SECTION 08 00 10
DOORS AND WINDOWS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Flush Steel Doors

B. Steel frames

C. Door Hardware

D. Vinyl Windows

1.2 RELATED REQUIREMENTS

A. Section 06100 - Rough Carpentry

B. Section 09 91 00 - Painting

1.3 REFERENCES

A. ANSI/NFPA 80 - Standard for Fire Doors and Windows.

B. ANSI/DHI A 115.IG - Installation Guide for Doors and Hardware.

C. ANSI/BHMA A 156 - Specifications for Hardware Preparations in Standard Steel Doors and Frames.

D. ANSI/BHMA A156.7 - Hinge Template Dimensions.

E. ANSI A 250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcing.

F. ANSI/SDI A 250.8 - SDI-100 Recommended Specifications for Standard Steel Doors and Frames.

G. ANSI A 250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.

H. ANSI A 250.11 - Recommended Erection Instructions for Steel Frames.

I. ASTM A 366/A 366M - Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality.

J. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

K. ASTM A 924 - Specification for General Requirements for Steel Sheet, Metallic Coated by the Hot Dip Process.

L. ASTM A 1008/1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

M. ASTM E 90 - Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.

N. ASTM E 152 - Standard Methods of Fire Tests of Door Assemblies.

O. ASTM E 413 - Classification for Rating Sound Insulation.

P. SDI-111 - Recommended Standard Details for Steel Doors & Frames.

Q. NAAMM/HHMA-820 TN01 - Grouting Hollow Metal Frames

R. NAAMM/HHMA-820 TN03 - Guidelines for Glazing of Hollow Metal Transom, Sidelight and Windows

S. NAAMM/HMMA-840 - Guide Specification for Installation and Storage of Hollow Metal Doors and Frames.

T. ANSI/UL 10C - Standard for Safety for Positive Pressure Fire Tests of Door Assemblies.

U. NFPA 252 - Standard Method of Fire Tests of Door Assemblies.

V. Federal Emergency Management Agency (FEMA) 361 Guidelines.

W. UL - Building Materials Directory; Underwriters Laboratories Inc.

X. ANSI A117.1 - American National Standard for Accessible and Useable Buildings and Facilities.

Y. ANSI A156.2 - American National Standard for Bored and Preassembled Locks & Latches

Z. ANSI A156.3 - American National Standard for Exit Devices

AA. ANSI A156.4 - American National Standard for Door Controls - Closers.

BB. ANSI A156.5 - American National Standard for Auxiliary Locks and Associated Products.

CC. ANSI A156.13 - American National Standard for Mortise Locks and Latches Series 1000.

DD. AAMA/NWWDA 101/I.S. 2 - Voluntary Standard for Aluminum and Poly (Vinyl Chloride) (PVC) Prime Windows and Glass Doors. Maintain one copy of each document on site.

EE. National Fenestration Rating Council (NFRC).

FF. ASTM E 1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials

GG. ASTM E 1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.

HH. IGCC – Classification of Insulating Glass Units; Insulated Glass Certification Council.

II. U.S. Department of Energy – Energy Star Windows Program.

1.4 SUBMITTALS

A. Product Data: Manufacturer's standard details and catalog data indicating compliance with referenced standards for doors, frames, hardware, windows, and al other items specified.

B. Certificates:

1. Manufacturer's certification that products comply with referenced standards.

2. Evidence of manufacturer's membership in the Steel Door Institute.

C. Shop Drawings: Door, frame, and hardware schedule. Show types, quantities, dimensions, specified performance, and design criteria, materials and similar data for each opening required.

1. Indicate frame configuration, anchor types and spacing, location of cutouts for hardware, reinforcement, to ensure doors and frames are properly prepared and coordinated to receive hardware.

2. Indicate door elevations, internal reinforcement, closure method, and cutouts for glass lights and louvers.

3. Details of glazing.

4. Complete schedules of hardware.

1.5 QUALITY ASSURANCE

A. Supplier: Qualifications: Company specializing in furnishing the products specified for projects of similar size and scope.

B. Installer Qualifications: Company specializing in installation of the products specified for projects of similar size and scope with minimum five years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handle, store and protect products in accordance with the manufacturers printed instructions and ANSI/SDI A250.10 and NAAMM/HMMA 840.

B. Store doors vertically in a dry area, under a proper vented cover. Place on 4 inch (102 mm) high wood sills to prevent rust or damage. Provide 1/4-inch (6 mm) space between doors to promote air circulation.

C. Store frames in an upright position with heads uppermost under cover. Place on 4 inch (102 mm) high wood sills to prevent rust and damage. Store assembled frames five units maximum in a stack with 2 inch (51 mm) space between frames to promote air circulation.

D. Do not use non-vented plastic or canvas shelters to prevent rust or damage.

E. Should wrappers become wet, remove immediately.

1.07 COORDINATION

A. Coordinate Work with other directly affected sections involving manufacture or fabrication of internal cutouts and reinforcement for door hardware, electric devices and recessed items.

B. Coordinate Work with frame opening construction, door and hardware installation.

C. Sequence installation to accommodate required door hardware.

D. Verify field dimensions for factory assembled frames prior to fabrication.

PART 2 – PRODUCTS

2.1 GENERAL

A. Provide steel doors, frames, hollow metal windows, door hardware, and vinyl windows of the size, type, and finish as indicated on the Drawings.

