the order of ABC left to right, top to bottom, or front to rear when viewed from the front of the switchgear

U. The main bus and other major components (such as breakers and transformers) shall be completely enclosed by grounded metal barriers, including a front barrier as part of the circuit breaker.

V. The bus and structure shall be constructed and braced to withstand short circuit stress developed by currents equal to main power circuit breaker close, carry, and interrupting ratings.

W. The main bus shall be tin plated high conductivity copper with a continuous current rating of 1200 A. Bus bars shall have a continuous current rating based on temperature rise and documented by design tests.

X. All bus joints will be silver surfaced and shall either be brazed or high pressure bolted.

Y. Bolted bus joints shall have no less than two (2) bolts per joint. Bolts shall be non-magnetic, where required, and shall be corrosion resistant material.

Z. All busbar connection points shall be silver plated.

AA. Access to bus bars shall be through removable front panels.

BB. Bus bars and all connections shall be insulated. Prefabricated boots shall be used on field bus joints.

CC. The design shall minimize the use of insulating tapes on factory bus joints.

DD. Insulating barriers shall be provided where the main buses pass from one section to another. Materials and instructions for connecting the bus joints between sections separated for shipment shall be supplied.

EE. All busbar stabs to which cables are to be connected shall have four (4) bolt holes with NEMA spacing suitable to allow up to four (4) NEMA two-hole pads to be attached to any single busbar stab.

FF. Busbar stabs shall be located to provide sufficient space for terminating cables with stress cones.

GG. External cables will enter through the bottom coverplates. Provisions for securing external cables at the bottom of the external cable wire trough shall be made. Adequate cable supports for bracing cables against short circuit stresses shall be provided.

HH. The total temperatures of the buses and insulation used in the assembly shall not exceed the limits specified in the latest revision of ANSI C37.20 for the environmental conditions as specified herein.

II. The temperature rise of current-carrying parts of the structure shall not be increased by the temperature of non-current carrying parts of the assembly.

JJ. A continuous ¼" x 2" (minimum size) copper ground bus shall extend throughout the switchgear lineup.

KK. The ground bus shall be accessible from each compartment without removing any barriers.

LL. The ground bus shall have a momentary current rating of not less than the momentary current rating of the main buses.

MM. A stationary ground contact shall extend from the ground bus into the circuit breaker compartment for grounding the circuit breaker in the fully connected and test position.

NN. A compression type terminal for #4/0 AWG cable connections shall be supplied at each end of the ground bus.

OO. Bus support and bus splice bolts shall not be used for making electrical connections to the ground bus.

PP. A space heater with thermostat shall be provided in each switchgear section. Thermostats shall be accessible without exposing energized parts.

QQ. Each space heater shall be fed from its own set of fuses located in the same switchgear section.

RR. Space heater voltage shall be 120 VAC.

SS. All wiring leaving a switchgear section shall be terminated on a terminal block.

TT. All devices, terminal blocks, and wiring shall be easily accessible while the equipment is in operation.

UU. Each major device in each switchgear section (circuit breaker, potential transformers, current transformers, surge arresters, and surge capacitors) shall be identified with an engraved metal nameplate that indicates manufacturer's name, equipment ratings, and general information.

VV. Appropriate labels warning of hazardous voltages shall be provided in clear view and shall be provided on the rear doors, shutters, breaker front and wherever else appropriate to ensure personnel safety.

WW. All labels, nameplates, instruction and warning plates shall be securely fixed to equipment with stainless steel rivets, plated self-tapping screws or other approved means. The use of adhesives is not permitted.

2.03 CIRCUIT BREAKERS

A. The circuit breakers shall be vacuum type, three-pole, single-throw, horizontal-drawout type with the current, voltage, and interrupting ratings as specified below:

Nominal Voltage Class:	15 kV RMS
System Voltage	12.47 kV
Maximum Voltage:	15 kV RMS
Voltage Range Factor K:	1.0
Continuous Current @ 60 Hz:	1200 A
Short Circuit Current @ 60 Hz and rated max kV:	20 kA RMS
Interrupting Time:	5 cycles
Rated Permissible Tripping Delay:	2 seconds
Rated Peak Voltage:	28 kV Peak
Closing and Latching Capability:	52 kA RMS

B. The circuit breakers shall be electrically operated, mechanically and electrically trip free with stored energy closing mechanisms and shall have provisions for manual spring charging, close, slow close, and trip.

C. The stored energy springs shall recharge immediately after closing the circuit breaker.

D. Circuit breakers shall have separately fused tripping and closing circuits. Fuses shall be accessible from the front of the circuit breaker compartment without the use of tools.

E. The trip and close circuits shall each be equipped with a visible disconnecting device.

F. Circuit breaker control voltage shall be 48 VDC.

G. Minimum controls for each circuit breaker shall include a control switch as well as red and green indicating (breaker status) lights. These shall be mounted on the section door for each breaker.

H. Protective relays, meters and test switches shall be provided as indicated on the drawings.

I. Circuit breaker shall be equipped with no less than five (5) "a" and five (5) "b" contacts. All contacts shall be wired through the secondary disconnect device to terminal blocks in the switchgear section.

J. Circuit breakers shall be equipped with position indicating contacts to indicate the position of the circuit breaker within the compartment. It shall be possible to monitor these contacts to determine if the circuit breaker is in the connected, test, or disconnected position.

K. Circuit breakers of equal rating shall be interchangeable. Circuit breakers of different voltage, current, or MVA ratings shall not be interchangeable. The circuit breaker compartment shall be designed to prevent interchanging circuit breakers of different ratings.

