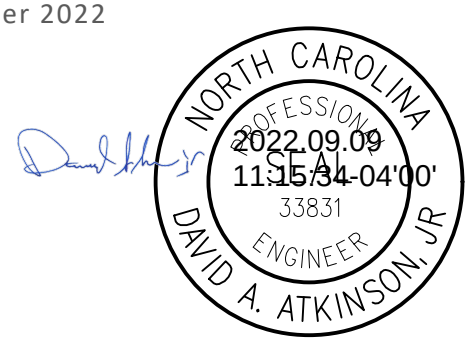
SECTION II – FAYETTEVILLE PWC

REQUEST FOR PROPOSAL FOR STANDBY POWER SYSTEM UPGRADES

September 2022



1.01 GENERAL SCOPE

A. The purpose of this document, hereafter referred to as the RFP, is to detail the technical specifications and requirements of a paralleling switchgear and standby power generation system. The entire system described and specified herein shall be complete turn-key design build project. The work shall include furnishing all materials, equipment, installation, testing, and commissioning of equipment.

B. The requirements in this RFP may not necessarily reflect all of the materials, labor, installation, and testing required, as the requirements do not provide a fully complete design. Instead, this RFP describes the minimum requirements for the system. All foundations, wiring, conduit, controls, and any other ancillary equipment shall be furnished and installed to provide a complete and operable system.

C. It is the intent under this RFP to require an installation complete in every detail whether or not indicated on the attachments or specified. Consequently, the Materialman is responsible for all details, devices, accessories and special construction necessary to properly install, adjust, test, and place in successful and continuous operation the equipment described herein.

D. The system shall consist of units of the size and capacity as specified herein, with accommodations for future increases in the capacity as specified herein.

E. The system shall be installed on the property of the Cross Creek Water Reclamation Facility, located at 601 North Eastern Boulevard, Fayetteville, North Carolina. The specific areas that are acceptable for installation, including maximum dimensions of each, is included in Appendix A.

F. The base bid for the system shall include EPA Tier 2 emissions compliant generators. The alternate bid, if provided by Materialman, shall include EPA Tier IV emissions complaint generators. Reference the Bid Form for additional information.

G. The following terms are used throughout this RFP, and are defined as follows:

1. Materialman – The design-builder, the single point of responsibility for the complete system specified herein

2. Commission – The Public Works Commission of Fayetteville NC, Sewer/Wastewater Division

3. Utility Company – The Public Works Commission of Fayetteville NC, Electric Division

1.02 MATERIALMAN RESPONIBILITIES

A. The responsibilities of the Materialman are as follows:

1. Shipment to, unloading, and installation at the project site, all items required by this RFP.

2. Site preparation for the placement of all equipment, which includes underground survey of selected equipment area(s) to ensure equipment is not installed on top of electrical lines, piping, etc. The Commission will make electrical line GIS data available to the successful Materialman after award.

3. Obtaining and paying for all permits, licenses, certificates, inspections, etc. associated with the work specified herein, including for both permanent and temporary construction, unless specifically defined as part of the Commission's scope.

4. Furnishing all design, drafting, engineering, material, work, and supervision to provide a fully operable system in accordance with this RFP.

5. Temporary power and lighting as required during construction.

6. Furnishing and installing all equipment as specified herein including, but not limited to, standby engine generator sets, paralleling switchgear, fuel storage tanks, transformers, reclosers and associated relays, foundations, all interconnecting conduit and wire, and site preparation work/grading.

7. Providing supervision of any work completed by subcontractors.

8. Furnishing all required documentation including shop drawing submittals and operation and maintenance manuals.

9. Testing, startup, and commissioning of all equipment to be provided.

10. Completing power systems studies and implementing recommended settings as specified herein.

11. Removal and disposal of existing engine generator set, fuel tank, and associated switchgear. The building in which the switchgear is installed shall remain for use

by the Commission as storage space (if not used by Materialman with cost deduct in proposal form). Existing engine generator-set is operable.

12. Removal of existing step-up transformer and loading it onto a truck owned by the Utility Company. Utility Company owns this transformer.

1.03 COMMISSION RESPONSIBILITIES

A. The responsibilities of the Commission are as follows:

1. Obtaining and paying for a construction permit with the North Carolina Department of Environmental Quality (NC DEQ).

2. Furnishing the site and access to that site for the system specified herein.

3. Furnishing Materialman with all available information pertaining to equipment outside the scope of this RFP with which the system must be interfaced.

4. Furnishing the Materialman with coordination data, recloser data, and other necessary data obtained from the Utility Company.

5. Control system integration work performed on the Commission's SCADA system to incorporate data received from Materialman scope of work. Materialman is not responsible for any work on the Commission's SCADA system.

1.04 GENERAL CONDITIONS

A. All material and equipment shall be the product of an established, reputable, and approved manufacturer; shall be new and of first-class construction; and shall be designed and guaranteed to perform the service required.

B. The Materialman shall examine the site and become familiar with conditions affecting the work. The Materialman shall investigate, determine, and verify locations of any overhead or buried utilities on or near the site, and shall determine such locations in conjunction with all public and/or private utility companies and with all authorities having jurisdiction. The Materialman shall be responsible for scheduling and coordinating with the Utility Company for temporary services.

C. All work will be taking place at a fully operational, 24-hour per day wastewater treatment facility. The Materialman shall not impede in any way, the ability for the treatment facility to be operational 24-hours per day.

1.05 CODES AND STANDARDS

A. All work, equipment and materials furnished shall conform with the existing rules, requirements and specifications of the following:

1. Insurance Rating Organization having jurisdiction

2. The Utility Company

3. The currently adopted edition of the National Electrical Code (NEC) and the National Electrical Safety Code (NESC).

4. The National Electric Manufacturers Association (NEMA)

5. The Institute of Electrical and Electronic Engineers (IEEE)

6. The Insulated Cable Engineers Association (ICEA)

7. The American Society of Testing Materials (ASTM)

8. The American National Standards Institute (ANSI)

9. The requirements of the Occupational Safety Hazards Act (OSHA)

10. The National Electrical Contractors Association (NECA) Standard of Installation

11. National Fire Protection Association (NFPA)

12. International Electrical Testing Association (NETA)

13. All other applicable Federal, State and local laws and/or ordinances.

1.06 SUBMITTALS TO BE INCLUDED WITH PROPOSAL

A. As part of the response to this RFP, the Materialman shall submit all drawings, lists, narrative descriptions, and equipment data sheets as required to accurately describe how the proposed system meets the requirements of this RFP. At a minimum, the following shall be provided in response to this RFP:

1. A written narrative text document describing the Materialman's understanding of the project and describing the quantity and kW rating of the standby engine-generator sets proposed.

2. Preliminary site layout drawing of all the equipment to be included herein.

3. Description of how much fuel storage will be provided and how that fuel storage will be achieved (bulk tank, base tanks, etc).

4. Preliminary single line diagram of the proposed switchgear, including all switchgear and generator ratings.

1.07 SUBMITTALS AFTER AWARD OF CONTRACT

A. Within fifteen (15) working days after the award of the Contract, the Materialman shall submit for approval a complete list of those items of materials and equipment

Materialman is required to furnish for the installation. The list shall include manufacturer names, catalog numbers, and catalog data sheets.

B. A minimum of twenty (20) working days before commencement of work, the Materialman shall submit detailed Drawings and Specifications for all fixtures and equipment items complete with all physical, mechanical, and electrical data. This submittal shall include drawings of all foundation designs complete with dimensions, steel reinforcing, and elevations shown. A conduit stub-out plan shall also be included.

C. The submittals shall bear the stamp of approval of the Materialman as evidence that the Drawings and materials have been checked and considered satisfactory to the Materialman. The review and approval of the Materialman's submittals does not relieve the Materialman of the responsibilities for errors, omissions, and deviations from the specified requirements and incidental work required for proper operation, equipment failure, function, and space requirements.

D. Two (2) printed copies and a digital copy in PDF format shall be provided to the Commission for each submittal. PDFs shall be bookmarked and searchable. All drawings shall be on a sheet size of 11x17 or larger as required. Submittals for equipment shall be as required in Sections 26 32 13, 26 23 00, and 23 13 01. Submittals for other equipment and general materials specified in this RFP shall be as follows:

    1. Low and medium voltage wire product data sheets, with proposed termination product data sheets.

    2. Transformer product data sheets

    3. Foundation drawings with conduit routing/stub up plan

    4. Overall site arrangement drawing show all equipment, with dimensions, and all external connections via ductbank to the areas external to the project/work site.

    5. Erosion control plan

E. The Commission shall be allowed two (2) weeks for approval of each submittal.

F. At the conclusion of the project, as-constructed drawings of the site arrangement, conduit/ductbank routing, detailed generator system single line diagram, and conduit stub up plans shall be provided in Autocad format.

G. Operation and maintenance manuals for all equipment shall be provided with drawings and bills of material reflecting the as-constructed conditions (including any field modifications made) of the equipment. The content of the operation and maintenance manuals shall be the same as is required for the submittals (drawings, product data sheets, bill of materials, etc) made for Commission approval.

1.08 DELIVERY AND SHIPPING

A. The price provided in the proposal shall include delivery, unloading, and installation at the address identified herein. The Materialman shall be responsible for securing all permits required for transporting equipment.

B. The Materialman shall have a representative on site to receive equipment and material deliveries. The Commission nor is personnel will be responsible for receiving any deliveries.

C. Before shipment, all equipment shall be assembled, wired, and tested to the greatest extent possible.

D. Materials may be stored in the lay down area identified for the site, so long as those materials are suitably protected from the weather. No Commission owned conditioned or indoor storage areas are available for Materialman use.

1.09 MAINTENANCE OF OPERATIONS

A. At no time during the course of this contract shall any work by the Materialman impede the Commission's operation of the treatment plant, which operates 24 hours per day, every day.

B. The existing standby power generation system, which consists of one (1) generator set, 480V switchgear, and a step-up transformer, shall remain in service as a standby power source to the treatment plant until the new standby power generation system specified herein is fully installed, commissioned, tested, and accepted by the Commission.

1.10 EQUIPMENT FOUNDATIONS

A. Materialman is responsible for design and construction of steel reinforced concrete foundations for the engine-generator sets, switchgear assembly, fuel tanks, and step-up transformer.

B. As part of the Preliminary Drawings, the Materialman shall submit to the Commission all structural foundation designs complete with steel reinforcing. The drawings shall be sealed by a Professional Engineer currently licensed in the State of North Carolina.

C. Concrete shall be mixed, delivered, placed, and cured in accordance with ACI 301 and ACI 318 and have a compressive strength as indicated by the Materialman's foundation design (minimum compressive strength of 4000 psi after 28 days).

D. All concrete foundations shall extend a minimum of 4" above final grade and shall bear a minimum of 6 inches below final grade.

E. Air entrained concrete shall be used in all applications where concrete will be exposed to moisture and cycles of freezing and thawing. The air content shall be between four

percent and six percent (4% and 6%). Air content shall be shown on each truck ticket from the batch plant.

F. Reinforcing steel shall be Grade 60 billet steel meeting requirements of ASTM A615. Reinforcing steel shall have two inches of clear cover below top of concrete and three inches of concrete cover above bottom of slab.

G. Prior to placing foundation slab, exposed subgrade shall be inspected by an approved geotechnical consultant currently licensed as a Professional Engineer in the State of North Carolina to confirm the subgrade is capable of supporting a bearing pressure of 2000 psf with a maximum settlement potential of one inch.

H. All conduits located beneath any foundation shall be encased in concrete. Suitable additional trade size 4-inch conduits shall be installed and properly stubbed out from the switchgear assembly for future power and control wiring connections to a future generator pad. Conduit Plan details shall reflect these conduits.

1.11 CONDUIT

A. Conduit uses shall be as follows:

1. All underground conduits shall be concrete encased and be made of Schedule 40 PVC.

    a. All 90 degree elbows or combinations of elbows in the PVC conduit runs that form a 90 degree bend shall be rigid galvanized steel.

2. All exposed outdoor conduits shall be PVC coated rigid galvanized steel.

3. All conduits within the generator or switchgear enclosures shall be electrical metallic tubing.

4. Where flexible conduits are required, they shall be the liquid-tight flexible metallic type.

B. Rigid galvanized steel conduit shall be hot dip galvanized on the inside and outside and made of heavy wall high strength ductile steel. Conduit shall be manufactured in accordance with ANSI C80.1 and shall be UL 6 Listed. Conduit fittings shall be UL 514B and UL 467 Listed and constructed in accordance with ANSI FB 1.

C. Where an external coating of polyvinyl chloride (PVC) is specified for conduit and fittings, the coating shall be 40 mil (minimum) thickness. Where an internal coating of urethane is specified for conduit and fittings, the coating shall be 2 mil (minimum) thickness. All conduit fittings shall have a sealing sleeve constructed of PVC which covers all connections to conduit. Sleeves shall be appropriately sized so that no conduit threads will be exposed after assembly.

D. Schedule 40 PVC conduit shall be manufactured in accordance with NEMA TC-2, UL 651 Listed, and suitable for conductors with 90 degree C insulation. All non-metallic fittings shall be UL 651 Listed and constructed in accordance with NEMA TC-3.

E. Liquid tight flexible metallic conduit shall be manufactured using a single strip of hot dip galvanized high strength steel alloy, helically formed into a continuously interlocked flexible metal conduit. Trade size 1-1/4 inch and smaller conduits shall be provided with an integrally woven copper bonding strip. Conduit shall be covered with an outside PVC jacket that is UV resistant, moisture-proof, and oil-proof. Conduit shall be UL 360 Listed.

F. Electrical metallic tubing shall be hot dipped galvanized on the inside and outside and made of cold-rolled steel tubing. Conduit shall be manufactured in accordance with C80.3 and shall be UL 797 listed. Couplings and nipples shall have threaded compression connectors with associated gland and shall be constructed of electro-galvanized steel. Fittings utilizing a set screw or indenter tool to secure the associated conduit to the fitting are not acceptable. Couplings and nipples shall be rain-tight and have a plastic insulated throat.

G. Power wiring (at any voltage) and analog signal (wiring) shall not be combined in the same conduit. All conduits (except those containing fiber optic cables) shall be provided with and equipment grounding conductor. Use of the conduit system as the equipment grounding conductor is not acceptable.

1.12 WIRE AND CABLE

A. Low voltage wire shall be as follows:

1. Power and control wire shall consist of insulated copper conductors with a nylon (or equivalent) outer jacket. Conductor insulation shall be rated 90°C for dry locations, 75°C for wet locations, and 600V. Insulated conductors shall be UL 83 Listed as NEC Type THHN/THWN.

2. Conductors shall be stranded copper per ASTM B-8 and B-3, with Class B or C stranding contingent upon the size.

3. Instrumentation cable shall consist of a single, twisted pair or triad of individually insulated and jacketed copper conductors with an overall cable shield and jacket. Conductor insulation shall be rated 90°C in both wet and dry locations, and 600V. The jacket shall be PVC and resistant to abrasion, sunlight, and flame in accordance with UL 1277. Cable shall be UL 1277 Listed as NEC Type TC (Power and Control Tray Cable). Cable and group shields shall consist of overlapped aluminum/polyester tape/foil providing 100% coverage. Instrumentation cables shall include an overall copper shield drain wire. Cables containing multiple twisted pairs or triads shall also include group shield drain wires. Conductors, including drain wires, shall be tin or alloy coated (if available), soft, annealed copper, stranded per ASTM B-8, with Class B stranding unless otherwise specified.

4. Unshielded twisted pair cable for network communications within buildings shall consist of 4 pair of 24 AWG copper conductors in a flame-retardant jacket. Cable shall be plenum rated (UL 910) and meet EIA/TIA-568 Category 6 specifications. Connectors shall be modular RJ-45 plug.

B. Medium voltage wire shall be as follows:

1. The cable to be furnished and installed for medium voltage circuits shall be shielded power cable, UL Listed as NEC Type MV-105. The voltage class of the cable for each circuit shall be as required for the application. In no case shall the voltage rating of the shielded power cable be less than the voltage rating of the circuit being supplied by the cable.

2. The conductor shall be annealed bare copper per ASTM B3, Class B compact or compressed stranded per ASTM B8 or B-496, with an extruded thermoset semiconducting EPR conductor shield/screen (i.e. strand shield/screen). The conductor screen shall meet or exceed the electrical and physical requirements of ICEA S-93-639 (NEMA WC74) and S-97-682, AEIC CS8, and UL 1072.

3. The insulation shall be an ethylene-propylene rubber (EPR) based thermosetting compound which meets or exceeds the electrical and physical requirements of ICEA S-93-639 (NEMA WC74) and S-97-682, AEIC CS8, and UL 1072. Insulation level shall be 133% for the respective voltage class, and as specified elsewhere herein.

4. A thermoset extruded semiconducting insulation screen shall be extruded directly over the insulation and shall be easily strippable without the use of a release agent. The insulation screen shall meet or exceed the electrical and physical requirements of ICEA S-93-639 (NEMA WC74) and S-97-682, AEIC CS8, and UL 1072. The insulation thickness and voltage rating shall be as specified herein.

5. The semiconducting conductor shield/screen, insulation, and semiconducting insulation screen shall be simultaneously extruded utilizing an enclosed, true triple extrusion process to prevent contamination of the conductor shield/screen, insulation, and insulation shield.

6. The metallic insulation shield shall be a 5-mil bare copper tape helically applied over the insulation with a nominal 25% percent overlap. Cables using corrugated shield/drain wires are not acceptable.

7. The cable jacket shall be flame-retardant, moisture, abrasion, and sunlight-resistant PVC which meets or exceeds the electrical and physical requirements of ICEA S-93-639 (NEMA WC74) and S-97-682, and UL 1072. Sizes #1/0 AWG and larger shall be listed and marked “Sunlight- Resistant FOR CT USE” in accordance with the NEC.

8. The shielded power cable shall be Okoguard-Okoseal as manufactured by the Okonite Company, Uniblend XLF PVC High Speed as manufactured by General Cable, SIMpull CT1 ET as manufactured by Southwire Company equivalent, or equal.

9. Shielded power cable termination kits shall be factory engineered for the application, rated for the voltage class of the associated cable. The insulator material for the termination shall be suitable for outdoor applications and made from UV-stable, non-tracking (per ASTM D2303) materials. Sealant materials to help prevent moisture ingress and contamination shall also be included. All terminations shall meet or exceed all rating requirements for IEEE 48 Class 1 terminations. These terminations shall meet the test sequence requirements prescribed by IEEE 48, including 130°C load cycling and 130°C impulse withstand.

10. Terminations for outdoor exposed locations shall be provided with insulating skirts. Terminations for indoor locations, or within weather-protected outdoor equipment shall not be required to have insulating skirts, so long as the termination length does not require the termination to be partially installed into the associated conduit. Insulating skirts shall be provided where termination would otherwise be partially installed into the associated conduit.

11. Splicing of medium voltage cables is not permitted on this project. Medium voltage cables shall be tested in accordance with NETA ATS (latest edition) prior to connection to equipment.