2.2 DOORS AND FRAMES

A. General: Construct doors, frames, and hollow metal window frames to the following designs and gages:

1. Doors: Zinc-Iron Alloy-Coated Galvannealed steel, ASTM A 653, Class A60:

   a. Thickness: 16 gage (1.3 mm).

   b. Include Galvannealed components and internal reinforcements with Galvannealed doors.

   c. Close and seal tops of doors to eliminate moisture penetration. Galvannealed steel top caps are permitted.

2. Finish: Clean, phosphatize and factory prime all doors. Finish coat in accordance with the Drawings and Specifications.

3. Hardware Reinforcements:

   a. Hinge reinforcements for full mortise hinges: minimum 7 gage (4.7 mm).

   b. Lock reinforcements: minimum 16 gage (1.3 mm).

   c. Closer reinforcements: minimum 14 gage (1.7 mm) steel, 20-inch (508 mm) long.

   d. Galvannealed doors: include Galvannealed hardware reinforcements.

   e. Projection welded hinge and lock reinforcements to the edge of the door.

   f. Provided adequate reinforcements for other hardware as required.

2.3 DOOR AND FRAME ACCESSORIES

A. Anchors: Manufacturer's standard framing anchors, specified in manufacturer's printed installation instructions for project conditions.

A. Door Bottom: In accordance with Door Schedule on Drawings.

B. Re-Light: Where indicated in Door Schedule on Drawings provide two panes of laminated safety glass in a steel frame finished to match door.

2.4 DOOR AND FRAME FABRICATION

A. Factory-welded frames: Head and jamb intersecting corners mitered at 45 degrees, with back welded joints ground smooth.

1. Continuous face weld the joint between the head and jamb faces along their length either internally or externally. Grind, prime paint, and finish smooth face joints with no visible face seams.

2. Externally weld, grind, prime paint, and finish smooth face joints at meeting mullions or between mullions and other frame members per a current copy of ANSI/SDI A250.8.

3. Provide temporary steel spreaders (welded to the jambs at each rabbet of door openings) on welded frames during shipment. Remove temporary steel spreaders prior to installation of the frame.

B. Provide cutouts and reinforcements required for electrical and security components specified elsewhere in this specification.

2.5 DOOR AND FRAME FINISHES

A. Chemical Treatment: Treat steel surfaces to promote paint adhesion.

B. Factory Prime Finish: Meet requirements of ANSI A 250.10.

C. Finish painting in accordance with the Drawings and Specifications.

2.6 DOOR HARWARE

A. Provide all door hardware in accordance with the Door Hardware schedules shown on the Drawings.

2.7 HOLLOW METAL WINDOWS

A. Provide hollow metal window frames equivalent to door frames.

B. Provide two panes of laminated safety glass with stops sealed to frame.

C. Finish paint equivalent to door frames.

2.8 VINYL WINDOWS

A. Acceptable Manufacturer: Cascade Windows, Alpine Windows, or approved equal.

B. Single Hung Windows:

1. Rating: Minimum DP35.

2. Glazing: ST Energy Star (Clear-Argon-Low E-HP Spacer)

1) U Factor: 0.30.

2) SHGC: 0.29.

3) VLT: 0.55.

3. Grid: Flat.

4. Color: White.

5. Operator Type: Slider.

6. Screen: Furnish with factory bug screen.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that project conditions are acceptable before beginning installation of frames. Verify that completed openings to receive knock-down wrap-around frames are of correct size and thickness.

B. Do not begin installation until conditions have been properly prepared.

C. Correct unacceptable conditions before proceeding with installation.

3.2 INSTALLATION

A. Install doors and frames in accordance with manufacturer's printed installation instructions and with Steel Door Institute's recommended erection instructions for steel frames ANSI A250.11 and NAAMM/HMMA 840.

B. Remove temporary steel spreaders prior to installation of frames.

C. Set frames accurately in position; plumb, align and brace until permanent anchors are set. After wall construction is complete, remove temporary wood spreaders.

1. Field splice only at approved locations indicated on the shop drawings.

2. Weld, grind, and finish as required to conceal evidence of splicing on exposed faces.

D. Glaze and seal exterior transom, sidelight and window frames in accordance with HMMA-820 TN03.

E. Apply hardware in accordance with hardware manufacturers' instructions and Section 08710 – Door Hardware. Install hardware with only factory-provided fasteners. Install silencers. Adjust door installation to provide uniform clearance at head and jambs, to achieve maximum operational effectiveness and appearance.

3.3 ADJUST AND CLEAN

A. Adjust doors for proper operation, free from binding or other defects.

B. Clean and restore soiled surfaces. Remove scraps and debris and leave site in a clean condition.

C. Finish Coat Touch-Up: Immediately after erection, sand smooth rusted or damaged areas of finish coat and apply coating to match.

3.4 PROTECTION

A. Protect installed products and finished surfaces from damage during construction.

END OF SECTION

SECTION 09 91 00

PAINTING

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Surface preparation, priming, and painting of interior and exterior building surfaces.

B. Applies to both shop fabrication and field construction.

1.2 RELATED REQUIREMENTS

A. Section 08 00 10 - Doors and Windows

B. Section 23 05 00 - Common Work Results for Mechanical

1.3 DELIVERY, HANDLING, AND STORAGE

A. All materials shall be new and be delivered to the project site in unopened containers. Paints shall be stored in a suitable protected area that is heated or cooled as required to maintain temperatures within the range recommended by the paint manufacturer.

B. Paint containers shall bear labels that plainly show the following:

1. Name or title of material.
2. Federal Specification number, if applicable.
3. Manufacturer’s name.
4. Manufacturer’s stock number and date of manufacture.
5. Color name and number.
6. Contents by volume, for major pigment and vehicle constituents.
7. Thinning instructions.
8. Application instructions.