L. Circuit breakers shall be equipped with self-aligning silver plated primary and secondary disconnects. Secondary disconnect devices shall automatically disengage from the circuit breaker compartment as the breaker is racked into the disconnected position.

M. Circuit breakers shall be equipped with grounding contacts, an operations counter, and a mechanically operated position indicator that clearly indicates when the circuit breaker is in the connected, test, and disconnected position.

N. The circuit breaker compartments shall be equipped with a mechanism for racking the breaker into and out of the connected position. The racking mechanism shall be designed such that the breaker will be self-aligning and will remain aligned within the cubicle during the racking process.

O. Circuit breaker racking shall be accomplished with the door closed and latched.

P. In the connected position, the circuit breaker shall be held rigidly in the operating position. In the disconnected position, the breaker shall be easily removable from the compartment.

Q. Interlocks shall be provided to prevent moving the breaker into or out of the connected position unless the primary contacts are open.

R. Stored energy springs shall automatically discharge when the breaker is racked into or out of the compartment.

S. Racking devices shall have provisions to padlock in the connected, test, or disconnected position.

T. When the racking mechanism is locked in the disconnected position, the breaker shall be removable from the compartment.

U. Racking mechanism padlocks shall not interfere with breaker operation.

V. Interlocks shall be provided to prevent the breaker from being electrically or mechanically closed when it is at any position between the connected and test position.

W. Dead front protection shall be maintained throughout the racking process.

X. An adder for optional remote racking shall be included.

2.04 POTENTIAL TRANSFORMERS

A. Potential transformers shall be provided with the ratios as indicated on the one-line diagram. The potential transformers shall be rated as follows:

1. 15 kV class transformers

Insulation Class:	15 kV
BIL level, kV crest:	110
Accuracy Class at Rated Voltage (minimum):	0.3 W,X,M,Y,Z

B. Potential transformers shall be mounted in roll-out or tilt-out compartments.

C. Connections to potential transformer trays shall be rigid bus bars insulated to full voltage of the switchgear section in which they are connected.

D. Current limiting fuses shall be provided on the primary of each potential transformer provided in the assembly.

E. When the potential transformers are in the disconnected position, the transformers and primary fuses shall be automatically disconnected and grounded.

F. Potential and current transformers shall be dry type and shall be designed and rated in accordance with the latest revision of ANSI C57.13.

G. Potential transformers shall be suitable for use in grounded wye configuration. Three line-to-ground connected PT's are required for each set.

H. Removable cartridge fuses shall be provided in each ungrounded leg of the secondary side of voltage transformers.

I. Cartridge fuses and fuse blocks shall be rated 600 VAC.

2.05 CURRENT TRANSFORMERS

A. Current transformers shall be provided with the ratios as indicated on the one-line diagram. The current transformer shall be rated as follows:

Insulation Class:	600 V
Accuracy Class:	C100
Thermal Rating Factor:	2.0

B. The current transformers shall be rigidly mounted and shall be capable of withstanding the stresses of their associated circuits.

C. Current transformers shall be adequately insulated and shielded from all high voltage parts.

2.06 CONTROL POWER TRANSFORMERS

A. Control Power Transformers (CPT's) shall be provided as indicated on the one-line diagram. The CPT's shall be sized to provide adequate power for the battery charger, lights, receptacle loads, ventilation fan, and heaters. The minimum rating shall be 15 kVA.

B. CPT's shall be mounted in roll-out compartments.

C. Connections to CPT trays shall be rigid bus bars insulated to full voltage of the switchgear section in which they are connected.

D. Current limiting fuses shall be provided on the primary of each CPT provided in the assembly.

E. When the CPT's are in the disconnected position, the transformers and primary fuses shall be automatically disconnected and grounded.

F. CPT's shall be dry type.

G. A secondary circuit breaker shall be provided in each ungrounded leg of the secondary side of the CPT's.

H. Secondary devices shall be rated 600 VAC.

I. A throw-over scheme shall be included to ensure that control is provided in the event of losing one of the two source feeds.

2.07 WIRING

A. Wiring shall be switchboard type SIS with 600V insulation. Conductor shall be annealed, tin coated copper and shall not be less than #14 AWG in size. All current circuits shall be a minimum of #12 AWG in size. Wiring utilized must pass the vertical flame tests specified in the latest version of the following standards: IEEE-383 paragraph 2.5.6 (ICEA S-19-81 Section 6.19.6), ICEA S-66-524 paragraph 6.12.5 and UL VW-1. Equipment case grounds shall be connected to the ground bus with Belden 8661 braided ground wire or equivalent.

B. All control wiring shall be landed on the devices or terminal blocks with ring-tongue terminals having insulated compression barrels. Fork terminals are unacceptable. No more than two wires may be terminated at any one connection point. A non-ferrous lock-washer shall be used at each termination.

C. There shall be no splices in the wiring. All connections shall be made on terminal studs or devices.

D. All wires shall be marked with the opposite end destination at each end except jumpers to points on the same device or terminal block which are shorter than 12 inches in length. Such jumpers need not be marked.

E. Vertical and horizontal troughs with removable covers for concealing wiring runs shall be provided.

F. Current transformer shorting terminal blocks shall be provided complete with shorting bar and screws.

G. Terminal blocks shall be provided with marking strips. Marking strips shall be marked as shown on the drawings that are a part of this specification.

H. All devices shall be mounted so that standard hand tools can be used on nuts and screws without removing other devices.