C. Fiber optic cable shall be as follows

1. Specifications:

a. Fiber Type: Graded Index (GI) Multimode

b. Fiber/Cladding Diameter: 62.5/125 microns

c. No. Fibers: 8, Color-coded

d. Cable Construction: Loose Tube w/ Ripcords

e. Filling: Water Swellable Dry Block

f. Armored: No

g. Central Member: Dielectric (Kevlar)

h. Rating: Gigabit Ethernet

i. Bandwidth: 200/500 MHz-km at 850/1300 nm

j. Maximum Attenuation: 3.5 dB/km at 850 nm; 1.5 dB/km at 1300 nm

k. Application Type: Direct-burial/Conduit/Aerial

l. Sheath: UV Resistant

m. Max. Tensile Load: 600 lb (2700 N) installation; 200 lb (890 N) long term

n. Minimum Bend Radius: 7 in (17.4 cm) under maximum tensile load; 4.6 in (11.6 cm) unloaded (installed)

o. Operating Temperature: -40 to 70 degrees C

p. Operating Relative Humidity: 0 to 100%

2. Upon entering a cabinet, panel or console, loose tube fiber optic cable shall be broken out using fan-out kits and terminated in a fiber optic patch panel. All individual fibers shall be terminated and all connections shall be tested. Tight buffered cable shall then be routed to the individual destinations as needed (or loose tube cable for runs to other buildings).

3. Where cable is required to be routed to numerous, separate destinations within a building, loose tube cable shall be broken out immediately upon entering the building, all individual fibers terminated in a patch panel, and tight buffered, plenum rated cable shall be routed to the individual destinations.

4. Fiber optic cable for installation within buildings shall comply with all applicable fire and building safety codes for such applications.

5. Fiber optic cable shall utilize mechanically spliced, field installable, SC, LC, or ST compatible connectors. Connections shall have a typical loss of 0.35 dB or better and shall provide stable optical performance after numerous rematings. Connections shall utilize physical contact terminations utilizing UV or heat cured adhesive. Where applicable, field terminations shall use a simple procedure requiring minimal training.

1.13 TRANSFORMER

A. Furnish and install a single 3750kVA, liquid-filled pad-mount transformer to step up the generator system voltage. Transformer shall have a 480V or 600V primary to match generator output voltage and 12,470V secondary. Transformer shall be radial feed, have copper or aluminum coils, an oil drain piped to the exterior of the enclosure, and shall have lockable hinged doors over enclosing the primary and secondary terminations.

1.14 RECLOSERS AND RELATED APPURTENANCES

A. The Materialman shall furnish and install reclosers, associated relays, recloser bypass switches, voltage and current instrument transformers, surge arrestors, fused cut-outs, and wooden poles for each of the two (2) electric utility services. Wooden poles shall be

used to mount the reclosers and related appurtenances at the approximate locations shown in Appendix A. The recloser associated with the Hoffer utility service shall be named XCR-HO, and the recloser associated with the Cape Fear utility service shall be named XCR-CF.

B. The electric utility service that comes from the Hoffer Substation is an aerial service that turns into an underground service near the treatment plant property line. Reclosers and related appurtenances shall be installed in the aerial portion of the service.

C. The electric utility service that comes from the nearby Cape Fear Substation is underground all the way from the pump station and through the treatment plant site. Coordinate with the Utility Company to install reclosers and related appurtenances on this service. The Utility Company will make modifications to bring the underground line up the poles to the equipment furnished by the Materialman. All terminations on the wooden poles shall be furnished and installed by the Materialman.

D. Reclosers shall be the Viper Series by G&W, no exceptions. Reclosers shall have a closing speed of no more than 60ms to ensure proper operation during generator/utility paralleling operations. Reclosers shall be provided with bypass switches. Reclosers shall be coordinated with and approved by the Utility Company prior to being submitted for Commission approval. Other recloser requirements shall be as follows:

1. Minimum Design Voltage – 15.5kV
2. Impulse Level (BIL) – 110kV
3. Continuous and Load Break Current – 800A
4. 8-Hour Overload – 960A
5. 60Hz Withstand, kV RMS, Dry, 1 min – 50kV
6. 60Hz Withstand, kV RMS, Wet, 10 sec – 45kV
7. Interrupting Rating RMS – 12.5kA
8. Making Current RMS, asymmetrical – 20kA
9. Peak, asymmetrical – 32kA
10. Short-circuit Current, symmetrical, 3 second – 12.5kA
11. Mechanical Operations – 10,000

E. The relays associated with each recloser shall be SEL model 651R, no exceptions. The following minimum IEEE functions shall be provided and enabled in each relay:

1. 25

2. 27/59

3. 47

4. 67

5. 81O/U

6. 32

F. Voltage and current transformers, surge arrestors, and fused cut outs shall be suitable for use on a 12,470V system and be provided with appropriate current and BIL ratings for the system.

1.15 POWER SYSTEMS STUDIES

A. The Materialman shall furnish power systems studies that are completed under the direct supervision of a professional electrical engineer currently licensed in the state of North Carolina. The professional engineer shall sign and seal the final version of the studies and shall have no less than 15 years of experience in completing the types of power system studies required herein. Power systems studies shall be based on the quantity and size of engine-generator units to be furnished and installed under this RFP, as well as identified future units as specified in Section 26 32 13.

B. Power systems studies to be provided are as follows:

1. Short Circuit Study: The short circuit study shall be performed in accordance with the latest editions of IEEE Std. 399 and IEEE Std. 141. The study input data shall include the engine-generator set short circuit contributions, resistance and reactance components of the branch impedances, the X/R ratios, base quantities selected, and other source impedances. Short circuit close and latch duty values and interrupting duty values shall be calculated on the basis of assumed three-phase bolted short circuits at each bus, and other significant locations through the system. The short circuit tabulations shall include symmetrical fault currents, and X/R ratios. For each fault location, the total duty on the bus, as well as the individual contribution from each connected branch, shall be listed with its respective X/R ratio. The short circuit study data shall be used for proper equipment selection based on calculated short circuit values and all input and output data from the software model.

2. Protective Device Coordination Study: A protective device coordination study shall be performed to provide the necessary calculations and logic decisions required to select power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated current transformers, and low voltage circuit breaker trip characteristics and settings. The coordination study shall include all equipment from the Electric Utility protective devices (reclosers), reclosers provided under this RFP, and all adjustable circuit protective devices within the

switchgear and at the engine-generator sets. The coordination study shall also include the first circuit protective device downstream of each Electric Utility owned transformer on site, to ensure proper coordination with the various distribution equipment around the plant. The phase and ground overcurrent protection shall be included as well as settings of all other adjustable protective devices.

3. Arc Flash Hazard Analysis: An Arc Flash Hazard Study shall be performed in accordance with IEEE Std. 1584, NFPA 70E, and OSHA 29-CFR, Part 1910 Subpart S. The scope of the arc flash hazard analysis shall include only the equipment to be furnished under this RFP. The arc flash hazard analysis for the other (existing) equipment on the treatment plant site will be provided by others. Arc flash warning labels shall be produced for each location that allows access to energized parts. Labels shall be printed in color on adhesive backed labels. Labels shall be an ANSI Z535.4 compliant (minimum size 4 in. x 6 in.) thermal transfer type label. For incident energy values of less than 40 cal/cm^2, the labels shall have an orange colored header with the word “WARNING”. For incident energy values equal to and above 40 cal/cm^2, the labels shall have a red colored header with the word “DANGER”. Each label shall include incident energy, operating voltage, arc flash hazard protection boundary, and date of issuance.

C. All power systems studies shall be completed in accordance with the following codes and standards:

1. Institute of Electrical and Electronic Engineers (IEEE):

   a. Standard 141, Recommended Practice for Electrical Power Distribution for Industrial Plants

   b. Standard 241, Recommended Practice for Electrical Power Systems in Commercial Buildings

   c. Standard 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Systems

   d. Standard 399, Recommended Practice for Industrial and Commercial Power System Analysis

   e. Standard 1584-2018, IEEE Guide for Performing Arc-Flash Hazard Calculations

2. American National Standards Institute (ANSI):

   a. Standard C37.90, IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus

   b. Standard C37.91, Guide for Protective Relay Applications to Power Transformers

c. Standard C37.95, Guide for Protective Relaying of Utility-Consumer Interconnections.

d. Standard C37.96, Guide for AC Motor Protection

e. Standard C.57.13, Standard Requirements for Instrumentation Transformers

f. Standard C57.109, Guide for Liquid-Immersed Transformer Through Fault-Current Duration

3. National Electrical Code (NEC)

4. NFPA 70E, Standard for Electrical Safety in the Workplace (2021 edition)

D. The power system studies shall be performed with the aid of SKM Systems Analysis Power Tools for Windows (PTW) software, Version 9.0 or newer, or ETAP software version 20. No other software analysis packages are acceptable. At the conclusion of project, the model files and any necessary supporting files shall be turned over to the Commission.

E. All recommended protective device settings adjustments shall be performed by the Materialman after approval from the Commission and/or Electric Utility. Arc flash hazard warning labels shall be installed by the Materialman after approval from the Commission.

1.16 GROUNDING

A. Provide an equipment grounding conductor in every power and control conduit, sized in accordance with the NEC. Use of conduit as an equipment grounding conductor is prohibited.

B. A grounding electrode system that surrounds the perimeter of the generator and switchgear site/work area shall be furnished and installed. Grounding electrode system shall consist of not less than eight ground rods interconnected via exothermic welding around the perimeter by a #4/0 bare copper cable. Ground rods shall be copper clad, 10 feet in length, ¾ inch in diameter, and UL 467 Listed. Make necessary connections from equipment to this grounding electrode system in addition to bonding each generator enclosure frame, switchgear enclosure frame, and fuel tank to the grounding electrode system.

C. Furnish and install ground rod test wells at each of the four corners of the site/work area. All additional ground rods shall be buried.

1.17 SITE WORK

A. The materialman shall be responsible for all site work/geotechnical engineering associated with the generator site.

B. The materialman shall be responsible for all permitting, erosion control plans, storm water retention plans etc. associated with the generator site.

C. Prior to beginning construction, the site shall be cleared and stripped/undercut 3” below existing grade. Waste/debris shall be removed from the site and disposed of accordingly.

D. Prior to site finish rocking site shall be in good condition, free of debris, and graded. Site shall be free of ruts, excavation, or other abnormal conditions as a result of site construction/equipment.

E. Site shall be finished with a 3” layer of washed 57 stone on top of a 3” layer of ABC stone.

F. The Commission’s existing fence shall be modified by the Materialman as required to protect any expanded area of the generator site.

1.18 STANDBY ENGINE GENERATOR SETS

A. Standby engine generator sets shall be as specified in Section 26 32 13, Engine Generators, which is included in Appendix B.

1.19 LOW VOLTAGE SWITCHGEAR

A. Low voltage switchgear shall be as specified in Section 26 23 00, Low Voltage Switchgear, which is included in Appendix B.

1.20 SUPPLEMENTARY FUEL SYSTEMS

A. Supplementary fuel systems (if required) shall be as specified in Section 23 13 01, Supplementary Fuel Systems, which is included in Appendix B.

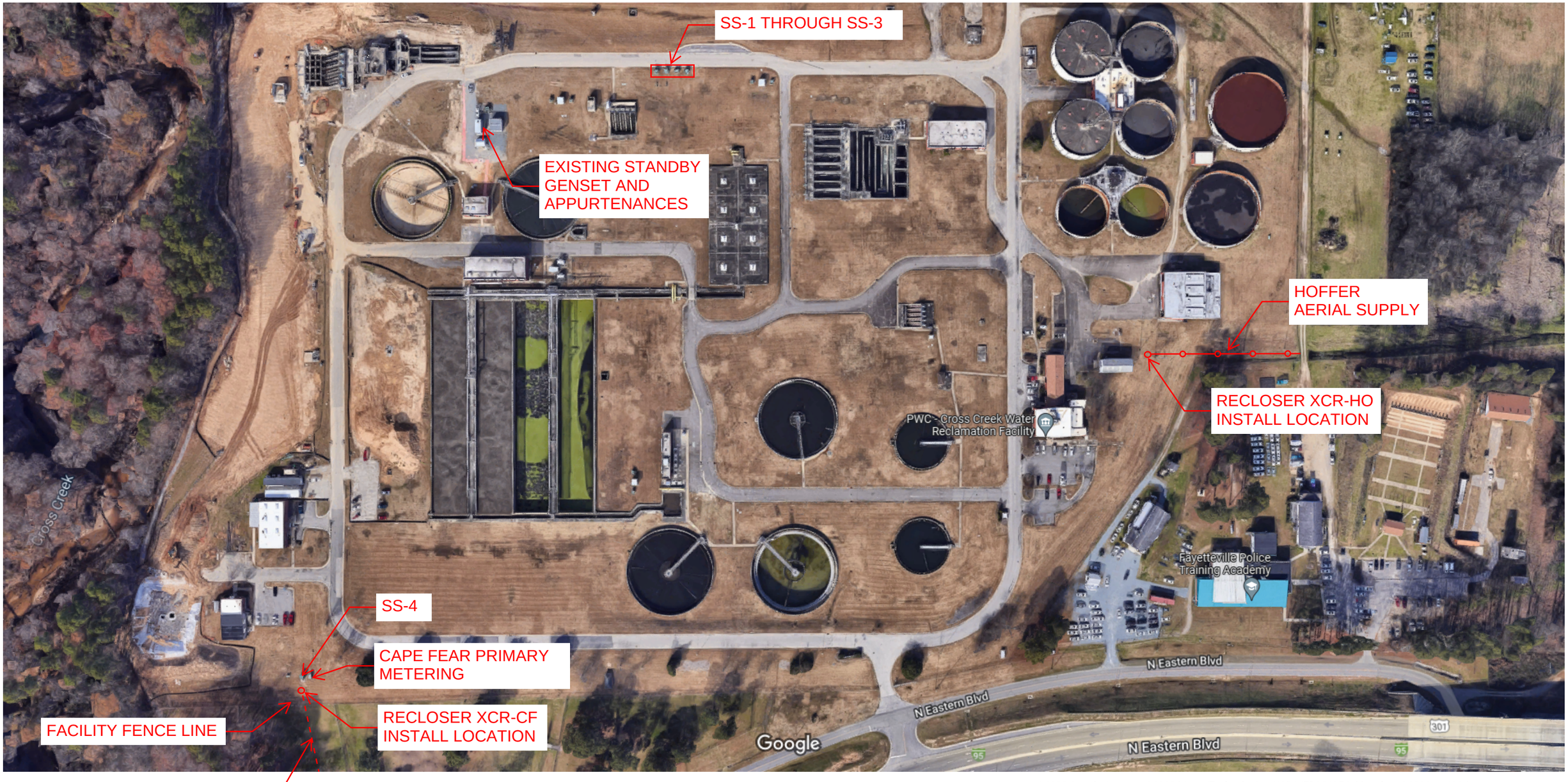
1.21 WARRANTY

A. Warranties for equipment specified under sections 26 32 13, 26 23 00, and 23 13 01 shall be as specified in those respective sections. For all other equipment and materials included under this RFP, a two-year warranty shall be provided, which begins upon Commission acceptance of that equipment and materials. Warranty shall include all labor and materials required to make the covered repairs.