1.4 SUBMITTALS

A. Submit Technical Data Sheets for each type of paint specified and associated thinner. Include specific color for each product.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Epoxy: Self-priming, two-part epoxy, minimum 80% solids, low VOC compliant. PPG Amerloc 2 VOC or approved equal. Custom tint to ANSI 61 gray.

B. Cold Galvanizing: Cold application, single product galvanic coating, minimum 95% dry film solids, low VOC compliant. ZRC or approved equal.

PART 3 – EXECUTION

3.1 GENERAL

A. All materials of a paint system, including primer and finish coats, shall be produced by the same paint manufacturer. Thinners, cleaners, driers, and other additives shall be as recommended by the paint manufacturer of the particular coating.

B. Paint all exposed surfaces, whether or not designated in "Schedules", except where the natural finish of the material is specifically noted as a surface not to be painted. Where items or surfaces are not specifically mentioned, paint these the same as adjacent or similar materials or areas, or as directed by the Authority. If color or finish is not designated, Contractor shall notify the Authority of these items. Authority will select the color or finish from standard colors available for the materials systems specified.

3.2 EXAMINATION

A. It is the intent of these Specifications that Contractors and their subcontractors employed on the jobsite will leave the surfaces of their work in such a condition that only minor cleaning, sanding, and filling is required prior to surface preparation and painting. It is the responsibility of the Contractor to inspect and provide substrate surfaces that are prepared in accordance with these Specifications and the printed directions and recommendations of the paint manufacturer whose product is to be applied.

3.3 PROTECTION OF MATERIALS NOT TO BE PAINTED

A. Remove, mask, or otherwise protect factory finished surfaces, hardware, plumbing fixtures and other surfaces not intended to be painted. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process. Openings in motors shall be masked to prevent paint and other materials from entering the motors.

3.4 ENVIRONMENTAL CONDITIONS

A. Apply paint only when the temperature of surfaces to be painted and the surrounding air temperatures are the manufacturer's recommended maximum and minimum allowable range.

B. Do not apply paint in heavy dust or smoke laden atmosphere.

C. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or to damp or wet surfaces.

D. Painting may be continued during inclement weather, only if the areas and surfaces to be painted are enclosed and heated within the temperature and humidity limits specified by the paint manufacturer during application and drying periods.

E. Do not apply paint materials when temperature and humidity conditions can reasonably be predicted to change from manufacturer's application limitations prior to the elapse of adequate drying time.

3.5 SAFETY

A. Painting shall be performed in strict accordance with the safety recommendations of the paint manufacturer; with the safety recommendations of the National Association of Corrosion Engineers contained in the publication, Manual for Painter Safety; federal, state, and local agencies having jurisdiction.

3.6 PAINT MIXING

A. Multiple-component coatings that have been mixed shall not be used beyond their pot life. Only the components specified and furnished by the paint manufacturer shall be mixed. No intermixing of additional components for reasons of color or otherwise, even within the same generic type of coating, will be permitted.

B. Paint materials shall be kept sealed when not in use.

3.7 LOCATION WHERE PAINTING IS PERFORMED

A. Surface preparation and painting shall be done at the project site, or in the shop fabrication facility.

3.8 PREPARATION OF SURFACES

A. General:

1. Perform preparation and cleaning procedures in strict accordance with the paint manufacturer's instructions and as herein specified for each particular substrate condition.

2. Remove all hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish painted; or provide surface-applied protection prior to surface preparation and painting operations. Remove, if necessary for the complete painting of the items and adjacent surfaces. Following completion of painting of each space or area, reinstall the removed items by workmen skilled in the trades involved.

3. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program the cleaning and painting so that contaminants from the cleaning process will not fall onto wet, newly-painted surfaces.

B. Preparation of Structural Steel Surfaces and Doors:

1. Minimum surface preparation shall be Commercial Blast Cleaned per SSPC-SP6. Remove all oil and grease in accordance with the Solvent Cleaning requirements outlined in this section.

2. Coating Time: Coat any bare steel within 8 hours or before flash rusting occurs.

3. Sharp edges, surface defects, or protrusions shall be ground flat and smooth. Any welded areas shall be sanded before painting.

C. Preparation of Existing Coated Surfaces:

1. Existing coated or primed surfaces to be repainted or final coated shall be solvent cleaned and freshwater rinsed. Loose, abraded, or damaged coatings shall be cleaned to substrate by Hand or Power Tool, SSPC-SP2 or SSPC-SP3. Surrounding intact coating shall be feathered. One spot coat of the specified primer shall be applied to bare areas overlapping the prepared existing coating. One full finish coat of the specified primer or finish coat(s) shall be applied overall. If an aged, plural-component material is to be top coated, contact the coating manufacturer concerned for additional surface preparation requirements.

2. In the case of an application of a cosmetic coat the exact nature of the existing coatings is not known in all cases; and, while it is assumed that they have oxidized sufficiently to prevent lifting or peeling when over coated with the paints specified, the compatibility shall be checked by application to a small area prior to starting the painting. If lifting or other problems occur, request disposition from the Authority.

D. Solvent Cleaning: Solvent cleaning shall consist of removal of foreign matter such as oil, grease, soil, drawing and cutting compounds, and any other surface contaminants by the use of solvents, emulsions, cleaning compounds, steam cleaning, or similar materials and methods which involve a solvent or cleaning action. This method conforms with SSPC-SP1. For primed or previously painted surfaces the solvent shall be compatible with the existing coating.