2.08 SURGE ARRESTERS

A. Surge arresters shall be provided as indicated on the one-line diagram.

B. The mounting location should be chosen to provide easy access for testing and replacement.

C. Surge arresters shall be distribution class and rated as follows:

Arrester Class:	15 kV
Maximum Continuous Operating Voltage:	7.65 kV

2.09 STATION BATTERIES

A. A bank of nickel-cadmium (NiCad) storage batteries, battery charger and battery rack shall be supplied. The nominal voltage of the NiCad battery bank shall be 48 VDC. The batteries and battery charger shall be sized in accordance with IEEE std. 485 and IEEE std. 1115. The alarms shall include alarms for remote status monitoring.

B. The battery rack and charger shall be mounted in the 72" workspace.

C. The NiCad batteries shall be sized and installed according to IEEE std. 1106.

2.10 ACCESSORIES

A. The manufacturer shall provide the following accessories with the switchgear:
1. Circuit breaker lift truck
2. Manual racking handle
3. Circuit breaker testing device
4. Two test plugs for relay test switches (FT1 style)
5. Optional remote racking equipment

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install in accordance with the NEC, as shown on the drawings, and as recommended by the manufacturer's instructions.

B. Install on concrete pad as indicated on Drawings. Anchor switchgear with rustproof bolts, nuts, and washers not less than ½ inch in diameter, in accordance with manufacturer's instructions.

C. Coordinate installation schedule with Owner.

D. Apply temporary heat to switchgear throughout periods when the switchgear environment is not controlled for temperature and humidity.

3.02 FIELD QUALITY CONTROL

A. Perform inspections and tests listed in NETA STD ATS 2017, Section 7.1 pages 23 - 27.

B. The following in the switchgear shall also be tested:
   1. Protective relays
   2. Arc flash sensors

C. The Owner will provide settings files for all protective relays and meters. The manufacturer shall participate with the Owner's engineer in the development of these settings. Manufacturer's involvement will include collaboration on all input and output assignments to support the Owners' engineer. The Owner's engineer will be responsible for protective settings and providing the settings files which will be uploaded to the relay in the field by the Contractor's testing personnel.

D. An authorized representative of the switchgear manufacturer shall technically supervise and participate during all of the field adjustments and tests. Major adjustments and field tests shall be witnessed by the Owner's engineer. The manufacturer's representative shall certify in writing that the equipment has been installed, adjusted, and tested in accordance with the manufacturer's recommendations.

E. Perform manufacturer's required field tests in accordance with the manufacturer's recommendations. In addition to manufacturer's recommendations and NETA STD ATS 2017, the following shall be performed:
   1. Visual Inspection and Tests:
      a. Compare nameplate data with specifications and approved shop drawings.
      b. Inspect physical, electrical, and mechanical condition.
      c. Confirm correct application of manufacturer's recommended lubricants.
      d. Verify appropriate anchorage, required area clearances, and correct alignment.
      e. Verify that circuit breaker sizes and types correspond to approved shop drawings.
      f. Verify tightness of accessible bolted electrical connections by calibrated torque wrench method, or performing thermographic infrared survey after energization and under load.
      g. Verify appropriated equipment grounding.
      h. Confirm correct operation and sequencing.
      i. Vacuum clean enclosure interior. Clean enclosure exterior.
      j. Inspect insulators for evidence of physical damage or contaminated surfaces.
      k. Verify shutter installation and operation.

l. Exercise all active components.
m. Verify the correct operation of all sensing devices, alarms, and indicating devices.
n. Verify that the vents are clear, and filters are installed correctly.
o. Inspect control power transformers.
p. Inspect switchgear heaters for correct operation.

2. Electrical Tests:
   a. Perform DC high potential tests on each bus section.
   b. Perform insulation resistance tests on all lightning arresters.
   c. Perform insulation resistance tests on all PTs and Control Power Transfomers.
   d. Perform ratio tests on all PTs and Control Power Transformers.
   e. Verify control power throwover scheme operates correctly.
   f. Perform phase rotation and phasing checks to ensure new switchgear matches existing and that generator and utility match.
   g. Verify circuit breakers are tripped by each protective device.
   h. Verify proper operation of source transfers between utility and generator.

F. The manufacturer shall provide the services of a factory-trained technician for one 4-hour training period for instructing the Owner's personnel in the maintenance and operation of the switchgear. Dates for this training shall be coordinated with the Owner.

3.03 DECOMMISSION AND REMOVAL OF EXISTING 15 KV METALCLAD SWITCHGEAR

A. Upon acceptance of the new equipment, construction, and training by the Owner, the existing 15 kV Metalclad switchgear and its contents shall become the property of the Contractor. It shall be promptly removed from the site and disposed of properly.

B. Decommissioning and removal shall not begin without approval from the Owner.

C. The concrete pad for the existing 15 kV Metalclad switchgear shall be left in place. All conduits shall be capped with properly sized caps.

END OF SECTION

ENGINE GENERATOR SET CONTROL AND PROTECTION UPGRADE SPECIFICATION – SECTION 26 23 13
APRIL 2019

CITY OF CONCORD
CODDLE CREEK WATER TREATMENT PLANT
6935 DAVIDSON HIGHWAY
CONCORD, NC 28027

Prepared by:

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NC FIRM #C-1503

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This document originally issued and sealed by Barry Wayne Tyndall, license number 015897, on 04/18/2019. This medium shall not be considered a certified document.