APPENDIX A – AREA OF WORK AND SINGLE LINE DIAGRAM

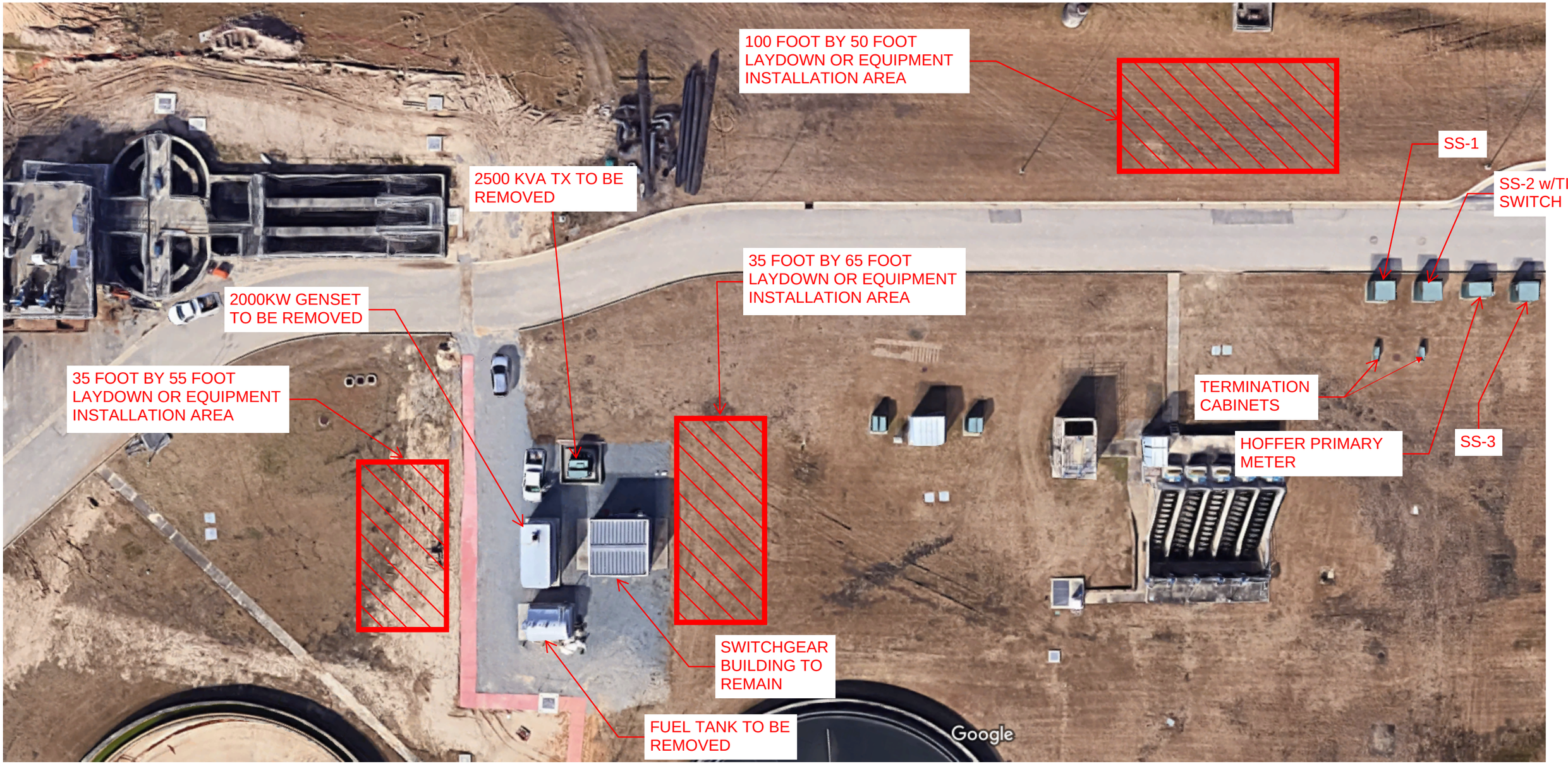
Google Maps

OVERALL AREA SITE PLAN



Google Maps 601 N Eastern Blvd

WORK AREA SITE PLAN



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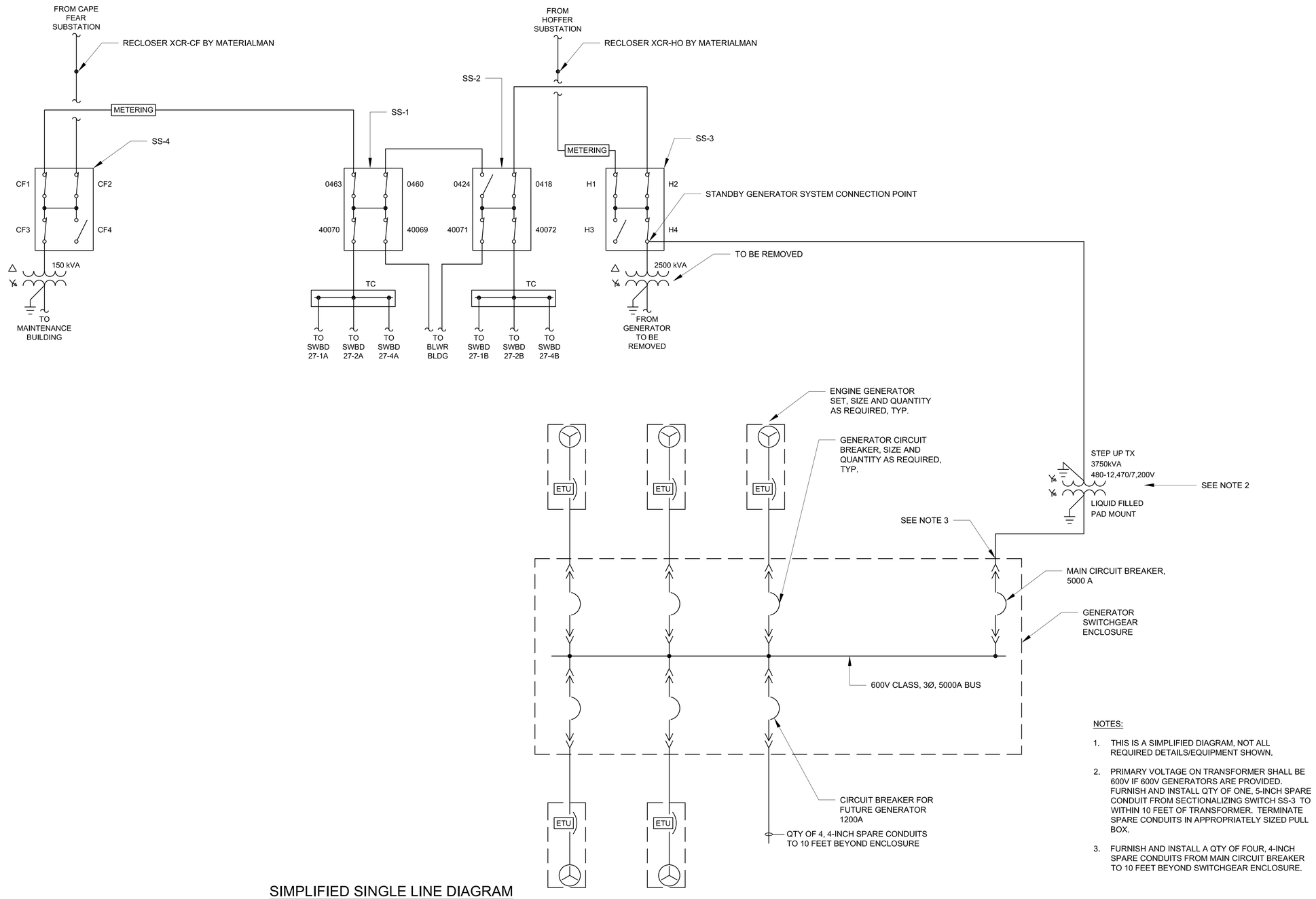

SIMPLIFIED SINGLE LINE DIAGRAM

NOTES:

1. THIS IS A SIMPLIFIED DIAGRAM, NOT ALL REQUIRED DETAILS/EQUIPMENT SHOWN.
2. PRIMARY VOLTAGE ON TRANSFORMER SHALL BE 600V IF 600V GENERATORS ARE PROVIDED. FURNISH AND INSTALL QTY OF ONE, 5-INCH SPARE CONDUIT FROM SECTIONALIZING SWITCH SS-3 TO WITHIN 10 FEET OF TRANSFORMER. TERMINATE SPARE CONDUITS IN APPROPRIATELY SIZED PULL BOX.
3. FURNISH AND INSTALL A QTY OF FOUR, 4-INCH SPARE CONDUITS FROM MAIN CIRCUIT BREAKER TO 10 FEET BEYOND SWITCHGEAR ENCLOSURE.

APPENDIX B – ADDITIONAL SPECIFICATIONS

SECTION 13 34 23.26
PRE-FABRICATED EQUIPMENT CENTERS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish, install, and place in satisfactory operation pre-fabricated equipment centers as specified herein.

B. Pre-fabricated equipment centers shall be used to enclose equipment that is furnished under Section 26 23 00, Low Voltage Switchgear, and that equipment shall be as specified in the respective Section.

C. Materialman shall be responsible for coordinating whether the electrical raceways and wire between equipment shown within the pre-fabricated equipment center will be furnished and installed by the equipment center manufacturer, or the Materialman's field personnel.

1.02 CODES AND STANDARDS

A. Products specified herein shall be in conformance with the following codes and standards as applicable:

1. Governing Building Codes

    a. Current Building Code of the State or Commonwealth in which the project is located.

    b. North Carolina Industrialized Building Code

2. ANSI Z97.1 – Safety Glazing Materials Used in Buildings

3. 16 CFR 1201 – Safety Standard for Architectural Glazing Materials

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the RFP, the Materialman shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

2. Spare Parts List

3. Operation and Maintenance Manuals

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4. Third Party Inspection and Certification Documentation (if required by State of NC)

5. Manufacturer’s Representative’s Installation Certification

B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete or illegible submittals will be returned to the Materialman without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Detailed drawings as follows:

a. Drawings shall show plan, front, and side views as well as appropriate section views of the pre-fabricated equipment center.

b. Drawings shall be annotated with appropriate linear dimensions, identify any shipping split locations, and include the shipping weight for each section of the equipment center.

c. Drawings shall adequately detail the conduit stub-up areas below each piece of equipment.

d. Equipment center erection drawings showing comprehensive details of wall panels, roof panels, base and floor. Erection drawings shall include connection details and anchoring details.

e. Structural calculations of structural system for equipment center showing compliance with governing building code for all components, connections, and anchorage of system shall be submitted with detailed erection drawings. Calculations shall be sealed by a Professional Engineer currently registered in the State or Commonwealth in which the project is located.

2. Product data sheets for all appurtenances and accessories (air conditioning unit, light fixture, etc.) that are furnished and installed within the equipment center.

3. Bill of material list.

4. Manufacturer’s installation instructions.

5. Manufacturer’s warranty statement.

6. Calculations used to size air conditioning units.

D. The shop drawing information shall be complete and organized in such a way that the Commission can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Materialman intends to provide are acceptable and shall be submitted.

E. Final approval of shop drawings will not be granted until all equipment shown within the pre-fabricated equipment center has been reviewed and accepted by the Commission.

1.05 OPERATION AND MAINTENANCE MANUALS

A. The Materialman shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the RFP. The manuals shall include:

1. Instruction books and/or leaflets.

2. All product data sheets previously included in the shop drawing submittals.

3. Final as-built layout drawing of the equipment center, incorporating all changes made during construction.

1.06 SPARE PARTS

A. All spare parts as recommended by the equipment manufacturer shall be furnished to the Commission by the Materialman.

B. In addition to the manufacturer recommended spare parts, the Materialman shall furnish the following spare parts:

No. Required	Description
4 sets	Air filters for each air conditioning unit
2 gallons	Paint for re-coating floor after construction is complete

1.07 WARRANTY

A. The manufacturer's warranty shall in no event be for a period of less than ten (10) years from date of delivery of equipment to the project site and shall include repair labor, travel expense necessary for repairs at the jobsite, and expendables used during the course of repair. Submittals received without written warranties as specified shall be rejected in their entirety.

B. The Materialman shall provide a complete warranty covering the equipment center structure as well as all accessories and appurtenances that are furnished and installed with the equipment center.

PART 2 – PRODUCTS

2.01 GENERAL

A. The equipment center shall be provided with large enough to accommodate all equipment specified to be installed inside.

B. The equipment center shall designed to be split by the manufacturer into as many sections as required to be transported to the project site.

2.02 EQUIPMENT CENTER STRUCTURE

A. Base and Floor

1. The base of the equipment center shall be constructed of welded steel I-beams, channels, and angle supports sized and reinforced to accommodate loading requirements. The height of the base steel shall be same around the entire outer perimeter of the equipment center to prevent debris and animals from getting under the base.

2. The base structure shall be designed to support the equipment center when installed on a concrete slab.

3. The base shall be cleaned and epoxy painted after welding is complete. The entire underside of the base shall be coated with a minimum 8 mil bituminous mastic. Base paint color shall be ANSI 61 light gray.

4. The floor of the equipment center shall be constructed of 3/16 inch thick (minimum) steel plate welded to the base framework. Floor material shall be painted tread plate to provide slip resistance, or flat steel coated with an enamel containing immersed sand. Floor paint color shall be ANSI 61 light gray.

5. All components of the base and floor shall be designed to withstand all applicable vertical and lateral loads in accordance with the requirements of the governing building code.

6. Anchorage of equipment center base to foundation slab or structure shall be designed and detailed by the equipment center manufacturer. Anchorage shall be designed to withstand all applicable vertical and lateral loads in accordance with the requirements of the governing building code.

B. Walls and Roof

1. Wall panel material shall be 12 gauge (minimum) aluminum or 14 gauge (minimum) galvanized steel formed in an interlocking design which is self-framing. No other material types are acceptable. Wall panels shall be capable of

withstanding all applicable vertical and lateral loads in accordance with the requirements of the governing building code.

2. Roof panel shall be material shall be 12 gauge (minimum) aluminum or 14 gauge (minimum) galvanized steel formed in a standing rib design eliminating the possibility of water entry. No other material types are acceptable. Roof panels shall be capable of withstanding all applicable vertical and lateral loads in accordance with the requirements of the governing building code.

3. Interior and exterior of wall and roof panels shall be painted in a 6-mil (minimum) ANSI 61 light gray color.

C. Doors

1. Personnel Entry Doors

a. Entry doors shall be double-wall construction with tempered or laminated safety glass windows meeting CPSC 16 CFR 1201 or ANSI Z97.1. The safety glass window shall large enough to cover no less than 1/3 of the door surface.

b. Automatic door closers, cellular neoprene gaskets, panic hardware, threshold, and door bottom seal shall be provided for each door. Doors shall open outward.

c. Lockset hardware shall be provided for each door with cylinder to match the Commission’s master key system. Coordinate keying with Commission.

d. Minimum single door size shall be 7 feet tall by 3 feet wide. Taller doors shall be provided as required for equipment installation/removal. Double doors shall be provided where indicated on the Drawings. Doors shall be provided with a continuous hinge or three ball bearing hinges for doors 7 feet tall and an additional ball bearing hinge for every additional 2 feet in door height.

2. Equipment Access Doors

a. Access doors for equipment located within the pre-fabricated equipment center shall be provided where indicated on the Drawings, and where required for outdoor access to rear-accessible equipment.

b. Equipment access doors shall be sized for the equipment that they serve and shall be provided with gaskets to maintain the rain-tight integrity of the enclosure.

c. Equipment access doors shall be hinged on one side and have a pad-lockable 3-point latching system on the other side. Provide doors with wind-stop hardware.

D. Insulation

1. The underside of the floor shall be provided with rigid foam insulation or spray-foam insulation to achieve a minimum value of R11.

2. The walls and roof shall be provided with rigid foam or fiberglass batt insulation to achieve a minimum value of R20.

2.03 FEATURES

A. Lighting

1. Interior linear fluorescent or linear LED interior lighting fixtures shall be ceiling mounted and provided in sufficient quantity to provide 30 foot candles average illumination at floor level.

2. Exterior lighting shall be provided over each personnel door. Exterior lighting shall be LED type with integral photocell.

3. Emergency and exit lighting shall be provided within the equipment center. Emergency lighting shall integral nickel-cadmium battery backup and provide illumination in accordance with NFPA-101, Life Safety Code. Exit fixtures shall be LED type and wall mounted over each equipment center personnel door.

B. Receptacles and Switches

1. Provide 3-way light switches at each personnel door to control the interior lighting of the equipment center.

2. Provide receptacles in the quantity and location as shown on the Drawings. If receptacles are not shown on the Drawings, a minimum of two receptacles shall be provided near each personnel door, one on the exterior and one on the interior of the equipment center.

C. Raceways, Boxes, and Wiring

1. All conduit factory-installed within the interior of the equipment center shall be electrical metallic tubing (EMT).

2. All cables and wiring factory-installed within the equipment center shall be furnished and installed in accordance with the RFP.

3. Pull and junction boxes shall be provided within the equipment center as required. Provide junction boxes on each side of an equipment center shipping split where factory-installed conduits need cross the split.

D. Climate Control

1. Calculations

a. The equipment center manufacturer shall perform calculations to determine the proper size of heating and air conditioning units for the equipment center. Calculations shall be submitted for review. The following parameters shall be used in the calculations:

1) 85 degree F maximum allowable indoor air temperature

2) 55 degree F minimum allowable indoor air temperature

3) Outdoor ambient high and low temperatures published in the ASHRAE Handbook for the location of equipment center installation

4) Heat gain of all equipment within equipment center shall be calculated based on each piece of equipment operating at 75% of its full load.

5) Insulation R values as specified elsewhere herein

2. Heating Air Conditioning Units

a. Package heating and air conditioning units shall be provided in the location as indicated on the Drawings, and at the calculated size required. Two (2) units shall be provided, allowing for 100% redundancy of heating and cooling.

b. Heating and air conditioning units shall be factory wired to a 480V source located in the equipment center. Air conditioning units shall be provided with a Heresite phenolic coil coating for corrosion prevention.

c. If the calculated heat gain of the equipment within the equipment center is enough to keep the indoor air temperature above the allowable minimum, electric heating shall not be required to be provided as part of the heating and air conditioning unit.

3. An automatic temperature controller shall be provided as part of the heating and air conditioning system, factory wired to each unit, with the following features:

a. Temperature setpoint control and display

b. Controls to alternate the operation of each unit and equalize run times

c. DPDT contact rated 5A (minimum) at 120VAC to indicate air conditioning unit failure

d. DPDT contact rated 5A (minimum) at 120VAC to indicate a low air temperature inside the equipment center, with adjustable setpoint (initially set at 50 degrees F)

e. DPDT contact rated 5A (minimum) at 120VAC to indicate a high air temperature inside the equipment center, with adjustable setpoint (initially set at 95 degrees F)

E. Grounding

1. A stainless steel grounding attachment pad shall be welded to the exterior base on each corner of the equipment center. Pad shall be provided with a threaded hole to allow a one- hole wire lug to be affixed.

2. A tin-plated copper grounding bar shall be provided around the entire interior perimeter of the equipment center. Grounding bar shall be installed at a height just below the ceiling and shall be 2 inches tall by ¼ inch thick. Install a #4/0 AWG bare copper grounding electrode conductor from at least two points on the grounding bar through the floor and out to the grounding electrode or grounding electrode system.

F. Miscellaneous

1. Provide a fire extinguisher on the interior of the equipment center at each personnel door. Fire extinguisher shall be 10 lb. capacity, hand portable, carbon dioxide type, with Underwriters' Laboratories rating of 4-A: 60 BC.

2. Provide a free-standing double-door painted steel storage cabinet for the Commission’s use in storing spare parts and operation and maintenance manuals. Storage cabinet shall be lockable with a 3-point locking system. Storage cabinet shall be provided with at least 4 adjustable shelves and shall be no less than 72 inches tall by 18” deep by 36” wide.

PART 3 – EXECUTION:

3.01 INSTALLATION

A. Manufacturer shall acquire all necessary permits to transport the pre-fabricated equipment center through each state between the factory and project site.

B. If the equipment center is split into multiple pieces for shipping, the open ends of the equipment center shall be weatherproofed to protect the equipment inside during transport and re-assembly of the shipping sections.

C. Materialman shall furnish and install all anchoring required for the equipment center in accordance with the manufacturer’s instructions.

D. Exposed electrical raceways installed within the equipment center by the Materialman's field personnel shall be coordinated with the equipment center manufacturer to ensure the raceways can be properly supported in accordance with the NEC. Raceways shall be conduits, cable tray is not acceptable.

E. Exposed electrical raceways installed within the equipment center by the equipment center manufacturer shall be conduits, cable tray is not permitted.

F. Automatic door closers shall be adjusted after installation to prevent doors from slamming shut or taking an unnecessary amount of time to close.

G. At the conclusion of all work within the equipment center, the floor shall be thoroughly cleaned and repainted with the same paint used to initially coat the floor.

3.02 INSPECTION AND CERTIFICATION

A. If required, a third-party shall inspect and provide a certification label for the equipment center in accordance with the industrialized building code. Certification documentation shall be provided to the Commission and an adhesive certification label shall be placed in a conspicuous place within the equipment center.

3.03 SERVICES OF A MANUFACTURERS REPRESENTATIVE

A. The Materialman shall provide the services of a qualified, factory-trained manufacturer's technical representative who shall adequately supervise the installation and/or assembly of the pre-fabricated equipment center. The manufacturer's representative shall certify in writing that the equipment center has been installed and/or assembled in accordance with the manufacturer's recommendations. No further work may be performed inside the equipment center until this certification is accepted by the Commission.

B. The services of the manufacturer's representative shall be provided for a period of not less than as follows:

1. One (1) trip of two (2) working days during the installation and/or assembly of the equipment center.

2. One (1) trip of one (1) working day two (2) months before the warranty expiration to identify any issues to be corrected under warranty.

C. Any additional time required to achieve successful installation shall be at the expense of the Materialman.

END OF SECTION

SECTION 23 13 01

SUPPLEMENTARY FUEL SYSTEMS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. This specification section shall be applicable only if a supplementary fuel system is needed to meet the requirements for fuel storage listed in Section 26 32 13 – Engine Generators.

B. Furnish all labor, materials, equipment and appurtenances required for the complete installation of the generator fuel supply specified herein.

C. The system shall consist of a single bulk fuel storage tank, associated piping, valves and hoses, level and leak detection system, and all accessories and appurtenances specified herein or required in order to provide a complete and operable system.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 26 32 13 - Engine Generators, and Section 26 23 00 – Low Voltage Switchgear.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. All work hereunder shall conform to the applicable requirements of the reference portions of the following standards.

1. Codes and Standards

    a. UL - Underwriters Laboratory

    b. API - American Petroleum Institute

    c. NFPA - National Fire Protection Association

1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the RFP, submit the following:

1. Shop Drawings showing arrangement, dimensions, accessories and installation details.

2. Manufacturer's data and installation instructions.

3. Total weights of each piece of equipment and approximate weight of shipped materials.

4. Piping diagrams showing all pipe sizes, lengths, fittings and other details of the proposed fuel and vent piping system. Diagrams shall provide sufficient detail for Commission review and approval of the system.

PART 2 – PRODUCTS

2.01 FUEL STORAGE TANKS AND ACCESSORIES

A. Provide an insulated double-wall steel tank. Tank shall be above-ground tank as defined by NFPA 30 and shall be UL 142 Listed and UL 2085 Listed. Tank storage capacity shall be as required to meet the total fuel storage requirements specified in Section 26 32 13, Engine Generators.

B. The Tank shall withstand internal air test pressure of 5 psi for 48 hours. All structural steel shall have a minimum thickness of 3/16" unless specified otherwise.

C. All exposed metal except stainless steel shall be powder coated to inhibit corrosion. Color of the tank finish shall be selected by the Commission during the submittal process.

D. Structural steel used in fabricated parts shall conform to requirements of "Standard Specifications for Steel for Bridges and Buildings" ASTM Designation A36. All shop welding shall conform to the latest standards of the American Welding Society. All welds on exterior seams shall be continuous and shall conform to UL 142.