3.9 APPLICATION OF PAINT

A. General:

1. Manufacturer's written instructions for applying each type of paint or protective coating shall be furnished to the Authority prior to application. Cleaned surfaces and all coats shall be inspected prior to the succeeding coat. Schedule such inspection with the Authority in advance. Apply all coatings in strict accordance with the paint manufacturer's recommendations, as reviewed by the Authority. Sufficient time shall be allowed between coats to assure thorough drying of previously applied paint.

2. Apply additional coats when undercoats, stains, or other conditions show through the final coat of paint until the paint film is of uniform finish, color, and appearance. Give special attention to ensure that all surfaces including edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

B. Application:

1. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only before final installation of equipment.

2. Finish exterior doors and frames, on tops, bottoms, and side edges, the same as the exterior faces, unless otherwise indicated.

3. Sand lightly between each succeeding coat.

4. Spray finish metal doors and frames and similar surfaces to achieve finishes that are completely void of brush stroke tracks and marks.

5. Units to be bolted together and to structures shall be painted and paint shall be fully cured prior to assembly or installation.

C. Film Thickness:

1. Coverage is listed as total minimum dry film thickness in mils (DFT). The number of coats is the minimum required irrespective of the coating thickness. Additional coats may be required to obtain the minimum required paint thickness, depending on method of application, differences in manufacturers, products, and atmospheric conditions. Maximum film build per coat shall not exceed the coating manufacturer's recommendations.

2. All surfaces shall be visually inspected to ensure proper and complete coverage has been attained.

3. Particular attention shall be given edges, angles, flanges, etc. Where insufficient film thicknesses are likely to be present, ensure proper millage in these areas.

D. Damaged Coatings:

1. Damaged coatings, pinholes, and holidays shall have the edges feathered and repaired in accordance with the recommendations of the paint manufacturer, as reviewed by the Authority.

2. All finish coats, including touch-up and damage-repair coats shall be applied in a manner which will present a uniform texture and color-matched appearance.

E. Unsatisfactory Application:

1. If the item has an improper finish color, or insufficient film thickness, the surface shall be cleaned and top coated with the specified paint material to obtain the specified color and coverage. Specific surface preparation information to be secured from the coating manufacturer and the Authority.

2. All visible areas of chipped, peeled, or abraded paint shall be hand- or power-sanded feathering the edges. The areas shall then be primed and finish coated in accordance with the Specifications. Depending on the extent of repair and its appearance, a finish sanding and topcoat may be required by the Authority.

3. Work shall be free of runs, bridges, shiners, laps, or other imperfections. Evidence of these conditions shall be cause for rejection.

4. Any defects in the coating system shall be repaired by the Contractor per written recommendations of the coating manufacturer.

3.10 SHIPPING

A. In all cases where pre-coated items are to be shipped to the jobsite, all efforts shall be made to protect the coating from damage. Coated items shall be battened to prevent abrasion. Contractor shall use non-metallic or padded slings and straps in handling. Items will be rejected for excessive damage, in the opinion of the Authority.

3.11 SCHEDULING PAINTING

A. Apply the first coat material to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

B. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and the application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

3.12 CLEANUP

A. All cloths and waste that might constitute a fire hazard shall be placed in closed metal containers or destroyed at the end of each day. Upon completion of the work, all staging, scaffolding, and containers shall be removed from the site or destroyed in a legal manner. Paint spots, oil, or stains upon adjacent surfaces and floors shall be completely removed, and the entire job left clean and acceptable to the Authority.

B. Upon completion of painting work, clean window glass and other paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

3.13 PROTECTION

A. Protect work of other trades, whether to be painted or not, against any damage by painting and finishing work. Correct any damage by cleaning, repairing or replacing, and repainting as acceptable to the Authority.

B. At the completion of work of other trades, touch up and restore all damaged or defaced painted surfaces.

END OF SECTION

SECTION 21 13 30

HIGH PRESSURE WATER MIST FIRE SUPPRESSION

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The work involves design, installation, testing, and certification of an automatic fire suppression system for two power generation modules. The modules will each contain three diesel engine generators as indicated.

B. The modules will be completely assembled off-site (shop fabricated), not field constructed in the communities of Napaskiak and Rampart. All fire suppression system installation, and the initial testing will occur off site and shall include but not be limited to:

1. Design system in accordance with the latest adopted editions of all applicable codes and standards, manufacturer's requirements, these specifications, and the Drawings.
2. Obtain a State of Alaska, Fire Marshal Plan Review Permit.
3. Furnish and install a complete system.
4. Program fire control panel.
5. Acceptance testing and certification of completed system.
6. Preliminary operation training with Authority staff.
7. Preparation for shipping.
8. Operation and Maintenance Manuals including as-built drawings..

C. Upon acceptance of shop fabrication installation and testing by the Authority, one module will be shipped to Napaskiak, Alaska, and one module will be shipped to Rampart, Alaska, for permanent installation and commissioning under a separate on-site contract. All final system testing, certification, commissioning, and training will occur on-site in these communities and will include but not be limited to:

1. Filling and charging system.
2. Final acceptance testing and certification of completed system.
3. Minimum four hours operation training with local operators and Authority staff.

1.2 RELATED REQUIREMENTS

A. Division 1.

B. Division 23.

C. Division 26.

1.3 QUALITY ASSURANCE

A. All equipment shall be new and shall be listed for the intended application. The entire system shall be designed and fabricated in accordance with recognized and acceptable engineering and industry practices.

B. Design shall be prepared by a registered mechanical engineer or technician with minimum NICET Level 3 certification. Designer shall have an appropriate State of Alaska design permit.