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Engine Generator Set Control and Protection Specification

1.0 PROJECT DESCRIPTION

The City of Concord is replacing the existing 12.47 kV main switchgear at the Coddle Creek Water Treatment Plant. This switchgear will be completely replaced including all protective relays, metering, controls, and PLC. As part of this project, the City is also upgrading the generator switchgear protective relaying, metering, control, and PLC. The generator switchgear, however, will remain in place. This includes the generator switchgear enclosure, generator breaker, PTs and CTs,

The new generator controls shall be integrated, compatible, and functional with the new 12.47kV Main Switchgear, existing generator, and all related components.

The system is to be fully integrated with the existing SCADA system. An SEL-RTAC is being required in the new 12.47 kV switchgear and is envisioned to be instrumental in the integration with the existing SCADA system. The project is to be completed in stages and must be coordinated with the Owner.

1.1 Description of System Operation

The control system shall be PLC based with a touchscreen operator interface. One touchscreen shall be located at the generator and one touchscreen shall be located in the new 12.47kV Main switchgear. The PLC's shall be an Allen-Bradley CompactLogix, ControlLogix PLC, or approved equal. Along with the required input and output modules, one spare input and one spare output module shall be provided on the PLC system. The touchscreen shall be a 15" LCD touch-only (no function keys) operator interface. The touchscreen shall operate with a Microsoft Windows operating system. It shall be possible to connect a standard PC keyboard and mouse to the touchscreen interface for configuration changes and program updates. A license of all software used in the development of the PLC ladder logic and touchscreen control system shall be provided to the Owner. Recovery media shall be provided to allow the computer to be restored to a "factory fresh" state automatically. Annunciation of system alarms shall be provided either via the operator interface or separate annunciators. The power supply for this equipment shall be supplied by a dedicated 24VDC source and shall be separate from the engine batteries.

Contractor to coordinate design and integration of system with Owner.

The following drawings are to be used in conjunction with this specification:

P1711178E300	Partial Medium Voltage System One-line Diagram
P1711178E301	Switchgear M One-line Diagram – Bus 1
P1711178E302	Switchgear M One-line Diagram – Bus 2
P1711178E310	52-1AL Panel Layout and Bill of Material – Upper Section
P1711178E311	52-1AL Panel Layout and Bill of Material – Lower Section
P1711178E312	52-2AL Panel Layout and Bill of Material – Upper Section
P1711178E313	52-T Tie Breaker Panel Layout and Bill of Material
P1711178E314	Typical Top Feeder Panel Layout and Bill of Material
P1711178E315	Typical Bottom Feeder Panel Layout and Bill of Material
P1711178E316	Transition Panel Layout and Bill of Material
P1711178E320	Switchgear M Contact Development
P1711178E321	Switchgear M Contact Development
P1711178E510	Switchgear M Typical Feeder AC Elementary Diagram
P1711178E511	Switchgear M Feeders 1BL and 2BL AC Elementary Diagram

P1711178E512 Switchgear M 1AL AC Elementary Diagram
P1711178E513 Switchgear M 2AL AC Elementary Diagram
P1711178E514 Switchgear M Tie Breaker AC Elementary Diagram
P1711178E520 Switchgear M 1AL DC Elementary Diagram
P1711178E521 Switchgear M 2AL DC Elementary Diagram
P1711178E522 Switchgear M Tie Breaker DC Elementary Diagram
P1711178E523 Switchgear M Feeder 1BU DC Elementary Diagram
P1711178E524 Switchgear M Feeder 1BL DC Elementary Diagram
P1711178E525 Switchgear M Feeder 1CU DC Elementary Diagram
P1711178E526 Switchgear M Feeder 1CL DC Elementary Diagram
P1711178E527 Switchgear M Feeder 2CU DC Elementary Diagram
P1711178E528 Switchgear M Feeder 2CL DC Elementary Diagram
P1711178E529 Switchgear M Feeder 2BU DC Elementary Diagram
P1711178E530 Switchgear M Feeder 2BL DC Elementary Diagram
P1711178E540 Communications Schematic

1.2 Related Work

A. Section 26 13 13, MEDIUM VOLTAGE METAL-CLAD SWITCHGEAR: Requirements for the new 12.47kV Main switchgear.

1.3 Modes

A. The engine generator set controls shall include a synchronizing mode switch (SMS) which shall allow the engine generator set to be placed in one of four modes via an IEEE 43 device. This device shall be an Electroswitch Series 24 control switch with four clearly labeled positions: “RUN”, “PERM”, “CHECK”, and “OFF.”
   1. RUN Position
      When in the RUN position, the system automatic synchronizer shall function normally to adjust engine speed and close the selected breaker (52-1AL, 52-T, or 52-2AL).
   2. PERM Position
      When in the PERM (permissive) position, the automatic synchronizer shall not adjust engine speed but will close the breaker when the phase angle is within acceptable limits.
   3. CHECK Position
      When in the CHECK position, all functions of the automatic synchronizer are functional except the breaker shall not receive a close signal.
   4. OFF Position
      When in the OFF position, the automatic synchronizer shall not function. Manual breaker closing shall require the SMS to be in the OFF position.

B. The engine generator set controls shall include an engine switch (ES) which shall allow operating modes via an IEEE 43 device. This device shall be an Electroswitch Series 24 control switch with four clearly labeled positions: “OFF”, “AUTO”, and “MANUAL.”

1. OFF Position
   When ES is placed in the OFF position, the generator breaker 52-G shall trip immediately and stop the engine. All unit alarms shall be turned off. All “engine lockout” conditions must be reset before generator operation can continue.
2. AUTO position
   The AUTO position shall enable the engine controls to respond to all system automatic start/stop operations.
3. MANUAL
   The MANUAL position shall disable automatic operation and enable manual control of the generator and generator breaker.