E. Inner steel tank shall be covered with insulation as required to achieve UL 2085 listing.

F. All pipe connections shall be on top of the tank, adequately-sized NPT and shall include the following:

1. One 4” fuel filling port

2. One 2” port for level gauge

3. One 2” port for level sensors

4. One 2” interstitial cavity access port

5. One 4” normal tank vent port

6. One 6” emergency tank vent port

7. Two spare 2” ports

8. One 2” level stick port

9. Size and quantity of fuel supply and return ports as required to serve each generator base mounted tank.

10. Size and quantity of fuel supply and return ports as required for the fuel polishing system.

G. Provide 5 gallon (minimum) spill containment device with lockable lid around fuel filling port and level stick port. Provide level stick for manual measurement of fuel measurement. Provide level gauge atop tank that continuously indicates the fuel level inside.

H. The fuel tank shall have normal vent protected with a cover.

I. Fuel tank shall be furnished with all necessary valves and gauges as listed herein and as required to meet all local, state, and federal regulations. A double poppet foot valve shall be supplied with all the tank withdrawal lines. The foot valve shall have poppets and a 20 mesh monel screen. The foot valve shall be supplied and installed using screwed connections and an extractor fitting and wrench.

J. The fuel fill port shall be equipped with an overfill prevention valve such that when the tank reaches 95% full the valve shall be mechanically closed to prevent further fuel flow. The overfill prevention valve shall be installed per the tank and valve manufacturers recommendations.

2.02 FUEL LEVEL AND LEAK DETECTION SYSTEMS

A. The fuel level and leak detection system shall utilize components from a single manufacturer for continuity and ease of integration.

B. Furnish and install an interstitial leak detector on the interstitial cavity access port, and a main tank low and high level sensor on another port. Both sensors shall be wired to the fuel tank control panel, and shall be provided with integral cables of the appropriate length.

C. Provide fuel tank control panel shall be provided adjacent to the fuel tank. Components of the fuel tank control panel shall be as follows:

1. NEMA 4X enclosure

2. LED indicating light for tank high level (tank 90% full)

3. LED indicating light for tank low level (tank 35% full)

4. LED indicating light for fluid detected in interstitial space

5. Alarm horn w/silence pushbutton and strobe light

6. Dry contacts to indicate fuel tank low level, high level, and interstitial space leak to the PLC located in the switchgear.

D. Fuel tank control panel shall be by Omntec, Veeder Root, or equal, and shall be supplied by the accessory power unit located in the switchgear, as specified in Section 26 23 00.

E. Furnish and install a fuel level monitor that is capable of delivering a continuous analog fuel level reading to PLC located in the switchgear. Fuel level monitor shall be loop powered and not require a separate source of 120VAC power for operation.

2.03 FUEL AND VENT PIPING SYSTEM

A. Fuel and vent piping standard weight, Schedule 40 and shall conform to ASTM A53 with black finish.

B. Fill pipes and discharge lines shall be metallic and be designed and installed to minimize the generation of static electricity by terminating the pipe within six (6) inches of the bottom of the tanks and shall be installed to minimize excessive vibration.

C. The piping system shall contain a sufficient number of manual control valves, anti-siphon valves, and check valves to operate the system properly and under meet all applicable Code requirements.

D. Piping systems shall be substantially supported and protected against physical damage and excessive stresses arising from settlement, vibration, expansion, contraction or exposure to fire.

E. Flexible joints shall be listed and approved and shall be installed at points where differential movements in the piping can occur. Pipe unions shall be installed within 24 inches of each connection to both the bulk tank and the day tank.

F. Bends in the piping shall be in accordance with ANSI Z223.1.

G. Joints for pipe 4 in or less shall be threaded, made up with thread compound suited for the service. Fittings for steel pipe 4 in or less shall be standard malleable iron, 150 lbs. Fittings shall conform to ASTM A47, Grade 32510 service rating. Joints for fittings shall be threaded.

H. Vent caps shall be cast aluminum with threaded connection to piping. Provide a mesh insect screen.

I. All support hardware required for the fuel and vent piping system shall be furnished and installed as required.

2.04 FUEL POLISHING SYSTEM

A. Provide tank with a fuel polishing system meeting the requirements of the fuel polishing systems specified in Section 26 32 13. Fuel polishing system shall be supplied from the accessory power unit located in the switchgear, as specified in Section 26 23 00.

PART 3 – EXECUTION

3.01 INSTALLATION

A. The Materialman shall furnish and install the fuel tanks, piping, valves and accessories in accordance with the manufacturer's instructions.

B. The tanks shall be installed on a concrete pad in accordance with the requirements in the RFP. All piping, valves, fittings, conduit, wiring, etc. required to interconnect system components shall be furnished and installed by the Materialman. Caulking of screwed joints or holes will not be acceptable.

C. The initial filling of the fuel storage tank shall be provided by the Materialman. Fuel tanks shall be filled to full capacity. At the conclusion of all generator field testing, the Materialman shall refill the fuel storage tank back to its full capacity. Fuel shall be ultra-low sulfur diesel Grade No. 2D S15 in accordance with ASTM D-975. Fuel shall be new and free from contaminants and water.

D. Fuel and vent piping shall be painted after installation to provide corrosion protection.

3.02 SERVICES OF MANUFACTURER'S REPRESENTATIVE

A. The Materialman shall provide the services of a qualified manufacturer's technical representative who shall adequately supervise the installation and testing of all equipment specified herein.

B. The technical representative shall be provided for a period of not less than two (2) days as follows:

1. At least one trip of one (1) day to check and supervise the installation of all equipment and connections.

2. One trip of one (1) day after installation of the equipment to supervise initial start-up and operation and instruct the Commission's personnel in the proper operation and maintenance of the equipment.

C. Any additional time required to achieve successful installation and operation shall be at the expense of the Materialman. The times specified are exclusive of travel time to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory service.

D. The manufacturer's technical representative shall submit to the Commission a report, at the completion of the work, detailing the representative's installation approval, inspection and any deficiencies noted.

END OF SECTION

SECTION 26 23 00
LOW VOLTAGE SWITCHGEAR

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Materialman shall furnish, install, test, and place in satisfactory operation, dead-front type, low voltage, draw-out, metal enclosed power circuit breaker switchgear as specified herein.

B. The line-up shall contain circuit breakers, metering equipment, control devices, and all accessories as specified herein and as required to result in a complete and operable power distribution equipment assembly.

C. The line-up shall contain a single main circuit breaker to connect the bus to the plant electrical distribution system, the quantity and size of circuit breakers required to connect each generator that is furnished under this Contract, and a spare circuit breaker for a future engine-generator set. Reference Appendix A for a simplified single line diagram of the switchgear assembly.

D. The switchgear assembly shall be provided in a weatherproof housing. This housing may be a pre-fabricated equipment center as specified in Section 13 34 23.26 **or** an enclosure that is common with the engine-generator units specified under Section 26 32 13. If a common housing is provided, the switchgear assembly shall be installed in a separate room within the housing. The existing switchgear building may also be used for the switchgear assembly if a deductive cost is provided in the proposal form.

E. The Materialman shall obtain the switchgear from one manufacturer who shall also manufacture the structure and major equipment components, which includes, but is not limited to, assemblies of circuit breakers and auxiliary housings, drawout type air circuit breakers, instrument transformers, meters, relays, and controls. Sub-contracting of wiring is not acceptable.

F. Circuit breaker control and relaying/metering circuits shall be wired in accordance with the requirements specified herein.

G. The switchgear shall be provided by the engine-generator set manufacturer and/or dealer specified in 26 32 13, Engine Generators, in order to provide a complete, coordinated power generation system.

1.02 CODES AND STANDARDS

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A. The switchgear assemblies and power circuit breakers shall comply with the following codes and standards:

1. American National Standards Institute (ANSI):

    a. C37.13 – Low Voltage AC Power Circuit Breakers Used in Enclosures.

    b. C37.16 – Preferred Ratings, Related Requirements and Application Recommendations for Low Voltage Power Circuit Breakers and AC Power Circuit Protectors.

    c. C37.20.1 – Standard for Metal - Enclosed Low Voltage Power Circuit Breaker Switchgear.

    d. C37.51 – Standard Conformance Test Procedures for Metal-Enclosed Low Voltage AC Power Circuit Breaker Switchgear Assemblies.

2. Institute of Electrical and Electronic Commissions (IEEE).

3. National Electrical Manufacturers' Association (NEMA):

    a. SG3 – Low-Voltage Power Circuit Breakers.

    b. SG5 – Power Switchgear Assemblies.

4. Underwriters Laboratories, Inc. (UL):

    a. UL 1558 – Metal-Enclosed Low Voltage Power Circuit Breaker Switchgear.

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the RFP, the Materialman shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

2. Operation and Maintenance Manuals

3. Spare Parts List

4. Proposed Testing Methods and Reports of Certified Shop Tests

5. Manufacturer’s Field Start-up Report

6. Manufacturer’s Representative’s Installation Certification

B. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete or illegible submissions will be returned to the Materialman without review for resubmittal.

C. Shop drawings for each switchgear assembly shall include but not be limited to:

1. Equipment specifications and product data sheets identifying all electrical ratings.

2. Complete assembly, layout, installation, and foundation drawings with clearly marked dimensions.

3. Assembled weight of units and approximate total shipping weight.

4. Example equipment nameplate data sheet.

5. Plan, front and side view drawings, including overall dimensions of each switchgear assembly. Identify shipping splits and show conduit stub-up area locations on the drawings.

6. Internal wiring diagram of each low voltage switchgear compartment. Each wiring diagram shall include wire identification and terminal numbers.

7. Internal compartment-to-compartment interconnection wiring diagrams including wiring identification and terminal numbers.

8. Complete one-line diagram of each switchgear line-up and complete three-line diagram for each switchgear line-up. These drawings shall indicate devices comprising the switchgear assembly including, but not limited to, circuit breakers, control power and instrument transformers, meters, relays, and control devices. Clearly indicate electrical ratings of all devices.

9. Bill of material list for each switchgear assembly including each switchgear compartment.

10. Nameplate schedule for each compartment.

11. Manufacturer's installation instructions.

12. Manufacturer's written warranty statement.

13. Written sequence of operation for automatic transfer controls.

14. DC battery system sizing characteristics.

15. The shop drawing information shall be complete and organized in such a way that the Commission can determine if the requirements of these specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Materialman intends to provide are acceptable and shall be submitted.

1.05 OPERATIONS AND MAINTENANCE MANUALS

A. The Materialman shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the RFP. The manuals shall include:

1. Instruction books and/or leaflets.

2. Recommended spare parts list.

3. Final as-built construction drawings included in the shop drawings incorporating all changes made in the manufacturing process.

1.06 SPARE PARTS

A. The switchgear shall be furnished with all spare parts as recommended by the equipment manufacturer. In addition to the spare parts recommended by the manufacturer, the Materialman shall furnish the following minimum spare parts for each switchgear assembly:

Number Required	Description
2 sets	Fuses of each size provided.
1	Spare PLC CPU programmed with the final as-built program version.
1	PLC Power Supply
1	PLC I/O module for each type used

B. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

C. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Materialman shall properly store and safeguard such spare parts until completion of the Work, at which time they shall be delivered to the Commission.

D. Spare parts lists, included with the shop drawing submittal shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

1.07 WARRANTY TERMS

A. The manufacturer's and Materialman’s warranty shall in no event be for a period of less than ten (10) years from date of delivery of equipment to the project site and shall include repair labor, travel expense necessary for repairs at the jobsite, and expendables used during the course of repair.

B. The Materialman shall provide a complete warranty covering all equipment included in the scope of supply. This warranty shall include, but is not limited to, the following:

1. All paralleling and transfer controls

2. Complete switchgear lineup, including all components and accessories

3. Pre-fabricated equipment center, if provided.

4. DC battery system and charger

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. The equipment covered by these specifications is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily.

B. It is the intent of these specifications that the switchgear be produced by a single manufacturer who shall be responsible for matching all components and providing equipment which functions together as a system.

C. The switchgear shall be manufactured by Power Secure, Russelectric, ASCO, Cummins Power Generation, or Caterpillar. Circuit breakers shall be manufactured by Eaton, Square D, Siemens, or ABB.

2.02 LOW VOLTAGE METAL ENCLOSED SWITCHGEAR

A. General

1. Switchgear shall be UL 1558 Listed.

B. Ratings

1. Operating voltage rating shall be 480 for 600VAC as required. The entire assembly shall be suitable for 600 volts maximum AC service.

2. Rate complete switchgear assembly to withstand mechanical forces exerted during short circuit conditions. Short circuit conditions shall be defined by the power systems studies included in the RFP. The bus system shall have a minimum ANSI 30-cycle short circuit withstand rating. Test switchgear for conformance according to ANSI C37.51.

3. All ratings shall be tested to the requirements of ANSI C37.20.1, C37.50 and C37.51 and U.L. witnessed and approved.

C. Stationary Structure

1. The switchgear structure shall be constructed of formed sections of smooth and leveled steel, welded together and reinforced where necessary with formed steel members. The sides shall be covered with removable bolt on covers. The resulting structure shall be rigid and self-supporting.

2. The rear of structure shall be covered with concealed hinged, padlockable steel doors for access to buses, connections, and other equipment mounted within. The ends of the structure shall be closed with removable steel panels held in place with slotted head bolts or concealed screws. The hinged access doors shall be provided with 2-point latches, door stops, structural reinforcing to prevent sagging and provisions for padlocking. Knurled screwhead type fasteners are not acceptable.

3. Secondary control devices and associated wiring shall be isolated from all high voltage primary devices by grounded metal barriers. Primary circuits such as circuit breakers, transformers, and buses shall also be isolated from each other and from personnel by grounded metal barriers.

4. Each vertical steel unit forming part of the switchgear line-up shall be a self-contained housing having one or more individual breaker or instrument compartments, a centralized main bus compartment, and a rear cabling compartment. Each individual circuit breaker compartment shall be segregated from adjacent compartments and sections, including the bus compartment, by means of grounded steel barriers. It shall be equipped with drawout rails and primary and secondary disconnecting contacts. Current transformers for feeder instrumentation shall be located within the appropriate breaker cells.

5. The stationary part of the primary disconnecting devices for each power circuit breaker shall consist of a set of contacts extending to the rear through a glass polyester insulating support barrier; corresponding moving finger contacts suitably spaced shall be furnished on the power circuit breaker studs which engage in only the CONNECTED position. The assembly shall provide multiple silver-to-silver full floating high pressure point contacts with uniform pressure on each finger maintained by springs. Each circuit shall include the necessary three-phase bus connections between the section bus and the breaker line side studs. Load studs

shall be equipped with insulated copper load extension busses. Bus extensions shall be tin-plated where outgoing terminals are attached.

6. The secondary disconnecting devices shall consist of floating fingers mounted on the removable unit and engaging flat contact segments at the rear of the compartment. The secondary disconnecting devices shall be silver-plated and sliding contact engagement shall be maintained in the CONNECTED and TEST positions.

7. The removable power circuit breaker element shall be equipped with disconnecting contacts, and interlocks for drawout application. It shall have four positions, CONNECTED, TEST, DISCONNECTED and REMOVE, with the first three permitting closing the compartment door. Breakers shall be dead-front, through door construction, allowing racking with the door closed. The breaker drawout element shall contain a worm gear levering "in" and "out" mechanism with removable lever crank. Mechanical interlocking shall be provided so that the breaker is in the tripped position before levering "in" and "out" of the cell. The breaker shall include a provision for padlocking open to prevent manual or electric closing. The padlocking shall also secure the breaker in the CONNECTED, TEST, or DISCONNECTED position by preventing levering.

8. An insulating flash shield shall be mounted above each circuit breaker to prevent flashover from the arc chutes to ground.

9. Hinged doors shall be provided for the fronts of the drawout circuit breaker compartments.

10. Hinged panels shall be provided for mounting of meters, protective relays, and other devices. Doors and panels shall be equipped with concealed hinges and suitable latches. Doors and panels shall have one-inch (1") deep formed edges with double returns where necessary to assure stiffness.

11. A glass polyester safety shutter shall be furnished to automatically cover the bus stabs in the circuit breaker compartment when the circuit breaker unit is moved to the TEST, DISCONNECTED, or REMOVE position.

12. Provide a rear compartment steel or glastic barrier between the cable compartment and main bus to protect against inadvertent contact with the main or vertical bus bars. Provide full height and depth metal barriers between adjacent vertical structures in the cable compartment. Provide a full height and depth glass polyester barrier with appropriate slots for the main bus between adjacent vertical structures in the bus compartment.

13. Equip each cable compartment with cable lug adapters complete with hydraulic compression lugs which can be mounted up or down at a 45 degree angle to facilitate cable termination with a minimum bending radius. Provide lugs including

grounding lugs, suitable for copper cable, of quantity and size required for the required cables. Mechanical type lugs utilizing a set screw are not acceptable.

14. The withdrawal type units and the stationary sections for these units shall be assembled in jigs which accurately locate the contacts, holding devices, and interlocks. One removable unit of each type and rating shall be tried in each stationary compartment of same type and rating. Each stationary compartment shall be checked with its own removable unit to insure interchangeability.

15. Switchgear shall be furnished complete with fused, thermostatically controlled space heaters. One space heater shall be installed in each vertical structure. Utilize tubular type operated at half voltage for long life; 250 volt rated heaters at 120-volt. Power supplies to the space heaters shall be as specified herein. The Materialman shall wire heaters to provide temporary heating during storage.

D. Bus

1. Buses and main connections shall consist of tin-plated flat copper bars or copper channels of suitable size carried on supports fabricated from an approved insulating material. The buses shall be mounted in a compartment at the rear or above the circuit breakers. Bus sizes shall be based upon a maximum current density of 1000 amperes per square inch. All bus connections, including shipping breaks and for future bus extensions, shall be tin-plated and tightly clamped with through bolts. Provide all bus joints with Bellville type spring washers. Buses shall have a continuous current-carrying capacity of not less than that required for the entire generator system, including future generator capacity as identified herein.

2. Insulate/isolate buses to protect against spread of arcing faults and accidental contact by people or foreign objects.

3. Provide the 3-phase bus of each unit with insulation to completely encase each bar, including where provisions have been made by splicing adjacent units together, or making connections to disconnecting devices.

4. Fabricate bus bar molded insulation, molded insulation covers for bus joints, and bus insulated supports from insulation possessing flame-retardant and self-extinguishing, dielectric and anti-hydroscopic properties.

5. A tin-plated ground bus of adequate capacity (1/4-inch by 2-inch minimum) shall be furnished and installed throughout the switchgear structure. Each stationary unit shall be effectively connected to this ground bus. A substantial ground contact shall be provided between each breaker and removable element and the ground bus, which shall automatically be made before the primary contacts touch. Contact engagement to the ground bus shall be maintained in the CONNECTED and TEST positions. Ground relay panels with a No. 6 AWG insulated copper wire to the ground bus.

6. Main and ground buses shall be extended through all units, including spares and prepared spaces.

E. Removable Element

1. Removable element of each circuit breaker unit shall consist of a 3-pole power circuit breaker with trip-free stored-energy mechanism, positive mechanical interlock, primary and secondary disconnecting devices, auxiliary switches, position indicator, and control wiring. The removable element shall have four positions: CONNECTED, TEST, DISCONNECTED, and REMOVE, all of which permit closing of the compartment door.

2. Provide for mechanical locking of the removable element in the TEST and DISCONNECTED position. Lock shall not interfere with operation of the breaker and its mechanism.