C. The Contractor shall be authorized by the fire suppression system manufacturer to furnish and install the specified system. Field installation shall be performed by technicians certified by the manufacturer to install the specified system.

1.4 REFERENCED STANDARDS:

A. National Fire Protection Association (NFPA) 750: Standard on Water Mist Fire Protection Systems.

B. Underwriters Laboratories (UL) UL 864 Control Units for Fire Protective Signaling Systems

C. National Fire Protection Association (NFPA) NFPA 72 National Fire Alarm Code

D. National Electrical Manufacturer's Association (NEMA).

1.5 SUBMITTALS

A. Provide submittals in the manner described herein and in Division 1.

B. Provide submittals for all products and systems described in Division 21 specifications and shown on the Drawings to demonstrate compliance with the requirements of the project. Submittal to include:

1. Manufacturer, model numbers and quantity of each device.
2. Manufacturer and model of control panel, including installed options.
3. Agent piping layout including size and quantity of nozzles.
4. Calculations.
5. Shop drawings shall indicate compliance with all requirements of the specifications and shall contain at a minimum:
    a. Floor Plans and Isometrics for agent piping.
    b. Floor Plans and Diagrams for Wiring complete with circuit designation in accordance with Wire Schedule on the Drawings (A-B-C-D-E).
    c. Panel and device installation details.
    d. Bill of Materials
    e. Installation notes and system Sequence of Operation.

C. Based upon review comments by the Authority, issue final revised submittal including final construction drawings.

D. Submit a copy of State of Alaska, Fire Marshal Plan Review Permit to the Authority.

E. Prior to testing, certification, and training provide Operation and Maintenance Manuals. Manuals to include system description, manufacturer's catalog information,

programming, instructions, operations and maintenance literature, Material Safety Data Sheets (MSDS) for extinguishing agent, and as-built drawings of completed system. Deliverables to include one bound copy plus a PDF format electronic file of the entire manual.

1.6 SUBSTITUTIONS

A. All substitutions shall be noted on equipment submittals.

1.7 WARRANTY

A. Division 1 - Closeout Requirements: Warranties.

B. Provide a one-year manufacturer's warranty covering all materials and workmanship of all products supplied. Warranty shall commence from the date of system certification.

PART 2 - MATERIALS

2.1 FIRE SUPPRESSION AGENT

A. A high pressure water mist fire suppression system shall be furnished, Marioff Hi-Fog or approved equal. In order for a substitution of the suppression system to be approved it must have at a minimum the following salient features:

1) The system must use water mist as the sole extinguishing agent.

2) The system must use high pressure (2,000 PSI nominal) nitrogen as the sole driving agent without the aid of any pumps.

3) The system shall be a single pipe system utilizing stainless steel tubing not exceeding 1” outside diameter.

4) The complete agent rack including all water and nitrogen storage for one zone of coverage shall not exceed the following dimensions: 4’-6” Long x 1’-4” Wide x 7’-6” High.

2.2 AGENT RACK

A. A floor mounted rack shall be provided that contains the agent cylinders, nitrogen cylinder, and piping. Marioff Hi-Fog MAU 150 FS or approved equal.

B. The rack shall be designed for the appropriate seismic code and shall be adequately anchored to the module structure.

2.3 FIRE CONTROL PANEL

A. The Fire Control Panel shall be a Fike Cheetah XI-50 10-071-R1 or approved equal, and shall contain a microprocessor based Central Processing Unit (CPU). The CPU shall communicate with, supervise and control the following types of equipment used to make up the system: intelligent self-calibrating smoke and flame detectors, addressable modules, annunciators, and other system controlled devices.

B. Basic equipment to be included with Fire Control Panel shall be main board with display and keypad, door, hardware, and backbox for panel surface mount installation.

C. System Capacity and General Operation

1. The control panel shall be capable of 50 intelligent/addressable devices.
2. The system shall include two Class B (NFPA Style Y) programmable Notification Appliance Circuits. It shall also include three additional programmable Form-C alarm and trouble relays rated at a minimum of 2.0 amps @ 30 VDC.
3. The system shall support up to 99 programmable EIA-485 driven relays for an overall system capacity of 301 circuits.
4. The Fire Control Panel shall include a full featured operator interface control and annunciation panel that shall include a backlit Liquid Crystal Display, individual, color coded system status LEDs, and an alphanumeric keypad for the field programming and control of the fire system.
5. All programming or editing of the existing program in the system shall be achieved without special equipment, and without interrupting the alarm monitoring functions of the Fire Control Panel.
6. The Fire Control Panel shall provide the following features:
    a. Automatic detect test and drift compensation to extend detector accuracy over life (smoke and flame detectors monitored and automatically calibrated)
    b. Sensitivity Test, meeting requirements of NFPA 72, Chapter 5.
    c. Maintenance Alert to warn of excessive smoke detector dirt or dust accumulation.
    d. System Status Reports to display.
    e. Positive Alarm Sequence pre-signal, meeting NFPA 72 3-8.3 requirements.
    f. Periodic Detector Test, conducted automatically by software.
    g. Pre-alarm for advanced fire warning.
    h. Cross Zoning with the capability of: counting two detectors in alarm, two software zones in alarm, or one smoke detector and one thermal detector.
    i. Walk Test, with check for two detectors set to same address.
    j. Adjustable delay and discharge timers.
    k. The detector software shall meet NFPA 72, Chapter 7 requirements and be certified by UL as a calibrated sensitivity test instrument.
    l. The detector software shall allow manual or automatic sensitivity adjustment.
    m. Event history file in nonvolatile memory.
    n. Panel to have abort option to manually prevent release of extinguishing agent.
    o. Battery back-up in the event of normal AC power failure.
    p. Unit to be able to release extinguishing agent in at least two independent hazard zones.