C. Emergency Stop

A shrouded, red emergency stop button shall be placed on the generator control panel (located on the control section) and on the local engine control panel. Regardless of the position of any mode switches, these push buttons shall bring the engine generator set to a stop. These buttons shall also shut down any auxiliaries unless shutting the auxiliary down presents a greater hazard or potential for equipment damage than allowing it to continue running.

1.4 Pre-Start Conditions and Requirements

A. 24VDC control power must be available and turned on at the generator and master control panels. The engine batteries shall not be used for control power. Acceptable voltage range is 20-30VDC. If voltage exceeds these limits for an extended period of time, unit and or system failure will occur. A momentary voltage drop below 20VDC during engine starting will not cause a malfunction.

B. 48VDC control power must be available and turned on at the master panel located in the main switchgear and each breaker. Acceptable voltage range is 40-56VDC.

C. All active 5/15KV breakers must be racked into connected position. These breakers include 52-1AL, 52-T, 52-2AL, and 52G

D. The SMS, located on the master panel, shall be in the RUN position for normal operation. This enables full automatic operation of the system automatic synchronizer. If SMS is not in RUN auto closing of all system breakers shall be blocked.

E. All engine generator alarms and shutdown controls must be normal and reset. If any engine shutdown alarm is on the engine shall not start.

F. The engine switch, device ES, shall be in the AUTO position.

G. The generator lockout switch, 86G, shall be reset. Operation of 86G shall trip, and lock out, both the generator breaker 52G and the generator main breaker 52-2AL (located in the Main switchgear). Operation of 86G shall prevent and terminate standby operation.

H. The utility main breaker lockout switch, 86-1AL, shall be reset. All system automatic operation shall be terminated and inhibited when 86-1AL operates.

I. The generator main lockout switch, 86-2AL, must be reset. Operation of 86-2AL will trip, and lock out, both the generator breaker 52G and the generator main breaker 52-2AL (located in the Main switchgear). Operation of 86-2AL will prevent and terminate standby operation.

J. The generator and system PLC's shall have 48VDC power and 24VDC to the PLC rack.

1.5 Operating Methods

The engine generator set shall have one method of operation. This method shall be “STANDBY”.

A. Normal Conditions
   1. All alarms are reset and normal.

2. Breakers 52-1AL, 52-T, and all active feeder breakers are closed. Breakers 52-2AL and 52G are open. The breaker control switches for these breakers shall display a red target. Otherwise, automatic operation will be disabled and the “Automatic Operation Locked Out” alarm light will flash.
3. Generator shutdowns are in normal ready-to-run status. All engine-generator controls shall be set for automatic operation.

B. Standby Operation
1. General Information
   a. Unit shall start in a black plant mode. Utility voltage shall be monitored by 51-1AL. Standby operations shall start if utility voltage drops below a set point for an adjustable PLC time delay.
   b. Relay 51-1AL shall send a signal to the PLC for abnormal utility conditions determined by the Engineer. Upon receipt of this signal, standby operation shall start without additional delay.
   c. Sequence to return to normal shall not occur until normal utility voltage returns and 51-1AL signals acceptable conditions for utility service for a user-adjustable time delay.
   d. Standby operation shall be disabled if 86-1AL operates.
   e. Standby operation shall be disabled if 86-2AL operates.
   f. Standby operation shall be disabled if any breaker, 52-1AL, 52-T, 52-2AL, or 52G has been manually tripped using the breaker control switch prior to automatic operation. An “Automatic Operation Locked Out” alarm light shall be lit and a horn shall sound.
   g. If either breaker 52-1AL or 52-T is manually tripped by the breaker control switch, standby operation shall not terminate while plant loads are connected to the generator. Further automatic operation, however, shall be inhibited. A “Automatic Operation Locked Out” alarm shall be lit.
   h. System automatic synchronizer mode switch SMS must be in the run position.
   i. If SMS is in the OFF of CHECK position standby operation shall be disabled. Re-transfer to utility shall remain enabled. An “Automatic Operation Locked Out” alarm light shall be lit.
2. Standby Method
   a. Standby operation shall start without delay if 52-1AL is tripped for abnormal utility conditions and the PLC receives a signal from 51-1AL.
   b. Standby operation shall start if the utility undervoltage relay drops below a set point and operates after a set time delay to match existing.
   c. Breakers 52-1AL and 52-T shall trip at the start of standby operation. If either 52-1AL or 52-T is closed, standby operation shall be inhibited.
   d. The generator shall start and accelerate to rated speed and voltage without intentional time delay. Breaker 52G shall close when generator is at rated speed and voltage.
   e. Breaker 52-2AL shall close without time delay to connect the generator to B-side of the new 12.47kV Main switchgear.
   f. Breaker 52-T shall close after a time delay to match existing connecting the generator to A-side of the new 12.47kV Main switchgear. If load demand exceeds standby rating of the generator, 52-T shall trip after a 1 second time delay. Once tripped, 52-T shall not be allowed to re-close until standby operation has ended.
   g. Failure of the generator shall cause breakers 52-2AL and 52-G to open and be locked out. Breakers 52-1AL and 52-T shall close as soon as utility power is available.
3. Stop Standby Operation
   a. A “Utility Power Available” light shall turn on when the utility undervoltage relay and 51-1AL are normal. (“Normal” conditions include no 27/59, 81 O/U, or 47N). 51-1AL shall notify the PLC when normal conditions have returned.