3. Provide an interlock on each circuit breaker unit to prevent the circuit breaker from being removed while breaker is closed and to prevent breaker from being placed in CONNECTED position unless the breaker is open. If the circuit breaker is closed, the interlock shall trip the breaker before it can be placed in CONNECTED position.

F. Circuit Breakers

1. Each circuit breaker shall be drawout type and enclosed in a separate metal compartment.

2. Circuit breakers shall be rated in accordance with Underwriters Laboratories Standards, with the following minimum ratings:

a. Nominal voltage: 480VAC or 600VAC as required.

b. Maximum design voltage: 600 volts

c. Low frequency withstand: 2.2 kV

d. Frame continuous current rating: as required.

e. Sensor rating: Same as frame rating.

f. Rated interrupting time: 5 cycles.

g. Interrupting capability at rated voltage: as required by power systems studies. To assure a fully selective system, all circuit breakers shall have 30 cycle short time withstand ratings equal to their symmetrical interrupting ratings, regardless of whether equipped with instantaneous trip protection or not.

h. Where circuit breakers are equipped with current limiters, the combination shall have short time ratings in accordance with the characteristics of the limiter selected.

3. Circuit breakers shall be UL listed for application in their enclosures for 100 percent of their continuous current rating.

4. Circuit breakers of equal rating shall be completely interchangeable.

5. Equip each circuit breaker with secondary disconnecting contacts to automatically engage in the CONNECTED and TEST position to complete circuits as required.

6. Provide a means for racking in and out of the compartment and between positions. Provide a means for holding the circuit breaker in the compartment in all positions. Include a provision for padlocking open to prevent manual or electric closure of the circuit breaker.

7. Provide interlocking to prevent a closed-circuit breaker from racking to or from any position. Provide an additional interlock to assure automatic discharging of the closing springs upon insertion or removal of the breaker into or out of the compartment.

8. Circuit breakers shall be equipped with arc suppressors and individual poles shall be separated by insulating barriers. Main contacts shall be silver faced. Arcing contacts shall have non-welding and high conductivity features.

9. Each low voltage power circuit breaker shall be equipped with current sensors and a self-powered microprocessor-based trip device to sense overload and short circuit conditions. Trip devices shall be interchangeable so that any trip device can be used with any frame size circuit breaker. The device shall measure true RMS currents. Peak sensing devices will not be accepted. All adjustment setting switches shall be digitally encoded type with gold contacts. Trip units shall be removable.

10. Equip each circuit breaker with a microprocessor-based trip unit complete with rating plug. The trip units shall be furnished complete with all additional modules required to facilitate all trip unit functions. Trip units shall have adjustable long, short, instantaneous and ground fault functions. Trip units shall be provided with a reduced energy let-thru mode to reduce arc-flash energy where required by the NEC. The trip unit manufacturer shall match the manufacturer of the circuit breakers and other components of the switchgear assembly.

11. A programmable alarm relay output shall be provided to activate based on threshold and time delay values associated with any of the measured parameters. Alarm output operation shall be recorded in an event log.

12. Circuit breakers shall be equipped with a self-coupling primary and secondary disconnect contacts and arranged with a disconnect mechanism for moving it physically between the CONNECTED and DISCONNECTED positions.

13. A TEST position for each circuit breaker shall be provided and so interlocked to insure proper sequence and safe operation.

14. Each circuit breaker faceplate shall include a drawout position indicator, spring charge indictor, push-to-trip button, push-to-close mechanism release button, and open-close indicator.

15. Each circuit breaker shall be provided with "a" and "b" auxiliary contacts which will open or close when the breaker is open or closed. Each breaker shall also be provided with an alarm switch or contact to indicate that the breaker has tripped. All of these contacts shall be wired to terminals in each compartment for use in indicating breaker status. Each circuit breaker shall be furnished with enough auxiliary contacts to indicate breaker position as required for this Contract.

G. Operation and Interlocks for the Low Voltage Switchgear

1. Normally the main circuit breaker and generator circuit breakers shall be in the OPEN position.

2. The main circuit breaker shall be interlocked with reclosers XCR-CF and XCR-HO and shall function as follows:

a. Permit closing of main breaker when either recloser is CLOSED and generator(s) voltage and frequency are within acceptable limits and synchronized with the utility power.

H. Current Transformers

1. Ring type current transformers shall be dry type, for indoor service, insulated for 600 volts, 10 kV BIL. Design shall have a mechanical and thermal rating to withstand short-circuit current, stresses, and heating effects equal to the rating of the circuit breaker of the application.

2. Current ratio shall be as required.

3. Transformers shall be rated in accordance with ANSI Standard C37.20.1, with accuracy of the current transformers suitable for BO.5 metering accuracy at rated burden. The transformers shall be sized for the necessary burden for the required devices, minimum.

4. Identify the current transformers for polarity with standard marking or symbols. The transformers shall be capable of carrying rated primary current continuously without damage.

5. Run secondary wiring from current transformers in suitable wiring trough, or conduit, to proper short-circuiting type terminal blocks for connection to relays, instruments, and other devices.

6. Door mounted test blocks for all current transformers in the switchgear shall be provided.

I. Potential Transformers

1. Potential transformers shall be indoor dry type, single-phase, 60 hertz.

2. Potential transformers shall have an accuracy classification determined according to ANSI Standards. The potential transformers shall be suitable for metering accuracy, the burden to be served for the required devices plus 20 percent, and shall meet the following minimum requirements:

   a. BIL: 10kV

   b. Primary Voltage: 480 or 600 volts as required

   c. Secondary Voltage: 120 volts

   d. Winding Ratio: 4:1

   e. Metering Accuracy Class: 0.3 at rated burden

3. Identify polarity with standard markings or symbols. Connect secondaries to potential buses as required. Protect potential transformers with primary and secondary fuses. Protect primary side with current-limiting fuses.

4. Door mounted test switches located at the switchgear. Test switch wiring shall be plainly marked to indicate the respective circuits to each pole of the switch.

J. Accessory Power Unit

1. The enclosure shall be furnished with a panelboard. This unit shall serve as the onboard accessory power supply for all accessories specified herein or required. Panelboard shall be provided with an equipment enclosure suitable for the environment in which it is installed and shall be provided with a local disconnecting means. The enclosure manufacturer shall furnish and install conduit and wire necessary to provide the power from the unit to all accessories within enclosures. A spare 2-pole 20A circuit breaker in the nearby existing switchgear building within panel EM-WP-1 (120/240V single phase) shall be replaced by the Materialman with a larger circuit breaker to serve the onboard accessory power panelboard via a Materialman furnished distribution panelboard. Panel EM-WP-1 is a 150A Eaton PRL1 panelboard. Panelboard ampacity and number of branch circuit breakers shall be as required to serve the accessory loads specified herein.

K. Control Wiring and Control Terminal Blocks

1. Wire and factory test switchgear to satisfy the requirements of the operation described or necessary.

2. Switchgear secondary wiring shall be NEC Type SIS, single-conductor, stranded copper, rated 600 volts, 90 degrees C bundled and secured with nylon ties. Provide flexible stranding for swinging doors and panels. Minimum wire size shall be No. 14 AWG for voltage transformer wiring, interlock wiring, and control circuit wiring. For current transformer circuits, minimum wire size shall be No. 12 AWG. Number 10 AWG or larger wire shall be used to decrease resistance as required.

3. Route outgoing control wires for outgoing or "cell-to-cell" interconnecting wiring to the master terminal blocks with suitable numbering strips numbered in agreement with the manufacturer's detailed wiring diagrams. Provide a minimum of 10 percent (10%) spare terminal blocks for each circuit breaker and auxiliary compartment.

4. Number wiring with shrink-type tag devices at both ends consistent with the manufacturer's detailed wiring diagrams. Duplication of wire numbers and terminal block numbers is not acceptable.

5. One control power circuit cut-out device shall be furnished in each circuit breaker housing. If cut-out device has exposed conductors (i.e., knife switch), the exposed conductors shall be suitably protected against inadvertent contact.

L. Control Devices

1. Furnish and install control devices as required.

a. Pilot devices

1) All pilot devices shall be provided with a legend plate. Legend plates shall have a white background and black lettering and indicate the function of the respective pilot device.

2) All pilot devices shall be selected and properly installed to maintain the NEMA 250 rating of the enclosure in which they are installed. All pilot devices shall be UL 508 Listed.

3) All pilot devices shall be 30.5mm in diameter, unless otherwise indicated. 22mm devices are not acceptable.

4) Indicating lights shall be LED type, with the proper voltage rating to suit the application, and push-to-test feature.

b. Relays and timers

1) Relays and timers shall be furnished with an integral pilot light for positive indication of coil energization.

2) Relays and timers shall have tubular pin style terminals with matching 11-pin DIN rail mount socket. Spade or blade style terminals are not acceptable.

3) Relays and timers for all electrical equipment under this Contract shall be of the same type and manufacturer.

2. For each electrically operated circuit breaker, provide door-mounted circuit breaker pistol grip control switch with red (closed) and green (open) indicating lights to indicate breaker contact position. Provide amber indicating lights to indicate breaker lockout status and tripped status, and blue indicating lights for trip coil status monitor.

M. Nameplates

1. Provide engraved plastic nameplates to identify switchgear units, door mounted devices, and internal components.

2. Nameplates shall be engraved with the circuit number and circuit names to match approved production drawings.

3. Label the switchgear per the requirements of NEC, Articles 110-21 and 110-22.

N. Power Metering

1. Provide a power metering unit at the main circuit breaker to monitor the total standby power being served to the treatment plant, as well as a power metering unit for each generator circuit breaker to monitor each generator’s contribution.

2. Power meter shall be provided with event capture capabilities, 1GB of memory (minimum), and network communications port. A hardware gateway (if required) shall be provided in the switchgear. The hardware gateway shall convert the network communications from the respective meter to the EtherNet\IP or Modbus TCP protocol for communication of metering parameters to the plant control system via the network switch specified herein. The following parameters shall be communicated as a minimum:

a. Current (all phases)

b. Voltage (all phases)

c. KW, KVAR, KVA

d. Power Factor

O. Warning Signs

1. Provide a minimum of 2 warning signs on the front of the switchgear lineup and 2 on the back.

    a. Red laminated plastic engraved with white letters approximately ½-inch high.

    b. Signs shall read "DANGER HIGH VOLTAGE"

P. Accessories

1. Switchgear accessories shall be provided as follows:

    a. Manual handles for operating circuit breakers.

    b. One complete integral lifting device consisting of rails, hoist and dolly shall be furnished for each switchgear assembly for installing or removing breakers. The elevating table type lifting device is not acceptable.

    c. Secondary couplers for operating a power circuit breaker in the DISCONNECTED position.

    d. Auxiliary power module to provide power for testing the trip unit when the breaker is in the DISCONNECTED or REMOVED position.

    e. Test plugs for draw-out relays and meters.

    f. Auxiliary switches with at least two (2) unused normally open and two (2) unused normally closed contacts on each circuit breaker.

Q. Direct Current Battery Systems for Switchgear Control

1. Furnish and install battery systems as specified herein, to operate breaker mechanisms, supply transition/paralleling controls, and power trip unit displays. One battery system shall be provided for the entire switchgear assembly.

2. The battery system shall be capable of operating 100% of the circuit breakers simultaneously. One-minute discharge rate down to final 1.75 volt/cell shall be equal to trip current drawn by 100% of breakers tripping simultaneously.

3. Batteries shall be sealed pocket plate nickel-cadmium type, cabled to produce a 48 VDC output.

    a. Each switchgear cell shall have a fused direct current circuit. Provide batteries with a rack assembly to house the batteries and charger.

    b. Furnish a current limiting battery charger to automatically recharge the batteries. Include overload protection, silicon diode full wave rectifiers,

voltage surge suppressors, direct current ammeter, and fused alternating current output. Amperage output to be not less than 10 amperes. Battery charger shall be supplied from the switchgear accessory power unit specified herein.

4. Minimum battery system ratings shall be as required by the switchgear manufacturer plus 25% spare capacity.

R. Surge Protective Devices

1. A single Type 1 surge protective device (SPD) shall be provided integral to the switchgear enclosure. The SPD shall be UL 1449 Listed and shall bear the UL mark. Units that are “manufactured in accordance with” UL 1449 or tested by other testing agencies “in accordance with” UL 1449 are not acceptable and will be rejected.

2. SPD shall be rated for the voltage and configuration of the equipment to which it is connected. The short circuit current rating of the SPD shall match or exceed the rating of the equipment to which it is connected.

3. SPD shall have a Maximum Continuous Operating Voltage (MCOV) of at least 115% of the nominal voltage of the equipment to which it is connected.

4. The Nominal Discharge Current (In) of the SPD shall be 20kA. Peak surge current ratings shall not be used as a basis for applying the SPD to the system.

5. The surge current rating for the SPD shall be 200kA.

6. SPD shall be provided with the following accessories:

a. Each individual module shall feature an LED indicating the individual module has all surge protection devices active. If any single component is taken off-line, the LED shall turn off and another LED shall illuminate, providing individual module as well as total system status indication.

b. Surge counter and audible alarm with reset/silence switch.

c. One set of Form C (SPDT) dry contacts rated for at least 5A at 120VAC.

2.03 AUTOMATIC TRANSFER AND GENERATOR PARALLELING AND LOAD SHARING CONTROLS

A. Generator paralleling, synchronizing, and load sharing controls shall be provided with the switchgear package. All generator control components and main circuit breaker controls shall be furnished and installed within the switchgear weatherproof enclosure. Controls shall be installed to allow parallel operation and closed transition power transfer in both directions between the standby power generators and the utility sources. The

controls shall include devices to automatically synchronize and parallel the generator sets with each other and with the electric utility source. Once in parallel, the load controls shall softly load/unload the generators as required to provide required power transfer at separation and at retransfer to the utility.

B. Generator and transfer controls shall be **non-proprietary**. The Commission shall have the ability to install engine generator sets in the future that do not match those provided under this project. Generator and transfer controls shall be compatible with Woodward control products.

C. The generator and transfer controls shall consist of the following components and features as a minimum:

1. An automatic, digital, load control and synchronizing system. This system shall consist of microprocessor-based synchronizing and load sharing controllers for each generator source and each utility source. The synchronizing and load sharing controllers shall control all aspects of generator set operation including, but not limited to, voltage control, speed control, automatic engine starting and stopping, synchronization, load sharing, VAR sharing, power factor control, and generator circuit breaker control.

2. A Master Generator Switchgear PLC (PLC-GEN) and a digital operator interface to allow monitoring and control of the generator system. The PLC shall be a Modicon Momentum, Allen-Bradley Compact Logix, or GE VersaMax. The PLC shall be furnished with a gateway or third party communications module as required to communicate with other devices. The Materialman shall be responsible for providing modules/gateways as required to communicate with the Commission's SCADA system. Provide Ethernet switch with suitable number of ports to connect to all devices specified herein and connect to the Commission's SCADA system via fiber optic cable.

    a. PLC-GEN shall also be provided with analog and discrete input/output cards as required to interface with the signals from the bulk fuel storage tank system (if provided) and the hardwired signals from each generator. PLC-GEN shall serve as a data collector for these signals so that they can be forwarded on to the Commission's SCADA system.

3. The operator interface shall be a minimum 19 inch (diagonal), color TFT industrial display. This display shall support a minimum resolution of 1920 x 1080pixels. Interface shall be accomplished via a key protected touch screen permanently affixed to the display. The touch screen shall be clear glass, with light transmission of 95% or better, furnished with a surface acoustic wave or resistive touch interface. Navigation and operation shall be intuitive such that help screens are not required. The operator interface shall support complete generator set and system control in both automatic and manual modes. The operator interface shall be furnished with communication capabilities to communicate with the Master

Generator Switchgear PLC. The touch screen display shall provide indication of the following signals for each generator (minimum):

a. Engine Run

b. Engine Stopped

c. Engine Overspeed

d. Low Oil Pressure Alarm

e. Low Oil Pressure Shutdown

f. Engine Temperature Alarm

g. Engine Temperature Shutdown

h. Failure to Synchronize

i. Engine Summary Alarm

j. Engine Summary Shutdown

k. Engine Control Switch (ECS) in Off position

l. Engine Control Switch (ECS) in Manual position

m. Engine Control Switch (ECS) in Auto position

n. Engine Control Mode Switch (at Engine-Generator Set) in “Auto” Position

o. Low/High Battery Voltage

p. Engine in Cool Down Mode

q. Battery Charger Failure

r. Gen Breaker Fail to Close

s. Gen Breaker Fail to Open

t. Generator Circuit Breaker Open

u. Generator Circuit Breaker Closed

v. Generator Circuit Breaker Tripped

4. The touch screen display shall provide the following signals and commands for main system control:

a. Generator System Control Switch (SCS) in “Auto” Position

b. Master Generator Switchgear PLC Failure

c. Station Battery Failure

d. Utility Source Available

e. Utility Source Failed

f. Utility Source Protective Relay Alarm

g. Main Circuit Breaker Open

h. Main Circuit Breaker Closed

i. Main Circuit Breaker Tripped

j. Main Circuit Breaker Locked Out (86)

k. Failure to Synchronize

l. System General Alarm

m. Disable Automatic Generator Load Management.

5. Graphic displays shall be created to provide indication of the signals described above. As a minimum, provide a graphic display screen for each of the following:

   a. Overall system including the main circuit breaker, utility voltage, power distribution bus, the generators and respective circuit breakers.

   b. Event summary display.

   c. Alarm summary display.

6. Manual load control and transfer system to back-up the automatic load control and synchronizing system. The manual system shall be operable upon failure of the automatic system, allowing manual paralleling of each generator set with the other generator sets. A selector switch for selection of the system auto/manual load control shall also be provided. The manual system shall consist of voltage and frequency adjustment equipment and manual synchronizing selector switches for each generator circuit breaker. The manual synchronizing selector switch and the voltage and frequency adjustment equipment shall be accessible from the front of the Generator System Control Panel. The manual synchronizing selector switches shall be furnished with a single, removal T-handle to permit the activation of only one manual synchronizing circuit at any given time.

7. A DC control power system for the generator control system components, the operator interface, and the PLC. The DC control power system shall be sourced from the switchgear battery system.

8. Provide the following as physical devices (not soft devices simulated via the touch screen):

    a. Hand-Off-Auto engine control switch (ECS) for each generator. In the “Hand” position, the generator shall start and synchronize to the generator bus. In the “Off” position, the generator shall not operate under any condition. In the “Auto” position, the generator start/stop control shall be from the generator control system.

    b. Generator System Hand-Manual-Auto control switch (SCS). In the “Auto” position, the generator control system shall automatically transfer from utility to generators. In the “Hand” position, transfer from utility to generators and re-transfer from generators to utility shall be initiated by pushbuttons as specified below. In “Manual” position, the transfer and synchronizing function shall be by the manual load and circuit breaker controls.

    c. Selector switch for each utility source to simulate a loss of utility voltage (for testing purposes).

    d. Pushbutton to initiate transfer from utility to generators.

    e. Pushbutton to initiate retransfer from generators to utility source.

    f. Digital metering for each generator and the utility main circuit breaker:

    g. An analog synchroscope with 360 degree movement (not a digital display) for each generator on a swing out panel.

    h. System reset pushbutton.

    i. Emergency stop pushbuttons for each generator.

    j. Circuit Breaker open-close control switches with circuit breaker status (open, closed, tripped, lockout) indicating lights for all circuit breakers.

    k. White indicating lights near the main circuit breaker control switch to indicate utility source availability.

D. The generator paralleling and transfer controls and each individual engine generator control panel shall communicate with each other over a network.