2.4 SECONDARY POWER SOURCE BATTERIES

A. Secondary power shall be provided by 12 volt batteries. The batteries shall be sealed and shall be completely maintenance free.

B. Batteries shall have sufficient capacity to power the fire system for not less than twenty-four hours standby operation plus 30 minutes of alarm upon a normal AC power failure. Note that this is in excess of minimum NFPA requirements.

2.5 HEAT DETECTOR

A. UL Listed, adjustable temperature heat detector. Fike 60-1039 or approved equal. Set to activate at 135°F for normal temperature and 190°F for high temperature.

2.6 FLAME (OPTICAL) DETECTOR

A. UL Listed, flame detectors shall be multi-spectrum, UV/Dual IR/Vis electro-optical, automatic calibrating, digital fire detectors. Honeywell FS-20X or approved equal. Install on swivel mount.

2.7 SMOKE (PHOTOELECTRIC) DETECTOR

A. UL Listed, automatic calibrating type, photoelectric smoke detector. Detector to be addressable and provide analog signal to the control panel which may be used for maintenance of detector. Fike 63-1052 or approved equal.

2.8 ANNUNCIATORS

A. Interior Annunciator (Alarm and Discharge) - UL Listed, Horn/strobe combination, minimum 75 candela. Gentex GEC3-24WR or approved equal.

B. Exterior Annunciator (Alarm) - Weatherproof, UL Listed horn/strobe combination, minimum 75 candela. Gentex WGEC24-75WR or approved equal.

C. Exterior Strobe (Discharge) - Weatherproof, UL Listed strobe, minimum 75 candela. Gentex WGES24-75WR or approved equal.

2.9 MANUAL PULL STATION

A. Manual pull station(s) shall be UL Listed, addressable, double action, and provide visible indication that station has been operated.

1. FIRE SUPPRESSION RELEASE: Honeywell MS-2H or approved equal.

2.10 DEVICE MONITORING MODULES

A. UL Listed modules designed for use with intelligent and addressable equipment as required. Fike Series 55 or approved equal.

2.11 PLACARDS

A. Provide placards in compliance with NFPA as required. Provide additional warning placards as indicated on the plan in accordance with the Placard Schedule.

2.12 RACEWAYS AND CONDUCTORS

A. Route all wiring in separate dedicated raceways for all fire suppression system wiring at no cost to Contractor. All raceways shall be electrical metallic tubing (EMT). All raceways, junction boxes, pull boxes, and cover plates shall be painted red.

B. All conductors shall be soft drawn copper, Type XHHW insulation; 600V and 75C rated; gauge and color as indicated by service in accordance with the following schedule:

120V AC Power - 12 AWG, stranded, color per station service scheme.

24V DC Power, Detection, and Alarm Circuits - 14 AWG, color in accordance with the Wire Schedule.

2.13 NOZZLES

A. In Total Flooding and Local Application zones nozzles shall be open spray head type, Marioff 4S 1MC 8MB 1100 or approved equal.

2.14 PIPING

A. Contractor shall furnish, install, and pressure test agent discharge tubing/piping in accordance with manufacturer's recommendations.

2.15 SUPPORT

A. Contractor shall furnish and install industry standard hangers for agent discharge piping, raceways, panel and all devices.

2.16 FITTINGS, VALVES, CONTROLS, AND DEVICES

A. Contractor shall furnish and install all required fittings, valves, control devices, and accessories as required to provide the types of coverage required for each zone as indicated on the Drawings.

PART 3 - EXECUTION

3.1 DESIGN

A. The system shall be designed and installed in accordance with the latest adopted editions of all applicable codes and standards and manufacturer's requirements.

B. Design fire suppression system with two zones of coverage as shown on the Drawings.

1. Zone 1 (Generation Room) shall contain agent rack, discharge piping and nozzles. Two flame detectors shall be cross-zoned so that any one detector will set off alarm and shut-down generators. Any second detector will begin a 30 second countdown to agent release. Two high temperature heat detectors shall be cross-zoned in the same sequence as the flame detectors. Exit shall have a manual “FIRE SUPPRESSION RELEASE” pull station which will begin a 30 second countdown to agent release when activated.

2. Zone 2 (Control Room) shall contain the control panel, one smoke detector and one normal temperature heat detector. Either detector will set off alarm and will shut-down generators. Exit shall have a manual “FIRE SUPPRESSION RELEASE” pull station which will begin a 30 second countdown to agent release when activated.

C. Provide annunciators and other devices where specifically indicated on the Drawings.

3.2 INSTALLATION - GENERAL

A. The system shall be installed in accordance with the Contract Documents, the approved submittal, and all manufacturer's requirements.

B. Contractor shall perform all work with skilled craftsmen specializing in said work with all required certifications. Install all materials in a neat, orderly, and secure fashion, as required by these specifications, manufacturer's requirements, and commonly recognized standards of good workmanship.

3.3 INSTALLATION – SHOP MODULE ASSEMBLY

A. Upon completion of shop testing, all water shall be drained and/or blown out of the system to prevent freeze damage and the batteries shall be disconnected.

B. The system shall be left with one fully charged nitrogen cylinder installed in the rack plus one fully charged spare nitrogen cylinder shipped loose with the module.

3.4 INSTALLATION – ON SITE

A. As previously specified, the final testing and commissioning will occur on site under a separate contract. The on-site work by others will include but not be limited to:

1. Filling and charging systems.
2. Final acceptance testing and certification of completed systems.
3. Minimum four hours operation training at each site with local operators and Authority staff.
4. Verify that each system has one fully charged nitrogen cylinder installed in the rack plus one fully charged spare nitrogen cylinder.