b. A “Utility Power Stable” light shall turn on and the transfer to utility power sequence shall start when the stabilize time delay is complete. Stabilize time delay shall user adjustable via the touchscreen.
c. If breakers 52-1AL and 52-T are open, breaker 52-1AL shall close without additional time delay. The new 12.47kV Main switchgear A-side loads shall connect to utility and B-side loads to the generator. Breaker 52-T shall be selected for closing by the PLC. Once the generator is in synch with the utility, 52-T shall close.
d. If 52-1AL is open and 52-T is closed, breaker 52-1Al shall be selected for closing by the PLC. Once the generator is in synch with the utility, 52-1AL shall close.
e. The generator shall unload to 100kW. Breakers 52-2AL and 52-G shall open and the generator shall cycle through normal stop cycle.

4. Additional Operation Requirements
a. If 52-2AL or 52-G is manually tripped after start of automatic operation, an alarm shall be enabled. After a set time delay to match existing, breaker 52-1AL then 52-T shall close. An “Automatic Operation Locked Out” alarm shall be enabled and further automatic operation shall be disabled.
b. Once a system breaker has been manually tripped using the control switch, the breaker must be manually closed before system automatic operation can continue.
c. There shall be the ability to manually control generator and generator breaker to transfer plant load to generator or transfer load to utility. A touchscreen operator interface is being provided with the new 12.47kV Main switchgear to assist with manual transfer to utility.

2.0 DESCRIPTION OF SYSTEM PROTECTION, METERING AND CONTROL

All existing protective relaying, metering and control shall be replaced. All relays, meters and controls shall be new, and shall be the manufacturer’s latest revision including software. Contractor to coordinate design and integration of system with Owner.

A. Engine Generator Set Protective Relaying, Metering and Control

1. The engine generator set shall be protected by a Schweitzer Engineering Laboratories SEL-700G relay. The relay shall be rated for 5A current inputs, 120V potential inputs, and 48VDC power supply input. It shall be provided with Flexitest test switches, or approved equal. The test switches must allow testing of the relay by shorting out all current circuits, opening potential circuits, opening the trip and close output circuits, and opening any digital inputs (e.g. breaker status contact). Trip output circuits shall have red handles. All potential circuits shall be wired so that the incoming potential is on the same side of the test switch as the incoming current circuits. This relay must contain the following functions as a minimum.

27	Undervoltage
32	Reverse Power
40	Loss of Excitation
46	Negative Sequence Overcurrent
51V	Voltage restrained Overcurrent
51G	Ground Overcurrent (5A input)
59	Overvoltage
81O/U	Over and Under Frequency
87G	Generator and Transformer Differential

2. It shall also have one front RS-232 serial communications port for programming and interrogating the relay locally via a computer. It shall have one fiber port and one rear RS-232 communications port both with DNP 3.0 Level 2 protocol. A generator lockout

relay shall also be provided. The lockout relay shall be an Electroswitch LOR. These relays shall be mounted on the existing 4.16 kV generator breaker sections.

3. An Electroswitch Series 24 breaker control switch shall also be provided with trip and close positions; however, the close position shall only be functional when the breaker is in the TEST position. This equipment shall also be mounted on the existing4.16 kV generator breaker section.

4. A SEL-735 meter shall be included on the generator breaker section for metering the real and reactive power and energy produced by the generator.

5. The manufacturer shall include other metering and control functions in the touchscreen interface, such as virtual meters, including synchronizing scopes, voltmeters, watt/var and power factor meters or unless specified otherwise by the Owner.

6. The PLC control system shall integrate with the owner's SCADA system via a Schweitzer Real-time Automation Controller (RTAC). All control functions, metering, indication and unit alarms within the PLC's shall be available to the Owner via the RTAC. The information available shall be suitable to allow the Owner to monitor the details of the unit's operation and status via the Owner's SCADA system. The system shall allow the Owner to remotely start, stop, and set the peak shaving setpoint via the Owner's SCADA system.

7. The new 12.47kV Main switchgear equipment shall integrate with the Owner's system via the RTAC. Equipment shall include protective relays, meters, and the PLC.

3.0 GENERAL REQUIREMENTS

A. Workmanship
   1. All workmanship and material shall be of the highest quality and all material shall be new, unused and free from defects affecting appearance and serviceability. The material used and the design and construction used in the manufacture of the components and of the complete assembly of the system shall be such as has been proven to be satisfactory for the application.

B. Equipment Mounting
   1. All controls, instruments and protective devices shall be installed on the front switchgear swing-out doors. Auxiliary devices such as terminal blocks and fuse blocks shall be mounted on the interior side sub-panels and mid-section panels.
   2. All devices shall be mounted so that standard hand tools can be used on nuts and screws without removing other devices. Internal equipment should not interfere with door mounted equipment when the door is closed.

C. Equipment Wiring
   1. The Seller shall furnish, install and wire all equipment required and the system shall be complete so that fieldwork will consist only of connecting external equipment and devices.

D. Arrangement
   1. Arrangement and wiring drawings for instruments, relays, devices, and accessories shall be submitted for approval by the Owner.

E. Warranty
   1. A statement describing the Seller's standard warranty and conditions shall be submitted with the bid.

F. Commissioning
   1. The Seller shall provide factory-trained personnel for the commissioning of the engine generator controls upgrade, including the integration with the 12.47 kV metal-clad switchgear.
   2. All modes of operation shall be verified to be functioning per the specifications and drawings.