E. The transfer controls shall be designed so that the system will automatically transfer to the generators in the event of a utility failure and back to utility after the utility source is

restored whether the Master Generator Switchgear PLC (PLC-GEN) is operational or not. The automatic generator synchronizing, paralleling, load sharing, and closed transition transfer operations shall be initiated using the transfer from/to utility pushbuttons whether the Master Generator Switchgear PLC (PLC-GEN) is operational or not.

F. In the event the generators fail to synchronize with the utility and the utility voltage and frequency are within acceptable limits, the transfer controls shall initiate a “fail to synchronize with utility” signal to the plant control system and continue to operate the plant from the generators.

G. Data from the generators, switchgear, and fuel systems shall be made available from the Master Generator Switchgear PLC (PLC-GEN) to the plant SCADA system via the fiber optic connection specified herein. Provide a register of all available data points, and the Commission will select up to 300 points to be transmitted. Manually initiated starting and stopping of generators and opening and closing of circuit breakers (as specified in Sequence of Operations herein) shall be provided via the plant SCADA system through the same fiber optic connection.

H. Transfer controls shall communicate with both reclosers (XCR-CF and XCR-HO) via fiber optic cable furnished and installed by the Materialman. Fiber optic cable shall be installed in PVC conduit that is direct buried.

I. Paralleling and transfer controls shall be set up to allow a future generator (via a spare circuit breaker) to be installed, connected, and put into operation without having to add any additional paralleling and load sharing hardware. The Commission shall simply be able to indicate to the controls that the additional engine-generator set is available, make minor programming adjustments, and the controls shall control and monitor the new unit as specified for the other generators herein.

2.04 SEQUENCE OF OPERATIONS

A. The normal switchgear mode of operation shall be as follows:

1. Utility present. Main circuit breaker open.

2. All generator circuit breakers open.

3. All generators off.

B. The treatment plant normally operates with loads split between the two electric utility sources named Cape Fear and Hoffer. A manually operated tie switch is located in Sectionalizing Switch #2, (SS-2) and that tie switch is only operated by the Utility Company, and only when one of the two sources is unavailable. The opening/closing of reclosers, sectionalizing switches, and circuit breakers associated with the two electric utility sources is controlled by the Utility Company and is not controlled by treatment plant operations staff. The opened and closed status of the SS-2 tie switch is available

at SS-2 and shall be wired into the logic used by the Materialman to meet the requirements herein.

C. As indicated on the Drawings, the switchgear will be connected through a transformer to a sectionalizing switch for the Hoffer electric utility source. The standby power system will only be able to serve treatment plant loads connected to the Hoffer electric utility source until the tie switch is manually closed by the Utility Company.

D. Reclosers XCR-CF and XCR-HO shall be interlocked with each other and with the tie switch at SS-2 such that if the tie switch is closed, only one XCR-CF or XCR-HO may be closed. If both reclosers are closed and the tie switch is closed, both reclosers shall be opened immediately. This interlock is to prevent the inadvertent connection of the Caper Fear and Hoffer sources together.

E. Loss of Single Utility Source

1. If a single utility source is lost, the recloser associated with that source shall open, but the engine-generators shall not be started. The Utility Company will attempt to close the tie switch and supply the entire plant from the remaining source. When the failed utility source returns and remains stable for more than 60 seconds (adjustable), the recloser associated with that source shall close.

F. Auto Start/Stop Sequence – Automatic Transfer Upon Failure of both Utility Sources

1. Initiate start sequence automatically when both utility sources fail, and the generator system control switch (SCS) is in the “Auto” position. Generator start sequence shall be automatically initiated if any of the following conditions are detected:

    a. Voltage on any phase of the utility source in service drops below 85 percent of nominal voltage or increases above 115 percent of nominal voltage.

    b. Frequency drops below 90 percent or increases above 110 percent of 60Hz.

    c. Voltage phase sequence imbalance (negative sequence) increases up to or above 5% percent.

2. The system shall have an adjustable start sequence time delay function of 0-999 seconds (initially set at sixty (60) seconds.

3. After the start sequence time delay function has timed out, the generator control system shall start all available generators and open both XCR-CF and XCR-HO.

4. When the first generator voltage and frequency are within acceptable limits, close its respective generator circuit breaker and connect to the switchgear bus. The generator control system shall synchronize the remaining available generators with

the bus and close the respective generator circuit breakers when generator voltage and frequency are within acceptable limits.

5. After a minimum of 2,500kw of available generators are connected to the bus, close the main circuit breaker. The remaining available generator(s) shall continue to synchronize and connect to the bus when their voltage and frequency are within acceptable limits.

6. All available generator sets supply the plant load as required.

G. Auto Start/Stop Sequence – Automatic Return to Single Utility Source

1. When a single utility source return is detected, the generator control system shall transfer to that utility source when the voltage, phase voltage balance, and frequency are within acceptable limits and after an adjustable time delay function of 0-120 minutes (initially set at 15 minutes).

2. The generator control system shall synchronize the operating generators with the single source, close the associated recloser, and operate the generators in parallel with the utility source.

3. The system shall softly unload the generators and open the main circuit breaker when only 100kW (adjustable) of the plant load is being served by the generators, and the remaining is being served by the utility source.

4. Open the operating generator circuit breakers and run the generators in an unloaded cool down mode for an adjustable time period.

5. When the cool down period is complete, the generator control system shall stop the generators.

H. Auto Start/Stop Sequence – Automatic Return to Both Utility Sources

1. Since the standby power system is connected to the Hoffer source through a sectionalizing switch, automatic return of the plant loads to both the Cape Fear and Hoffer utility sources is not possible. Under the condition of both utility sources returning, the controls shall follow the logic above for a single utility source return and transfer all loads to the Hoffer source.

I. Auto Start/Stop Sequence – Manually Initiated Transfer to Generator Source (Hoffer Utility Source Available)

1. The Operator initiates transfer to the generator source at the plant PLC Terminal when the SCS is in the “Auto” mode. The Operator can also initiate the transfer to generator source by placing the SCS in the “Hand” position and pressing the “Initiate Transfer to Generator” pushbutton.

2. The generator control system shall close the main circuit breaker and start all available generators.

3. The generator control system shall synchronize the operating generators with the switchgear bus and close the respective generator circuit breakers when generator voltage and frequency are within acceptable limits.

4. The system shall softly unload the Hoffer utility source and open the XCR-HO recloser after 95% (adjustable) of the plant load has been transferred to the generator source.

5. All available generator sets shall supply the plant load as required.

J. Auto Start/Stop Sequence – Manually Initiated Transfer to Generator Source (Cape Fear Utility Source Available)

1. Since the standby power system is connected to the Hoffer source through a sectionalizing switch, manually initiated transfer of the plant loads from the Cape Fear utility source to the generator system is not possible.

K. Auto Start/Stop Sequence – Manually Initiated Return to Single Utility Source

1. The Operator initiates transfer to the utility power source at the plant PLC Terminal when the SCS is in the “Auto” mode. The operator can also initiate the transfer to normal source by placing the SCS in the “Hand” position and pressing the “Initiate Transfer To Utility” pushbutton.

2. The generator control system shall synchronize the operating generators with the single source, close the associated recloser, and operate the generators in parallel with the utility source.

3. The system shall softly unload the generators and open the main circuit breaker when only 100kW (adjustable) of the plant load is being served by the generators, and the remaining is being served by the utility source.

4. Open the operating generator circuit breakers and run the generators in an unloaded cool down mode for an adjustable time period.

5. When the cool down period is complete, the generator control system shall stop the generators.

L. Auto Start/Stop Sequence – Manually Initiated Return to Both Utility Sources

1. Since the standby power system is connected to the Hoffer source through a sectionalizing switch, manually initiated return of the plant loads to both the Cape Fear and Hoffer utility sources is not possible. Under the condition of both utility

sources returning, the controls shall follow the logic above for a single utility source return and transfer all loads to the Hoffer source.

M. Auto/Start Stop Sequence – Extended Parallel Mode (BASE BID)

1. For the base bid, all of the extended parallel mode functions, interlocks, and hardware as specified herein shall be provided and initially set up for use with the future generator only. The selection of which generator or generators are capable of being controlled by this extended parallel mode shall be programmable and modifiable only with an administrator password for the system.

2. The Operator initiates transfer to the generator source at the plant PLC Terminal when the SCS is in the “Auto” mode. The Operator can also initiate the transfer to generator source by placing the SCS in the “Hand” position and pressing the “Initiate Transfer to Generator” pushbutton.

3. The generator control system shall close the main circuit breaker and start the selected generator(s).

4. The generator control system shall synchronize the selected generator(s) with the switchgear bus and close the respective generator circuit breakers when generator voltage and frequency are within acceptable limits.

5. The system shall softly unload the utility source until only 100kW (minimum) of power is imported from the utility. The system shall adjust the selected generator(s) as required to serve all but this last remaining portion of load, which shall be required to be imported at all times.

    a. If at any time the level of imported power drops below this minimum, the main circuit breaker shall open immediately and isolate the switchgear bus from the electrical distribution system.

    b. If at any time the power flows from the plant through either recloser XCR-CF or XCR-HO) in the reverse direction (exporting to utility grid), the associated recloser shall open immediately and isolate that portion of the treatment plant from the utility grid.

6. All selected generator sets shall supply the plant load as required.

N. Auto/Start Stop Sequence – Extended Parallel Mode (ALTERNATE BID)

1. If an alternate bid is provided, all of the extended parallel mode functions, interlocks, and hardware as specified herein shall be provided and set up for use with all generators provided under this Contract.

2. The Operator initiates transfer to the generator source at the plant PLC Terminal when the SCS is in the “Auto” mode. The Operator can also initiate the transfer to

generator source by placing the SCS in the “Hand” position and pressing the “Initiate Transfer to Generator” pushbutton.

3. The generator control system shall close the main circuit breaker and start all available generators.

4. The generator control system shall synchronize the operating generators with the switchgear bus and close the respective generator circuit breakers when generator voltage and frequency are within acceptable limits.

5. The system shall softly unload the utility source until only 100kW (minimum) of power is imported from the utility. The system shall adjust the generators as required to serve all but this last remaining portion of load, which shall be required to be imported at all times.

    a. If at any time the level of imported power drops below this minimum, the main circuit breaker shall open immediately and isolate the switchgear bus from the electrical distribution system.

    b. If at any time the power flows from the plant through either recloser XCR-CF or XCR-HO) in the reverse direction (exporting to utility grid), the associated recloser shall open immediately and isolate that portion of the treatment plant from the utility grid.

6. All available generator sets shall supply the plant load as required.

O. The following manual start/stop sequences shall be capable of being carried out by plant operations staff. Provide all hardware and interlocks necessary to perform the following manual functions:

1. Manual Start/Stop Sequence – Manual Transfer to Generator Source

    a. Place the SCS in the “Manual” position. In “Manual” mode, all automatic transfer controls, synchronizing controls, and load sharing controls shall be disabled.

    b. Open reclosers XCR-CF and XCR-HO.

    c. Manually open the generator circuit breakers (if closed) and open the main circuit breaker (if closed).

    d. Start all available generators by placing the respective engine control switch (ECS) in the “Hand” position.

    e. Place the manual synchronizing switch for one of the generators in the “On” position using the removable T-handle and adjust the frequency and voltage using the voltage and frequency potentiometers. Manually close the

generator circuit breaker once the voltage and frequency are within acceptable limits. Place the manual synchronizing switch to the “Off” position and remove the T-handle. Repeat for all operating generators.

f. Close the main circuit breaker after the generators are synchronized to supply the plant load as required.

2. Manual Start/Stop Sequence – Manual Transfer to Utility Source

a. Place the SCS in the “Manual” position. In “Manual” mode, all automatic transfer controls, synchronizing controls, and load sharing controls shall be disabled.

b. Manually open the generator circuit breakers. Operate generators in an unloaded cool down mode and manually stop all operating generators at the end of the cool down period.

c. Manually open the main circuit breaker. Close recloser XCR-HO if utility voltage is present.

d. Close recloser XCR-CF if utility voltage is present AND the tie switch is in the open position. If both of these conditions is not present, XCR-CF shall not be capable being closed.

P. Automatic Generator Load Management Program

1. With the SCS in the “Automatic” position, and the Automatic Generator Load Management Program selector switch in the “ON” position, the generator controls shall stop running generators as follows:

a. If the load on all running generators is less than 25% (adjustable) of the generators full load rating and after an adjustable time delay (0-120 minutes, initially set at 15 minutes), disconnect the generator with the highest cumulative run time and initiate cool down cycle.

b. After the first generator has disconnected and after an adjustable time delay (0-120 minutes), if the load on all running generators is less than 30% (adjustable) of the generators full load rating and after an adjustable time delay (0-120 minutes, initially set at 15 minutes), disconnect another generator and initiate cool down cycle.

c. If a “Disable Generator Load Management Program” signal is received from the Plant Control System, the generator controls shall start all available generators and shall disable the Generator Load Management Program until the “Disable Generator Load Management Program” signal is removed.

d. In the event any generator alarms occur and the alarm is critical to the generator's operation (i.e. low coolant, over-temperature, etc) or generator shutdown occurs, the Generator Load Management Program shall be automatically disabled and all available generators shall start and synchronize to the generator bus.

Q. Utility Outage Simulation

1. When the selector switch is used to simulate a loss of voltage on both electric utility services, the appropriate automatic transfer sequence specified above shall be initiated.

2.05 SWITCHGEAR ENCLOSURE

A. If the switchgear is not enclosed within a common enclosure assembly shared with the engine-generator sets specified in Section 26 32 13 or not enclosed in the existing switchgear building (with deductive cost provided in proposal form), the switchgear shall be enclosed in a pre-fabricated equipment center as specified in Section 13 34 23.26, Pre-Fabricated Equipment Centers.

PART 3 – EXECUTION

3.01 INSTALLATION

A. The switchgear shall be furnished and installed as specified herein and in accordance with the manufacturer's installation instructions. The equipment shall be suitably protected and space heaters connected until accepted by the Commission.

B. The equipment shall be installed and checked in accordance with the manufacturer's recommendations. This shall include but not limited to:

1. Checking to ensure that the pad location is level to within .125 inches.

2. Checking to ensure that all bus bars are torqued to the manufacturer's recommendations.

3. Assemble all shipping sections, remove all shipping braces and connect all shipping split mechanical and electrical connections.

4. Secure assemblies to foundation or floor channels.

5. Inspect and install all circuit breakers in their proper compartments.

C. Install the switchgear to allow complete unit door swing required for unit removal. This is specifically required where a vertical section of switchgear is set next to a wall to the left of a switchgear section.

3.02 PAINTING

A. Prior to final completion of the work, all metal surfaces of the equipment shall be cleaned thoroughly, and all scratches and abrasions shall be retouched with epoxy paint that is same color as used for factory finishing coats.

3.03 TESTING

A. All tests shall be performed in accordance with the requirements of the RFP. The following tests are required:

1. Witnessed Shop Tests

    a. None required.

2. Certified Shop Tests and Reports

    a. Submit description of proposed testing methods, procedures, and apparatus.

    b. Submit notarized and certified copies of all test reports.

    c. As a minimum, the entire switchgear assembly shall go through a quality inspection before shipment. This inspection shall include, but is not limited to, the following:

        1) Physical inspection of the structure and the electrical conductors including bussing, general wiring, and units.

        2) General electrical tests including power circuit phasing, control circuit wiring, instrument transformers, meters, ground fault system, and device electrical operation.

        3) AC dielectric tests of the power circuits and control circuits.

        4) Markings/labels, including instructional type, Underwriters Laboratory (U.L.), and inspector's stamps.

    d. The manufacturer shall use integral quality control checks throughout the manufacturing process to maintain the correctness of the switchgear.

3. Field Tests

    a. Field tests shall be performed in accordance with NETA Acceptance Testing Specifications, latest edition.

    b. The manufacturer’s technical representative shall perform startup and functional testing of the switchgear controls. Functional testing shall include field verification of each and every part of the sequence of operations listed

herein. Representatives from the Commission shall be present to witness the functional testing.

c. Prior to commencement of the functional testing, a test plan shall be submitted for Commission approval. Test plan shall demonstrate how each part of the sequence of operations will be tested, and shall detail any required outages, switchovers, or the like that must be performed during the testing.

3.04 SERVICES OF MANUFACTURER'S REPRESENTATIVE

A. The Materialman shall provide the services of a qualified, factory-trained manufacturer's technical representative who shall adequately supervise the installation and testing of all equipment furnished under this Contract. The manufacturer's representative shall certify in writing that the equipment has been installed in accordance with the manufacturer's recommendations. No further testing or equipment startup may take place until this certification is accepted by the Commission.

B. The manufacturer’s technical representative shall perform startup and functional testing of the switchgear and controls as specified herein.

C. The Materialman shall provide training for Commission personnel. Training shall be conducted by the manufacturer's factory-trained representative who shall instruct Commission personnel in operation and maintenance of all equipment provided under this Section. Training shall be provided for two (2) sessions of eight (8) hours each. Training shall not take place until after all switchgear units have been installed and energized. Training shall be at times coordinated with the Commission.

D. The services of the manufacturer's representative shall be provided for a period of not less than as follows:

1. One (1) trip of two (2) working days during the installation of the switchgear.

2. One (1) trip of two (2) working days for the testing and startup of the switchgear.

3. One (1) trip of five (5) working days to perform the functional testing of the entire switchgear assembly and controls.

4. One (1) trip of two (2) working days to perform training as specified herein.

5. One (1) trip of one (1) working day two (2) months before the warranty expiration to identify issues to be corrected under warranty.

E. Any additional time required to achieve successful installation and operation shall be at the expense of the Materialman.

3.05 FIELD ADJUSTMENTS

A. The protective relays and/or trip units shall be set in the field by a qualified representative of the manufacturer, or an outside testing company retained by the Materialman, in accordance with the settings designated in the power systems study.

END OF SECTION

SECTION 26 32 13
ENGINE GENERATORS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Materialman shall furnish and install engine generator sets complete with all accessories and appurtenances as required and as specified herein.

B. The engine-generator sets shall have a 480VAC or 600VAC output and be rated no less than 500kW (standby rating) each. The total generation capacity (standby ratings) provided under this Contract shall be no less than 3,000kW, achieved by paralleling multiple units. When any single generator set is out of service, the generation capacity available (standby ratings) shall not be less than 2500kW. The multiple parallel units are permitted to be different kW ratings in order to achieve the total generation capacity desired. Achieving the desired total generation capacity with a single engine-generator set is not acceptable.

C. Use materials which are new, unused, and as specified. If not specifically indicated, use the best and most suitable materials of their kinds for the purpose intended, and for the design and expected conditions of service, subject to the approval of the Commission.

D. Provide workmanship that is first class in every respect. Employ workers thoroughly experienced in such work. A neat and workmanlike appearance in the finished work shall be required.

E. All materials used shall bear the inspection labels of the Underwriter's Laboratories, if the material is of a class inspected by the Laboratory.

F. Unless otherwise indicated, the materials to be provided under this Specification shall be the products of manufacturers regularly engaged in the production of all such items and shall be the manufacturer's latest design.

G. For the base bid, the engine generator sets shall fully comply with all current Environmental Protection Agency (EPA) emission regulations including, but not limited to, being EPA Tier 2 Emissions Compliant.

H. For the alternate bid, if provided by the Materialman, the engine generator sets shall fully comply with all current Environmental Protection Agency (EPA) emission regulations including, but not limited to, being EPA Tier 4 Certified. Sets with EPA Tier 4 Compliant or any other Tier rating on the engine will not be accepted for the alternate bid.