END OF SECTION

SECTION 23 05 00

COMMON WORK RESULTS FOR MECHANICAL

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The work to be included in these and all other mechanical subsections shall consist of providing, installing, adjusting and setting into proper operation complete and workable systems for all items shown on the Drawings, described in the specifications or reasonably implied. This shall include the planning and supervision to coordinate the work with other crafts and to maintain a proper time schedule for delivery of materials and installation of the work.

B. Local Conditions: The Contractor shall thoroughly familiarize himself with the work as well as the local conditions under which the work is to be performed. Schedule work with regard to seasons, weather, climate conditions, and all other local conditions which may affect the progress and quality of work.

C. See Division 1 of which contain information and requirements that apply to work specified herein.

D. In addition to general mechanical requirements this Section includes specific requirements for:

1. Painting and marking.
2. Valve tags, signs, and placards.
3. Flashing and sealing.

1.2 RELATED REQUIREMENTS

A. Division 1.

B. Section 09 91 00 – Painting.

C. All other Division 23 Specifications.

D. Divisions 21 and 26.

1.3 CODES AND STANDARDS

A. Codes: Perform all work in strict accordance with all applicable national, state, and local codes; including, but not limited to the latest legally enacted editions of the following specifically noted requirements:

1. International Fire Code - IFC.
2. International Building Code - IBC .
3. National Fire Protection Association (NFPA) NFPA 30 and NFPA 37.

B. Standards: Reference to the following standards infers that installation, equipment, and materials shall be within the limits for which it was designed, tested, and approved, in conformance with the current publications and standards of the following organizations:

1. American National Standards Institute – ANSI.
2. American Society for Testing and Materials – ASTM.
3. American Petroleum Institute (API).
4. American Society of Testing and Materials (ASTM).
5. American Society of Mechanical Engineers (ASME).
6. American Welding Society (AWS).
7. Underwriters Laboratory - UL.

1.4 QUALITY ASSURANCE

A. Division 1 – Quality Control.

B. Perform all work in accordance with above referenced codes and standards which are referenced to establish minimum requirements.

1. If the Contractor observes that the Drawings and/or Specifications are at variance with such codes and regulations, he shall promptly notify the Authority in writing.
2. Should the Contractor perform any work in non-compliance with the above-mentioned codes and regulations without such notice to the Authority, the Contractor shall bear all costs arising therefrom.

C. In addition, perform all work in accordance with the specific requirements of all Division 23 sections which follow. Wherever the specifications require higher grades of material or workmanship than required by the codes the specifications shall prevail.

D. Perform all work in a neat and workmanlike manner using skilled craftsmen who are qualified and experienced in the specific type of work.

E. Test all work as required by the specifications. Document all testing and submit results in accordance with specifications.

F. Perform pipe welding with experienced welder with current API or equivalent certification for pipe welding in all positions.

1.5 DRAWINGS, SPECIFICATIONS & SYMBOLS

A. The Drawings and Specifications are complementary; what is shown on one is as binding as if called for in both. Do not scale the Drawings. Locations of devices, fixtures, and equipment are approximate unless dimensioned.

B. Drawing symbols used for basic materials, equipment and methods are commonly used by the industry and should be universally understood. Special items are identified by a supplementary list of graphical illustrations, or called for on the Drawings or in the specifications.

1.6 SPECIFIC TERMINOLOGY

A. Streamlining: In many instances, the products, reference standards, and other itemized specifications have been listed without verbiage. In these cases, it is implied that the Contractor shall provide the products and perform in accordance with the references listed.

B. "Furnish" means to purchase material as shown and specified, and cart the material to an approved location at the site or elsewhere as noted or agreed to be installed by supporting crafts.

C. "Install" means to set in place and connect, ready for use and in complete and properly operating finished condition, material that has been furnished.

D. "Provide" means furnish all products, labor, sub-contracts, and appurtenances required and install to a complete and properly operating, finished condition.

E. "Product" is a generic term which includes materials, equipment, fixtures, and any physical item used on the project.

F. "Accessible" means arranged so that an appropriately dressed man 6-foot 2 inches tall, weighing 250 pounds, may approach the area in question with the tools and products necessary for the work intended, and may then position himself to properly perform the task to be accomplished, without disassembly or damage to the surrounding installation.

G. "Serviceable" means arranged so that the component or product in question may be properly removed and replaced without disassembly, destruction, or damage to the surrounding installation.

1.7 SUBMITTALS – GENERAL REQUIREMENTS

A. Provide submittals for all products and systems described in Division 23 specifications and shown on the Drawings to demonstrate compliance with the requirements of the project. Provide submittals in the manner described herein and in Division 1 with an index following specification format and with item by item identification.

B. Submittal review is for general design and arrangement only and does not relieve the Contractor from any of the requirements of the Contract Documents. Submittals will not be checked for quantity, dimension, fit or proper technical design of manufactured equipment. Where deviations of substitute product or system performance have not been specifically noted in the submittal by the Contractor, provision of a complete and satisfactory working installation of equal quality to system specified is the sole responsibility of the Contractor.

H. Submittals shall demonstrate compliance with the requirements of the project. Furnish all relevant data as appropriate including but not limited to:

1. Manufacturer's name and address, and supplier's name, address, and phone number.

2. Catalog designation or model number with rough-in data and dimensions.

3. Operation characteristics.
4. Complete customized listing of characteristics required. Indicate whether item is "As Specified" or "Proposed Substitution." Indicate any deviations on submittal. Mark out all non- applicable items. The terminology "As Specified" used without this customized listing is not acceptable.
5. Shop Drawings.