G. Training

1. The Seller shall provide a factory-trained representative who is well versed with the system for the purpose of training the Owner's personnel in the operation of the control system.

2. One 4-hour training session shall be provided. Scheduling of this training shall be coordinated with the Owner,

4.0 WIRING

A. Conductors

1. Wiring shall be switchboard type SIS with 600V insulation. Conductor shall be annealed, tin coated copper and shall not be less than #14 AWG in size. All current circuits shall be a minimum of #12 AWG in size. Wiring utilized must pass the vertical flame tests specified in IEEE-383 paragraph 2.5.6 (ICEA S-19-81 Section 6.19.6), ICEA S-66-524 paragraph 6.12.5 and UL VW-1.
2. Equipment case grounds shall be connected to the ground bus with Belden 8661 braided ground wire or equivalent.

B. Wiring Methods

1. All control wiring shall be landed on the devices or terminal blocks with ring-tongue terminals having insulated compression barrels. Fork terminals are not acceptable. No more than two wires may be terminated at any one connection point. A non-ferrous lockwasher shall be used at each termination.
2. There shall be no splices in the wiring. All connections shall be made on terminal studs or devices.

C. Marking

1. All wires shall be marked with the opposite end destination at each end except jumpers to points on the same device or terminal block which are shorter than 12 inches in length. Such jumpers need not be marked. Components shall be labeled using a two letter scheme. The letters "I" and "O" shall not be used. Double letters, such as "AA", "BB", etc., shall be reserved for terminal blocks. Terminal blocks, fuse blocks, and the ground bus shall be labeled and shown on the submittal drawings.

D. Wireways

1. Vertical and horizontal troughs with removable covers for concealing wiring runs shall be provided.

E. Terminal Blocks

1. Current transformer shorting terminal blocks shall be General Electric type EB. Shorting blocks shall be provided complete with shorting bar and screws.
2. Control terminal blocks shall be AVO States Type NT, sliding link, with marking strips or GE Type EB with marking strip. Marking strips shall be marked as shown on the Seller's submittal drawings.

5.0 NAMEPLATES

A. Nameplates shall be made of laminated phenolic, black surface with white core. Engraving will produce a black plate with white letters and numbers. All door mounted equipment shall be identified with nameplates. All terminal blocks shall also be identified with nameplates. Nameplates shall not be applied with adhesives, rather they shall be screwed or riveted to the door or subpanel of the switchgear.

6.0 APPROVED CONTROL AND PROTECTION SYSTEM MANUFACTURER

A. The manufacturer of the control and protection system shall be submitted for the Owner's review and approval prior to award of contract. After award of contract, the manufacturer of the control and protection system may not be changed without the Owner's written consent.

7.0 BIDDER'S SUBMITTAL DATA

A. Each Bidder shall submit sufficient information for the Owner and the Owner's engineer to determine that his offering meets the requirements of these specifications. As a minimum, information shall be submitted on the PLC, touchscreen, annunciator(s), protective relays, control switches and test switches included in the Bidder's proposal.

8.0 SELLER'S SUBMITTAL DATA

A. Drawings

1. The Seller shall prepare layout drawings, wiring diagrams and other drawings as necessary to demonstrate compliance with these specifications. These shall be drawn on AutoCAD Release 14 or later software. If the Seller does not use AutoCAD, other formats will be acceptable if drawings can be saved in the "DXF" format

B. PLC Ladder Logic

1. The Seller shall provide complete ladder logic diagrams which clearly identify the control scheme, its inputs and outputs. Drawings which represent large sections of code with a simple block will not be accepted. All inputs and outputs must be clearly labeled and identified as to function in the submittal drawings.

C. Bill of Material

1. The Seller shall submit a complete bill of material demonstrating compliance of the control and protection system with these specifications and the project drawings.

D. Approval Process

1. The Seller shall submit the aforementioned items for review and approval by the Owner's engineer. The review will be complete within 2 weeks after the engineer receives the submittal. Each drawing or list shall be marked with one of the following: "Approved", "Approved with Comments", "Revise and Resubmit". Resubmittals shall be completed within 2 weeks and returned to the Engineer.

E. Final Documentation

1. The Owner shall be provided with three (3) complete sets of the following after final drawing approval: Equipment service and instruction manuals, installation, operation and maintenance manuals, and final drawings. Manuals shall be bound in three-ring notebooks, and drawings shall be sent rolled and unstapled in a tube.

PRECAST ELECTRICAL MANHOLE
ELECTRICAL SPECIFICATION – SECTION 33 71 19
APRIL 2019

CITY OF CONCORD
CODDLE CREEK WATER TREATMENT PLANT
6935 DAVIDSON HIGHWAY
CONCORD, NC 28027

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SECTION 33 71 19

PRECAST ELECTRICAL MANHOLES

PART 1 GENERAL

1.01 SUMMARY

A. This section includes precast concrete electrical manholes and all appurtenances.

B. This section prescribes the minimum criteria to be applied when designing, manufacturing, and installing sectional precast concrete electrical manholes.

1.02 RELATED SECTIONS

A. Section 26 05 43 –Underground Ducts for Electrical Systems.

1.03 REFERENCES

A. ASTM A48 - Standard Specification for Gray Iron Castings; 2012.

B. ASTM A615 – Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

C. ASTM A706 – Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

D. ASTM C33 – Concrete Aggregates

E. ASTM C94 – Ready Mixed Concrete

F. ASTM C150 – Portland Cement

G. ASTM C260- Air-Entraining Admixtures for Concrete

H. ASTM C494 – Chemical Admixtures for Concrete

I. ASTM C 857 - Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures; 2014.

J. ASTM C 858 - Standard Specification for Underground Precast Concrete Utility Structures; 2010.

K. ASTM C 891 - Standard Practice for Installation of Underground Precast Concrete Utility Structures; 2011.

L ASTM C 1037 - Standard Practice for Inspection of Underground Precast Concrete Utility Structures; 2008.