I. Reference Section 26 23 00 – Low Voltage Switchgear and Section 23 13 01 – Supplementary Fuel Systems.

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1.02 CODES AND STANDARDS

A. The packaged engine-generator system shall comply with the following Codes and Standards as a minimum:

1. NEMA MG1 – Motors and Generators.

2. NEMA MG2 – Safety Standard for Construction and Guide for Selection, Installation and Use of Motors and Generators.

3. ISO STD 8528 – Reciprocating Internal Combustion Engines.

4. ISO STD 3046 – Performance Standard for Reciprocating Internal Combustion Engines.

5. NFPA 30 – Flammable and Combustible Liquids Code.

6. NFPA 37 – Standard for Installation and use of Stationary Combustible Engine and Gas Turbines.

7. NFPA 70 – National Electrical Code

8. NFPA 70E – Standard for Electrical Safety in the Workplace

9. NFPA 110 – Standard for Emergency and Standby Power Systems.

10. UL 508A – Industrial Control Panels.

11. EGSA – Electrical Generating Systems Association.

12. UL 2200 – Stationary Engine Generator Assemblies

13. UL 142 – Steel Aboveground Tanks for Flammable and Combustible Liquids.

14. UL 1236 – Standard for Battery Chargers for Charging Engine Starter Batteries.

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the RFP, the Materialman shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

2. Spare Parts List

3. Reports of Certified Shop and Field Tests

4. Operation and Maintenance Manuals

5. Manufacturer's Field Start-up Report

6. Manufacturer's Representative's Installation Certification

B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete or illegible submittals will be returned to the Materialman without review for resubmittal.

C. Shop drawings for each engine-generator set shall include but not be limited to:

1. Manufacturers printed specification sheets showing critical engine and generator set specifications including the following:

a. Dimensions, and weights

b. Guaranteed fuel consumption at 25%, 50%, 75% and 100% of full rated load

c. Engine bhp available

d. Brake Mean Effective Pressure (BMEP)

e. Engine jacket water heat rejection

f. Exhaust flow rate and temperature at 100% of rated load

g. Ventilation and combustion air requirements

h. Exhaust backpressure limitation

i. Liquid refill capacities

j. Voltage regulation characteristics

k. Guaranteed noise levels

2. Alternator technical electrical data, including, but not limited to:

a. Alternator efficiency at 50%, 75%, and 100% load

b. Telephone Interference Factor (TIF)

c. Harmonic waveform distortion

d. Type of winding insulation and generator temperature rise

e. Per unit subtransient impedance X'' and X/R ratios for positive, negative, and zero sequences

f. Transient reactance (Xd')

g. Synchronous reactance (Xd)

h. Sub transient time constant (Td'')

i. Transient time constant (Td)

j. DC time constant (Tdc)

k. Decrement curve

3. Manufacturer's printed warranty statement of the engine and generator set showing single source responsibility by the engine manufacturer.

4. Generator control panel equipment and features. Include a written explanation of the auto start/stop logic and operation.

5. Engine-generator set and accessory product data sheets including, but not limited to, the following:

a. Alternator strip heater

b. Radiator

c. Seismically rated vibration isolators

d. Flexible exhaust coupling

e. Exhaust silencer

f. Batteries

g. Battery charger

h. Engine manufacturer's shutdown contactors

i. Jacket coolant heater

j. Fuel cooler

k. Fuel tank(s) and pump(s)

l. Fuel level devices

m. Output circuit breaker and trip unit

n. Conduit

o. Wire and Cable

p. Wiring Devices

q. Lighting

r. Panelboards/combination power unit

s. Fuel polishing system

6. Normal operating ranges for systems temperature, pressure and speed.

7. Manufacturer's part number for the engine and generator operation guide, parts book, service manual, warranty policy, and installation guide.

8. Phone numbers of twenty-four (24) hour products support contacts and locations.

9. Drawing showing right hand, left hand, and top views of proposed assembly; battery rack, isolators, exhaust silencer, conduit stub up locations, and flexible fittings; wiring schematics, interconnection diagrams (point to point), and written description of engine generator controls and alarm circuits.

10. Control panel layout drawings and wiring diagrams.

11. EPA Certificate of Conformity for Exhaust Emissions

12. Drawings and specifications for base-mounted fuel storage tank with accessories and leak detection system.

13. Detailed drawings showing plan, front, and side views as well as appropriate section views of the weatherproof, engine-generator enclosure. Include product data sheets for all appurtenances to be furnished and installed in the enclosure. Drawings shall be of sufficient detail to assure proper installation by the Materialman.

D. The shop drawing information shall be complete and organized in such a way that the Commission can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Materialman intends to provide are acceptable and shall be submitted.

1.05 REPORTS OF CERTIFIED SHOP AND FIELD TESTS

A. Submit two (2) certified copies of all test reports. This includes all shop tests and field tests. Certified shop test reports for prototype engine-generator sets are unacceptable. The manufacturer's serial number for the actual engine-generator set furnished for this project shall appear on all test reports.

1.06 OPERATION AND MAINTENANCE MANUALS

A. The Materialman shall submit operation and maintenance manuals in accordance with the RFP. The manuals shall include:

1. Instruction books and/or leaflets.

2. Recommended spare parts list.

3. Final as-built construction drawings included in the shop drawings incorporating all changes made in the manufacturing process.

B. Manuals shall contain complete information in connection with assembly, operation, lubrication, adjustment, wiring diagrams and schematics, maintenance, and repair, including detailed parts lists with drawings or photographs identifying the parts. Manuals shall contain all information submitted as part of the shop drawing review process.

1.07 SPARE PARTS

A. Routine maintenance and adjustments shall be performed without the use of special tools or instruments. All spare parts as recommended by the equipment manufacturer shall be furnished to the Commission by the Materialman.

B. In addition to the manufacturer recommended spare parts, the Materialman shall furnish the following spare parts for each engine-generator set:

1. One (1) set of fuel oil particulate filters

2. One (1) set of air filters

3. One (1) set of lubrication oil filters

4. One (1) set of fuel/water separator filters

5. One (1) set of coolant filters

6. One (1) set of diesel exhaust fluid filters (alternate bid only)

7. Two (2) diesel exhaust fluid quality sensors (alternate bid only)

8. One (1) NoX sensor (alternate bid only)

C. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

D. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Materialman shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Commission.

E. Spare parts list, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

F. The dealer shall have sufficient parts inventory to maintain over-the-counter availability of at least 90% of any required part and 100% availability within 48 hours.

1.08 WARRANTY TERMS

A. The manufacturer's and Dealer's warranty shall in no event be for a period of less than ten (10) years or two thousand (2000) hours of operation, whichever comes first, from date of delivery of equipment to the project site and shall include repair labor, travel expense necessary for repairs at the jobsite, and expendables (lubricating oil, filters, coolant, and other service items made unusable by the defect) used during the course of repair.

B. Provided warranty shall cover all equipment included in the scope of supply. This warranty shall include, but is not limited to, the following:

1. Engine-generator set and respective auxiliary equipment

2. All controls for the engine-generator set

C. Batteries shall be provided with two (2) year full replacement guarantee, and a 24-month pro-rated replacement schedule thereafter.

1.09 OIL SAMPLING KIT

A. The generator set supplier shall provide an oil sampling analysis kit which operating personnel shall utilize for scheduled oil sampling. All equipment needed to take oil samples shall be provided in a kit and shall include the following:

1. Sample extraction gun

2. Ten (10) Bottles

3. Ten (10) Postage-paid mailers

4. Written instructions

1.10 PREVENTIVE MAINTENANCE AGREEMENT

A. The engine/generator set supplier shall provide a preventive maintenance agreement using qualified factory trained service personnel, for a period of 10-years. Provide all recommended fluids, dealer labor, travel labor and travel mileage to complete the suggested preventive maintenance as defined in the manufacturer's Operation and Maintenance Manual and as listed below. All parts shall be new and provided by the generator manufacturer. The maintenance agreement shall include the following as a minimum:

1. Check oil level, check oil pressure safety shutdown switches, complete an oil sample analysis, check oil pressure and gauges, and inspect the system for leaks. Change oil and oil filter if required.

2. Check coolant level, inspect/replace cooling system hoses, check high/low temperature alarms and shutdowns, inspect radiator, inspect fan and fan belts (tighten or replace as required). Flush coolant system and replace coolant if required.

3. Inspect the fuel system including fuel pumps and tank(s), check fuel pressure, inspect fuel filters and replace if required, and check for water in fuel storage tank.

4. Check the battery and battery charging system including a voltage test, check and clean battery terminals, check and inspect engine starting system.

5. Inspect and test the generator, check bearing grease and add grease if required, check terminations, and complete a generator winding insulation resistance (i.e. megger test).

6. Check engine control system including overspeed alarms and shutdowns, overcrank alarm, engine starter, circuit breaker and fuses, and test and adjust engine governor.

7. Check and the engine air intake and exhaust systems for leaks and damage. Check air filter and replace if required.

8. Inspect all components of the generator enclosure including, but not limited to, lights, louvers, fans, doors, etc.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be

designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed.

B. Consideration will be given only to the equipment of those manufacturers who have furnished comparable size diesel engine-generator sets for at least five (5) similar installations within the United States that have been in regular successful operation for not less than five (5) years.

C. The engine-generator set manufacturers shall be Power Secure, Cummins, or Caterpillar. The engine-generator set manufacturer and/or dealer shall be responsible for the entire engine-generator package including the engine-generator set with all accessories and equipment specified herein and all other devices required for a complete and operable system. The engine-generator set manufacturer and/or dealer shall also be responsible for the paralleling switchgear package specified in 26 23 00, Low Voltage Switchgear, in order to provide a complete, coordinated power generation system.

2.02 GENERAL DESCRIPTION

A. Each engine-generator set shall have the capability to operate at its rating for the duration of any power outage with all accessories including engine running devices, silencer, radiator, cooling fans, fuel system, and all appurtenances complete as it would be installed in the field.

2.03 ENGINE

A. The engine shall be diesel, 4 cycle, radiator cooled, and shall be turbocharged having an operating speed of 1800 RPM. Engine shall operate on ASTM D-975 Grade No. 2D S15 ultra-low sulfur diesel fuel. Engines requiring any other fuel type are not acceptable.

B. The engine will not be acceptable if the design is a conversion of a naturally aspirated engine to which a turbo-blower has been attached, unless the engine is certified by the manufacturer as having been analyzed and redesigned with ample provisions for increased stresses and bearing or heat loads due to increased pressures and rate of heat liberation.

C. Brake mean effective pressure (BMEP) shall not exceed 375 psi at rated load. Brake Horsepower (BHP), and engine-generator efficiency shall conform with ASME, IEEE and NEMA standards that electrical energy delivered by the machine is within the minimum certified guaranteed fuel oil consumption rate and evidence that these parameters have been met shall be furnished.

D. Only engine manufacturers' standard ratings shall be acceptable. No dealer special ratings will be acceptable.

E. Engine speeds shall be governed by an electronic isochronous governor that will sense generator speed and provide accurate load transient correction capability at less than 0.5 percent regulation, from no load to full load generator output.

2.04 ALTERNATOR

A. The specified standby kW rating shall be for continuous electrical service during interruption of the normal utility source, per NEMA standards.

B. The alternator shall conform to NEMA and IEEE standards. The alternator shall have a UL 2200 Listing. The alternator shall be brushless, salient pole, 2/3 pole pitch and synchronous.

C. The combination of alternators for all the units to be furnished under this Contract, with the largest unit out of service, shall deliver a combined 6,500 SkVA (minimum) at an instantaneous voltage dip of no more than 20% voltage drop.

D. Laminations and windings shall be designed for minimum reactance, low voltage waveform distortion and maximum efficiency.

E. The main stator coils shall be random wound. Insulation shall be Class F with a temperature rise of no more than 105 degrees C or Class H with a temperature rise of no more than 125 degrees C according to NEMA standards. The insulation system shall be made of epoxies and polyesters which are inorganic compounds and shall prevent fungus growth.

F. The rotor shall be dynamically balanced and include amortisseur windings to minimize voltage deviations and heating effects under unbalanced load conditions.

G. Radio interference suppression (both directions) shall be provided in accordance with NEMA and IEEE Standards.

H. The alternator shall have a brushless, permanent magnet generator (PMG) excitation support system to provide input to the automatic voltage regulator to enable the alternator to support 300% of rated current for 10 seconds to allow fault clearing.

I. Waveform deviation shall not exceed 5% from true sine wave. The transient response from no load to full load in one step of the engine-generator set shall not exceed a voltage dip of 35%, a frequency dip of 20%, and shall recover to complete steady state performance within 12 seconds for both voltage and frequency. The transient response from full load to no load in one step shall not exceed a voltage overshoot of 7% and shall recover to steady state performance within 3 seconds. Transient performance shall be in accordance with ISO 8528.

J. The Telephone Influence Factor (TIF) shall be less than 50.

K. The voltage regulator shall be an adjustable, solid-state, three-phase RMS sensing, volts/hertz type. Voltage regulation shall be a minimum of +/-0.25% from no load to continuous rating. The voltage regulator shall provide +/-10% voltage adjustment. The voltage regulator shall be located within the engine control panel.

L. An alternator mounted strip heater shall be furnished and installed as part of the system. The strip heater shall be energized to prevent condensation when the engine generator set is not running.

2.05 CONTROLS

A. Engine generator monitoring and controls shall be mounted in a single NEMA 1 enclosure. A suitable accessible terminal strip having all wires properly identified shall be furnished within the enclosure.

B. The control panel shall accept a dry contact input for engine starting from remote locations. The starting and stopping of the engine-generator set shall be initiated through the control panel only. When the engine starts, starting control shall automatically disconnect cranking controls. Four (4) cranking cycles of 10 seconds "ON", 10 seconds "OFF" shall be provided. The starting controls shall prevent re-cranking for a definite time after source voltage has been reduced to a low value, or the four (4) cranking cycles have been reached without a successful start. The automatic engine starting controls shall use industrial rated control type elements throughout, and controls shall have the capability to operate at 50% battery voltage.

C. Speed sensing shall be provided to protect against accidental starter engagement with a moving flywheel. Battery charging alternation output voltage is not acceptable for this purpose.

D. A UL 489 Listed generator/exciter field circuit breaker with shunt trip device shall be furnished and installed as part of the engine generator set. Shunt trip shall be activated upon engine-generator fault conditions.

E. Engine generator monitoring and control shall be provided using a microprocessor-based control panel complete with an LCD display. The devices necessary for automatic starting shall be on the engine and in the engine control panel. Control panel shall have integral paralleling and load sharing controls that are not manufacturer proprietary, and are compatible with Woodward controls. Generator output frequency and voltage shall be adjustable through the control panel keypad. The following hardware (minimum) shall be provided on the front of the control panel; the use of the LCD display and keypad to accomplish the same function is not acceptable:

1. Engine control mode switch or pushbuttons (Run-Off-Auto)

2. Large, red emergency stop pushbutton

F. The following parameters (minimum) shall be shown on the LCD display or otherwise be indicated at the control panel:

1. Engine oil pressure
2. Coolant temperature
3. Generator output voltage
4. Generator output current
5. Generator elapsed run time
6. Generator output frequency
7. Engine run
8. Engine fail
9. Low coolant temperature
10. Pre-high engine temperature
11. Pre-low fuel level
12. Engine speed (RPM)

G. The following events (minimum) shall cause an immediate shutdown of the engine-generator set if it is operating or prevent starting if it is not operating. The specific event that causes the shutdown/prevents starting shall be shown on the LCD display or otherwise be indicated at the control panel. A reset shall be required to clear the fault and allow the unit to operate:

1. Engine coolant high temperature
2. Engine low oil pressure
3. Low fuel level
4. Engine overspeed
5. Engine overcrank
6. Engine tried to start but failed
7. Low coolant level

H. The generator control panel shall have a communication port capable of transmitting all available engine-generator set data to the switchgear via either Ethernet/IP or Modbus RTU protocol.

I. The generator control panel shall have Form C dry contacts rated 5A (minimum) at 120VAC/24VDC for the following signals:

1. Engine coolant high temperature
2. Engine low oil pressure
3. Pre-low fuel level
4. Low fuel level
5. Engine overspeed
6. Engine overcrank
7. Engine tried to start but failed
8. Low coolant level
9. Engine fail
10. Engine run

J. The normally closed (NC) contacts for all of the above signals (except engine run and Pre-low fuel level) shall be wired in series to provide a common "Generator System Failure" alarm for remote indication. Other contacts shall also be wired as a part of this alarm as specified elsewhere herein.

2.06 GENERATOR OUTPUT CIRCUIT BREAKER

A. If a manufacturer’s offering includes controls that protect the alternator output and the cables connected to the alternator from short circuits and overloads, a main line generator output circuit breaker is not required. If this protection is not provided by the generator controls, the following shall apply:

1. A main line circuit breaker as specified herein shall be installed with each generator as a load circuit interrupting and protection device in a NEMA 1 (gasketed) dust-tight enclosure. Circuit breaker shall be UL 489 Listed and shall have an interrupting rating that is at least 10% greater than the maximum short circuit current available from the generator. Circuit breaker shall be rated to continuously deliver 100% of the generator output current available. The circuit breaker shall be provided with an adjustable electronic trip unit. The trip unit shall be provided with adjustable long-time, short-time, ground fault, and instantaneous settings. It shall operate both manually for normal operation and automatically for

protection against overload or short circuits. Generator/exciter field circuit breakers are not acceptable for this service.

2.07 ENGINE ACCESSORIES

A. Furnish and install the engine with all accessory equipment and appurtenances which are required for proper operation, including the following:

1. Heavy duty dry type air filter with restriction indicator

2. Heavy duty lubricating oil filter, bypass type, with replaceable absorbent-type elements

3. Lubricating oil cooler, water cooled

4. Heavy duty fuel oil filter, spin-on, with non-replaceable absorbent-type elements

5. Fuel oil fuel/water separator

6. Heavy duty crankcase vapor coalescer

2.08 MOUNTING

A. Couple the engine and generator together through a flexible, non-backlash type, all metal coupling which overcomes all normal misalignment stresses and transmits full engine torque with ample safety factor. Also provide flexible connections for piping connections.

2.09 COOLING SYSTEM

A. Provide a radiator manufactured of a non-corrosive material mounted on the engine. The radiator core shall be coated with a corrosion resistant coating. Corrosion resistant coating shall be a corrosion resistant baked phenolic coating or similar.

B. Connect the radiator to the engine internal cooling system with flexible piping. Furnish appropriately sized coolant expansion tank for the cooling system.

C. The engine shall be cooled through a radiator sized to continuously maintain safe operation at full load and at 105°F outside ambient air with 50% ethylene glycol coolant. A blower type fan and low noise fan drive and controls shall be furnished. The fan and all rotating members and drive belts shall be guarded and meet OSHA standards. Proof of 105°F ambient temperature capability shall be required.

D. Coolant

1. After the cooling system is flushed and cleaned, provide an initial fill of coolant consisting of 50% ethylene glycol. An anti-corrosion treatment shall be added during the initial fill.

2. The coolant shall meet the requirements of the generator manufacturer including corrosion inhibitors provided in the coolant to protect the engine cooling system.

E. The engine shall be equipped with coolant heaters. Heaters shall be in accordance with the following:

1. Unit mounted thermal circulation type coolant heater with coolant recirculation pump shall be furnished to maintain engine jacket coolant temperature as recommended by manufacturer in an ambient temperature of minus 20°F. The heater shall be thermostatically controlled and supplied from the onboard accessory power supply.