M. IEEE C2 - National Electrical Safety Code; Institute of Electrical and Electronic Engineers; 2017.

N. NFPA 70 – National Electrical Code; 2017.

O. ACI 318-11 – Building Code Requirements for Structural Concrete

P. AWS D1.4 – Structural Welding Code – Reinforcing Steel

1.04 SUBMITTALS

A. Product Data: Provide for nonmetallic conduit and manhole accessories.

B. Shop Drawings: Indicate dimensions, reinforcement, size and locations of openings, and accessory locations for precast manholes. Submit for approval before manufacturing begins.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Quality Assurance. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

D. Project Record Documents: Record actual routing and elevations of underground conduit and duct, and locations and sizes of manholes.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 400 miles (640 km) of Project.

1.06 WARRANTY

A. Submit manufacturer’s standard warranty.

PART 2 PRODUCTS

2.01 MANHOLES

A. Stay-Right Precast Concrete, Inc is the approved manufacturer. Products equal in all aspects from other manufacturers will be considered if there is a cost savings to the Owner.

B. Precast manhole shall be designed in accordance with ASTM C 858, comprising modular, interlocking sections complete with accessories. The manholes shall be manufactured in two (2) equal sized segments along with a joint for a removable top. The joining sections shall be manufactured in a manner that will result in a watertight joint when installed in place.

C. Loading: ASTM C 857, Class A-16 (HS20-44)

D. Shape: Rectangular.

E. Nominal Inside Dimensions: 12 feet x 9 feet

F. Inside Depth: 7 feet.

G. Wall Thickness: 6 inches.

H. Base Section: Include 3 inch (75 mm) deep x 10 inch (350 mm) round sump with cast sleeve, and one, 2 inch (25 mm) ground rod openings. Slope vault floor to sump. Provide sump cover. Sump cover shall be ASTM A48/A48M, Class 30B grey iron.

I. Top Section: Include 48 inch square opening for frame and cover. Top cover shall be removable in field. Include four lifting eyes in top cover.

J. Manhole Cover and Riser: Cover and riser frame shall be 48 inches square and shall form a water tight seal with vault. It shall be rated AASHTO HS20-44 loading. It shall be inscribed with the word "ELECTRICAL". The lid shall be hinged and padlockable.

K. Term-A-Duct conduit inserts, or equivalent, shall be installed per the drawings. They shall be sized for 5” Schedule 40 PVC conduit unless noted otherwise.

L. Cable Pulling Irons: Imbedded pulling irons shall be installed in the floor of the manhole on all four sides. They shall be recessed into the floor. Locate opposite each duct entry. Secure to reinforcement in floor. Pulling irons shall be constructed of galvanized rod and hardware.

M. Cable Rack Inserts: Minimum load rating of 800 pounds (365 kg). Locate at 18 inches on center.

N. Cable Rack Mounting Channel: 1-5/8 inch x 1-5/8 inch 12 gauge galvanized steel strut, 72 inch length. Mount on 36" centers on long wall, three per wall.

O. Cable Racks: Underground Devices, Inc Multimount cable support arms or approved equal, style MM-14 or MM-18 as shown on drawings.

P. Cable Supports: Porcelain clamps and saddles, or as indicated on drawings.

Q. Manhole Steps: Polypropylene plastic manhole step with 1/2-inch (13 mm) steel reinforcement.

R. Sump Covers: ASTM A 48; Class 30B gray cast iron.

S. Source Quality Control: Inspect manholes in accordance with ASTM C 1037.

T. Concrete shall be 4500 PSI at 28 days.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify routing and termination locations of duct bank prior to excavation for rough-in.

C. Verify locations of manholes prior to excavating for installation.

D. Verify well-compacted fill placed in bottom of manhole opening.

E. Interface installation of underground warning tape with backfilling. Install tape 6 inches (150 mm) below finished surface.

3.02 PRE-CAST MANHOLE INSTALLATION

A. Install and seal precast sections in accordance with ASTM C 891.

B. Install manholes plumb and level. Assemble per manufacturer's instructions.

C. Units shall be installed on a 12" thick level bed of 90% compacted granular fill, well graded from the 1" sieve to the No. 4 seive. Granular fill shall be compacted with a minimum of four passes with a plate compactor.

D. Use precast neck and shaft sections to bring manhole cover to finished elevation.

E. The manhole shall be installed in the orientation as shown on the drawings to ensure proper alignment with duct bank runs.

F. Attach cable racks to cable rack mounting channels after manhole installation is complete.

G. Install a 2/0 AWG bare copper ring grounding conductor around the inside perimeter of the manhole and anchor to the walls with metallic cable clips. Connect the ring grounding conductor to the ground rod by an exothermic welding process. Connect the cable rack mounting channels to the grounding ring via a bare #6 AWG solid copper grounding wire.

H. Dampproof exterior surfaces, joints, and interruptions of manholes after concrete has cured 28 days.

I. Ground rod openings, wire openings, and any other penetrations shall be sealed after installation of ground rod, wire, etc. with a cement grout mixture.

J. Backfill manhole excavation.

END OF SECTION