2. The heater shall be of sufficient capacity to keep the coolant at a suitable temperature for trouble-free starting.

3. Each heater shall be provided with a suitable contactor to automatically disconnect the heater when the engine is started.

2.10 ENGINE STARTING AND CHARGING SYSTEM

A. Each engine-generator set shall be provided with its own dedicated bank of engine starting batteries. Use of a shared battery bank is not permitted.

B. Engine starting batteries shall be sealed, lead-acid type, rated 12 volts, wired for 12V or 24V starting. Starting batteries shall have adequate capacity for rolling the engine for five (5), ten (10) second cycles without starting, and then operating the control devices in the local generator controls. The batteries shall be mounted on a suitable non-corrosive rack. Batteries shall have battery cables with lugs and shall be provided with lugs for connection to the battery charger.

C. Battery charger shall be a U.L. 1236 Listed, automatic, solid-state battery charger, 10 A (min.) current limited output, ±2% voltage regulation, ±10% line voltage variation, automatic float equalizing system, DC voltmeter, and DC ammeter. Provide a Form C unpowered (dry) contact to indicate a low battery alarm condition.

D. In addition, the engine shall be provided with an engine battery charging alternator that automatically charges the starting batteries during engine operation.

2.11 EXHAUST SILENCER

A. Furnish and install an exhaust silencer. Silencers shall be of critical type and sized to produce a high degree of silencing. Reference the sound attenuation requirements specified herein.

B. Silencer shall be mounted within or exterior to the generator enclosure dependent on generator size and manufacturers standards. Silencers mounted on the outside of the enclosure shall be 316 stainless steel construction on its interior and exterior. Silencers

mounted within the generator enclosure shall be painted steel and insulated using a calcium silicate material covered by a brushed aluminum skin.

C. Connect the silencer to the engine exhaust manifold with a high corrosion and temperature resistant stainless steel flexible convoluted exhaust pipe. Use flange-type connections. Provide a taper-cut tail pipe complete with rain cap to exhaust the gases to the atmosphere. The silencer system shall be designed, furnished, and installed to prevent moisture and condensation from corroding the silencer. All exterior components of the exhaust system shall be made of 316 stainless steel.

D. The silencer (if installed inside), exhaust piping, and expansion fittings, including collector box, shall be completely covered with a removable insulation blanket in order to protect operating personnel and to reduce noise. Insulation shall be of composite fiberglass and stainless steel construction capable of withstanding 1200°F continuously. The insulation blankets shall be tailored and custom fabricated to fit the contours of the manifolds. Average weight of the insulating blanket shall be 1.5 psf. Insulation shall conform to MIL-1-16411D, Type II and shall be custom fabricated to fit the contours of the components.

2.12 WIRING

A. Furnish and install internal wiring in the engine-generator set. All internal wiring between the generator and engine-generator control panel, the on-board power source and all accessories shall be provided.

2.13 FUEL TANKS

A. Total on-site fuel storage capacity shall be provided to operate all of the engine-generator sets at full load for no less than 48 hours. This shall be accomplished through a base mounted fuel tank(s) or a combination of base mounted fuel tank(s) and bulk fuel storage tank as specified herein.

B. Base Mounted Fuel Tank

1. The generator set shall be supplied with a U.L.-142 listed base mounted fuel tank of sufficient capacity to operate the engine-generator set at full load for a minimum of 24 hours. The tank, painted in a color as selected by the Commission, shall be fabricated from steel with a rupture basin and leak detection system. The alarm and indicator for the leak detection shall be mounted adjacent to the generator control panel and a contact for remote indication of a fuel leak condition shall be provided. This contact shall be wired as part of a common "Generator System Failure" alarm.

2. A level device shall also be furnished and installed to provide a local (generator control panel) and remote indication of pre-low fuel tank level and low fuel tank level. The pre-low fuel tank level shall activate a set of dry contacts for remote alarm indication. The low fuel tank level alarm shall shut down the engine to

prevent the fuel level from dropping below the fuel pickup piping in the fuel tank. The pre-low fuel level alarm shall activate when only 6 hours of fuel for full load operation remains in the fuel tank. The remote low fuel tank level alarm shall be wired separate from the "Generator System Failure" alarm. A separate level device shall be furnished and installed to provide an analog remote indication of the fuel level in the tank.

3. The tank shall be supplied with all necessary fuel supply, return, vent, and fill fittings and a fuel level gauge. The lockable fill port and level gauge shall be easily accessible from inside the enclosure. Provide a valve that automatically closes the fuel fill inlet when the tank level reaches 95% of its capacity. The vent line shall be piped to the outside and be equipped with a fill whistle. Four (4) spare 2-inch (minimum) ports shall be provided on top of the tank for future use, two (2) on each long side of the generator.

4. Fuel tank shall be equipped with necessary hardware and penetrations to interface with the fuel polishing system specified herein.

5. If the base mounted fuel tank does not provide the required total fuel storage capacity, the base mounted tank shall be provided with a duplex pumping system that refills the tank automatically from the bulk fuel storage tank. The tank refill system shall be configured to begin filling the base mounted tank back up when only 16 hours of fuel remain. The capacity of the duplex pumping system shall be such that the based mounted tank can be refilled to full capacity within 4 hours while the associated engine-generator is operating. Furnish and install all controls, level devices, valves, and other appurtenances necessary for successful operation. Provide a fuel return pump to return any excess fuel from the base mounted tank to the bulk fuel storage tank. Fuel pumping system shall be supplied by the onboard accessory power supply specified herein.

C. Bulk Fuel Storage Tank

1. If the base mounted fuel tanks do not provide the required total fuel storage capacity, furnish and install a single bulk fuel storage tank to provide the remaining on-site fuel storage. Furnish and install all tankage, pumping, piping, and appurtenances as required and as specified herein and as required by Section 23 13 01 – Supplementary Fuel Systems.

2.14 WEATHERPROOF ENGINE - GENERATOR ENCLOSURE

A. Furnish and install an outdoor, weather-protective housing. Individual housings may be provided or each generator, or a common housing may be provided for all of the generators to be furnished under this Contract. In addition, if a common generator housing is provided, this same housing may be used to enclose the switchgear assembly that is specified under Section 26 23 00, provided that the switchgear assembly is installed in a separate room within the housing.

B. The housing shall be furnished complete with a full sub-base floor resulting in complete enclosure. The enclosure shall be factory-assembled to the engine-generator set base and radiator cowling. Lifting eyes shall be provided. Housing shall provide ample airflow for generator set operation. The housing shall be constructed of 12-gauge (minimum) aluminum or 14 gauge (minimum) galvanized steel, reinforced to be vibration free in the operating mode. The housing shall have hinged personnel access doors. Each door shall have at least two latch-bearing points. All doors shall be lockable. All steel sheet metal shall be primed for corrosion protection and finish painted in a color as selected by the Commission. Roof shall be peaked to allow drainage of rain water. Unit shall have sufficient guards to prevent entrance by small animals. Batteries shall fit inside enclosure and alongside the engine (batteries under the generator are not acceptable). Unit shall have engine coolant and oil drains piped to outside the unit to facilitate maintenance. Each drain line shall have a valve located near the fluid source.

C. Provide walk-around access within the enclosure. Access shall be two feet (minimum) measured from the outermost engine generator component or four feet from the rails, whichever is greater. Interior height from the sub-base floor to the ceiling shall be 84" minimum. Doors shall have panic hardware and height shall be 72", minimum. "Skin-tight", "reach in", or "Drop-over" housings are not acceptable.

D. Enclosure shall be sound attenuated to provide sound level as specified herein.

E. Each enclosure shall be furnished with a panelboard. This unit shall serve as the onboard accessory power supply for all accessories specified herein or required. Panelboard shall be provided with an equipment enclosure suitable for the environment in which it is installed and shall be provided with a local disconnecting means. The enclosure manufacturer shall furnish and install conduit and wire necessary to provide the power from the unit to all accessories within enclosures. A spare 2-pole 20A circuit breaker in the nearby existing switchgear building within panel EM-WP-1 (120/240V single phase) shall be replaced by the Materialman with a larger circuit breaker to serve the onboard accessory power panelboards via a Materialman furnished distribution panelboard. Panel EM-WP-1 is a 150A Eaton PRL1 panelboard.

F. All hardware (nuts, bolts, screws, washers, etc.) that is installed on the exterior of the generator enclosure shall be stainless steel. Galvanized steel hardware is not acceptable.

G. Aluminum stairs or an aluminum platform, both complete with an aluminum handrail shall be furnished at each door. The Materialman shall extend the generator concrete pad as necessary to accommodate the installation of the aluminum stairs.

H. Linear LED lighting shall be provided in sufficient quantity to maintain 20 foot-candles of illumination at floor level and shall be suitable for operation in cold weather. Compact fluorescent lighting fixtures are not acceptable. Interior lighting shall be controlled by 3-way light switches located at each personnel door.

I. DC emergency lighting shall be provided within the enclosure, powered by the engine starting batteries. Emergency lighting shall illuminate if the accessory power supply for the enclosure detects a loss in its power supply.

J. Convenience receptacles shall be furnished at each personnel door within the enclosure. Receptacles shall be 125V, 20A, UL 943 Listed, GFCI, two-pole, three wire grounded type.

K. Conduit installed within the enclosure shall be EMT meeting the requirements specified within the RFP. Wire installed within the enclosure shall meet the requirements specified within the RFP.

L. All air intake louvers shall be furnished with rain guards or designed to eliminate water intrusion to the interior of the enclosure when the generator is operating at full load (maximum airflow) during rain events.

2.15 SOUND ATTENUATION

A. Extreme care shall be exercised in providing equipment for and setting the engine-generator in place to guard against excessive noise transmission and vibrations. Fasten to the underside of the skids seismically-rated spring type isolators.

B. The engine-generator enclosure shall be designed, furnished, and installed to reduce source noise to 85 dB(A) as measured at seven (7) meters from the enclosure.

2.16 FUEL POLISHING SYSTEM

A. A fuel polishing system shall be provided at an easily accessible location within each engine-generator set enclosure to filter particles and water from the fuel. The fuel polishing system shall filter at a rate that allows the entire base mounted tank to be polished within 36 hours. Polishing system shall be supplied from the onboard accessory power system specified herein.

B. If a bulk fuel storage tank is provided to meet the requirements specified herein, a fuel polishing system shall be provided for the bulk fuel storage tank as well. The fuel polishing system shall filter at a rate that allows the entire bulk fuel storage tank to be polished within 36 hours. Polishing system shall be supplied from the one of the onboard accessory power systems specified herein.

C. The fuel polishing system(s) shall have easily replaceable filter elements and have a valve and connection point for a hose to transfer fuel from the base mounted tank to another container. The filtration system shall consist of no less than five (5) stages.

D. The fuel polishing system(s) shall be provided with an integral controller that controls the operation of the system. The controller shall operate from the same power supply used for the pump. The controller shall be UL Listed and shall be comprised of a programmable logic controller (PLC), touch screen interface, motor starter, terminal

blocks, and all required circuit protective devices. The controller shall be provided in a NEMA 3R enclosure with integral thermostatically controlled strip heater. The controller shall allow the duration and frequency of fuel polishing activity to be set. The controller shall have a normally open dry contact output to indicate general alarm status. The following parameters shall be monitored by the controller:

1. Motor overload
2. Low flow
3. System pressure
4. Water level
5. Replacement needed for each filtration stage
6. Strainer vacuum

E. All required pipe connections, valves, piping, and other plumbing appurtenances shall be furnished as required for a complete and operable system. Install the fuel polishing system(s) in accordance with all manufacturer's instructions and shall locate it within each enclosure to not limit access to regular maintenance activities such as filter replacement and fluid changes.

2.17 EMMISSIONS REDUCTION SYSTEM (ALTERNATE BID ONLY)

A. Provide all equipment required to achieve EPA Tier IV Certified emissions. Any pumps, heaters or other accessories required for the emissions controls system shall be powered directly from the output of the generator. Connecting these items to the onboard accessory power unit within the enclosure is not acceptable, nor is requiring an additional electrical source that is furnished by others.

B. The diesel exhaust fluid tank for each engine-generator set shall be sized to provide no less than 48 hours of run time at the generator full load.

PART 3 – EXECUTION

3.01 INSTALLATION

A. The generator system shall be furnished and installed as indicated herein and as recommended by the equipment manufacturer.

B. The initial filling of the fuel storage tank(s) shall be provided by the Materialman. Fuel tank(s) shall be filled to full capacity. At the conclusion of all field testing, the Materialman shall fill the fuel storage tank(s) back to full capacity. Fuel shall be ultra-low sulfur diesel Grade No. 2D S15 in accordance with ASTM D-975. Fuel shall be new and free from contaminants and water.

C. The initial filling of the diesel exhaust fluid storage tank(s) (alternate bid only) shall be provided by the Materialman. At the conclusion of all field testing, the Materialman shall fill the storage tank(s) back to full capacity.

3.02 SERVICES OF MANUFACTURER'S REPRESENTATIVE

A. The Materialman shall provide the services of a qualified generator manufacturer's factory-trained technical representative who shall adequately supervise the installation and testing of all equipment furnished under this Contract. The manufacturer's representative shall certify in writing that the equipment has been installed in accordance with the manufacturer's recommendations. No further testing or equipment startup may take place until this certification is accepted by the Commission.

B. The manufacturer’s technical representative shall perform all startup and field testing of the generator assembly as specified herein.

C. The Materialman shall provide training for the Commission’s personnel. Training shall be conducted by the manufacturer's factory-trained representative who shall instruct Commission’s personnel in operation and maintenance of all equipment provided under this Section. Training shall be provided for two (2) sessions of four (4) hours each. Training shall not take place until after the generator has been installed and tested. Training shall be conducted at times coordinated with the Commission and shall occur during the same week as the training specified in Section 26 23 00 – Low Voltage Switchgear.

D. The services of the manufacturer's representative shall be provided for a period of not less than as follows:

1. One (1) trip of five (5) working days during installation of the engine-generator sets.

2. One (1) trip of two (2) working days to perform startup of the engine-generator sets.

3. One (1) trip of five (5) working days to perform the field testing of the engine-generator sets.

4. One (1) trip of one (1) working day to perform training as specified herein.

5. One (1) trip of one (1) working day two (2) months before the warranty expiration to identify issues to be corrected under warranty. Any additional time required to achieve successful installation and operation shall be at the expense of the Materialman.

3.03 TESTING

A. All tests shall be performed in accordance with the requirements of the RFP. The following tests are required:

1. Witnessed Shop Tests

    a. None required.

2. Certified Shop Tests

    a. Fully test the engine-generator set with all accessories in the manufacturer's plant before shipment.

    b. Record complete test data for frequency, amperes, volts, power factor, exhaust temperature, coolant temperature, and oil pressure.

    c. Generator load tests shall be conducted through the use of balanced, three-phase, dry-type, reactive (0.8 power factor) load banks. Conduct a continuous run test using the load bank without shutdown for the engine-generator set under the following load conditions (in this specific order):

        1) 1 hour - full load

        2) 1 hour - 3/4 load

        3) 1 hour - 1/2 load

        4) 1 hour - 1/4 load

    d. Fuel, lubricants, and other fluids as required for the shop tests shall be furnished by the manufacturer.

3. Field Tests

    a. Field tests shall be performed by the generator manufacturer’s technical representative. The Materialman shall obtain from the manufacturer and submit a detailed field test plan and procedures documenting the intended field test program.

    b. In the presence of the Commission, the representative shall inspect, adjust, and test the entire system after installation and leave in good working order. Field tests specific to each generator shall be conducted after the entire engine-generator system is installed including, but not limited to, the following: diesel fuel tanks including leak detection, exhaust silencer, radiators, enclosures, batteries, and all other equipment included in the complete system.

    c. Field test the generator enclosure to ensure the enclosure performs as specified herein. The generator enclosure field tests shall include water tests

to confirm the enclosure does not leak and that the air intake louvers eliminate water intrusion to the interior of the generator enclosure when the generator is operating at its full load capacity (maximum airflow). A garden hose shall be used to simulate falling rain for this test. Water supply and garden hose will be provided by the Commission for this test.

d. Field test, as far as practicable, all control, shutdown, and alarm circuits. Document the successful completion of these tests as witnessed by the Commission.

e. Generator load tests shall be conducted through the use of balanced, three-phase, dry-type, resistive (1.0 power factor) load banks. Conduct a continuous run test using the load bank without shutdown for each engine-generator set under the following load conditions (in this specific order) and in the presence of the Commission:

   1) 2 hours, full load

   2) 1 hour, 3/4 load

   3) 1 hour, 1/2 load

   4) 1 hour, 1/4 load

f. Record complete test data for frequency, amperes, volts, power factor, exhaust temperature, coolant temperature, and oil pressure every 15 minutes during the continuous run test. If any failures, malfunctions, and/or shutdowns occur during this test, the problems shall be fixed and the test shall be restarted. The test shall not be considered complete until the generator has operated without any shutdowns for the required consecutive hours under the conditions listed above.

g. After successful completion of the load bank tests, the generator system (all units operating together) shall then be operated for a minimum of four (4) hours with facility loads during a time period when the plant is operating at average demand. The same data shall be recorded at 15-minute intervals for this load test as for the load bank test.

h. After the completion of the switchgear/transfer controls startup (see Section 26 23 00 – Low Voltage Switchgear) and the load tests listed above, the generator and switchgear automatic transfer controls shall be tested as an overall system in the presence of the Commission. Utility service outages shall be simulated to allow automatic controls to perform the transfers, transfers shall not be manually initiated. As a minimum, the generator and switchgear automatic transfer tests shall be performed as follows:

1) Three (3) closed transition transfers from the utility service to the generator and then back to the utility service at 2000kW of load.

2) Three (3) closed transition transfers from the utility service to the generator and then back to the utility service under the then current plant operating load.

i. It is the intent that the tests above take place utilizing facility loads. If the system cannot be fully loaded as required by the facility loads, the manufacturer shall connect a resistive load bank to a spare circuit breaker in the switchgear as needed to test the system under the loads described above. If any failures, malfunctions, and/or shutdowns occur during any of the transfer tests listed above, the problems shall be fixed and the test shall be restarted. Each test shall not be considered complete until the generator/switchgear system has performed the required number of transfers consecutively without any failures or malfunctions. During the transfer testing above, the loads shall remain on the utility or generator source for at least five (5) minutes in between transfers.

j. Demonstrate the system will transfer properly with one (1) of the generators locked out (and thus prevented from operating).

k. All fuel, lubricants, and other fluids required to complete all field tests shall be paid for by the Materialman.

4. Oil Sampling and Analysis

a. The Materialman shall collect a sample of engine oil from each engine for analysis after the start-up and testing has been successfully completed. The oil samples shall be analyzed at an independent laboratory that is not a part of the engine supplier's facility. Immediate notification of results shall be provided to the Commission when the analysis shows any critical reading.

b. The sampling method shall be of the atomic absorption spectrophotometry method and be accurate to within a fraction of one part per million for the following elements:

1) Iron

2) Chromium

3) Copper

4) Aluminum

5) Silicon

6) Lead

c. The sample shall also be tested for the presence of water, fuel dilution, and coolant.

3.04 FIELD ADJUSTMENTS

A. The circuit breaker trip units shall be set in the field by a qualified representative of the Materialman, or an outside testing company retained by the Materialman.

3.05 PAINTING

A. Prior to final completion of the work, all metal surfaces of the equipment shall be cleaned thoroughly, and all scratches and abrasions shall be retouched with the same coating as used for factory finishing coats.

END OF SECTION