I. Provide submittals for all materials and equipment in the Division 23 specification sections which follow and submit under that specification section.

J. Equipment: Submit manufacturers catalog literature for each item indicated on the Mechanical Schedules on Sheet M1.1 under the Division 23 Sections that follow. See specific requirements under each section.

1.8 SUBMITTALS UNDER THIS SECTION

A. Product Data: Submit manufacturers catalog literature for paint, caulking, flashing, pipe marking, and all other items specified under this Section.

B. Valve Tags: Provide submittal for specific tags as indicated on the Schedule on Sheet M1.2.

C. Signs and Placards: Provide submittal for signs and placards as indicated on the Schedule on Sheet M1.2.

D. Qualifications: Submit a copy of current certification for the party or parties who will perform pipe welding.

1.9 RECEIVING AND HANDLING MATERIAL

A. See General Conditions and Division 1 regarding material handling.

B. Deliver packaged materials to the jobsite in unbroken packaging with manufacturer’s label, and store to facilitate inspection and installation sequence.

C. Protect all materials and equipment during the duration of construction work against contamination and damage. Replace or repair to original manufactured condition any items damaged during construction. Immediately report any items found damaged to the Authority prior to commencing construction.

1.10 TIMELY EXECUTION OF WORK

A. The work must be expedited and close coordination will be required in executing the work. The various trades shall perform their portion of the work at such times as directed so as to meet scheduled completion dates, and to avoid delaying any other trade.

B. The Authority will set up completion dates. Each Contractor shall cooperate in establishing these times and locations and shall process his work so as to ensure the proper execution of it.

1.11 LAYOUT AND COORDINATION OF WORK

A. Drawings are partly diagrammatic and it is not the intent to show in detail all features of work or exact physical arrangement of equipment. The locations of piping and equipment are approximate unless dimensioned. The exact locations and routing of piping shall be governed by structural conditions and physical interferences and by the location of mechanical terminations on equipment. Equipment shall be located and installed so that it will be readily accessible for operation and maintenance.

B. If piping is placed incorrectly with respect to equipment connections or if equipment connections are relocated without appropriate changes in the mechanical work and the resulting work is not coordinated, the work affected shall be removed and re-installed at the Contractor's expense, even if removal and replacement of portions of work by other trades is necessary.

1.12 COOPERATION AND CLEANING UP

A. The Contractor for the work under each section of the specifications shall coordinate his work with the work described in all other sections of the specifications, and shall carry on his work in such a manner that none of the work under any section of these specifications shall be compromised, hindered, or delayed at any time.

B. At all times during the progress of the work, the Contractor shall keep the premises clean and free of unnecessary materials and debris. The Contractor shall, on direction at any time from the Authority, clear any designated area or areas of materials and debris. On completion of any portion of the work, the Contractor shall remove from the premises all tools and machinery and all debris occasioned by the work, leaving the premises free of all obstructions and hindrances.

1.13 SPECIAL CONDITIONS AND REQUIREMENTS

A. Ensure that the appropriate safety measures are implemented and that all workers are aware of the potential hazards from electrical shock, burn, noise, rotating fans, pulleys, belts, hot piping, etc. associated with working near power generation and related equipment.

1.14 PROJECT RECORD DRAWINGS

A. In accordance with the requirements of Division 1 maintain record documents at the project site and make available for review by the Authority upon request.

B. Mark up a clean set of drawings as the work progresses to show the dimensioned location and routing of all mechanical work which will become permanently concealed. Show routing of work in concealed below grade or in blind spaces within the building.

C. At completion of project, deliver record documents in accordance with Division 1.

1.15 MECHANICAL SYSTEMS TESTING AND REPORTING REQUIREMENTS

A. Division 1 – Quality Control

B. Provide pressure tests of piping and tanks as indicated on the Drawings and in the Division 23 sections that follow.

C. Notify the Authority in writing seven (7) days in advance of pressure tests. The Authority shall have the option to be present at all testing.

D. Provide written documentation of all pressure tests. The Contractor may use their own test forms or upon request the Authority can provide forms for common tests. Test reports shall include at a minimum the following information: item or system identification, gauge pressure, air temperature, time, date, signature of person performing test, and photographs of testing in progress.

E. Cut out or disassemble all leaking joints. Repair and re-test until system proves leak-free. Retesting after the repair of defects shall be performed at no cost to the Authority.

F. Submit completed results of final successful tests along with photographs to the Authority for approval prior to Substantial Completion.

1.16 MECHANICAL INSTRUMENTATION CALIBRATION REQUIREMENTS

A. Division 1 – Quality Control

B. Calibrate all mechanical and electronic measuring devices as indicated in the Division 23 sections that follow.

C. Devices requiring calibration shall include but not be limited to: tank level gauges, pressure vacuum whistle vents, liquid level probes, float switches, thermometers, and temperature transmitters (sensors).

1.17 SUBSTANTIAL COMPLETION

A. In accordance with Section 01 77 00 - Contract Closeout Procedures, provide advance written notice to the Authority to schedule substantial completion inspection. Submit all required documents and ensure all conditions have been met.

B. Provide Authority access to the site. Provide on-site transportation, ladders, lifts, etc. for inspection and testing of the work.

C. Cooperate with the Authority and provide assistance at all times for the inspection of the mechanical work performed under this Contract. Remove covers, operate machinery, or perform any reasonable work which, in the opinion of the Authority, will be necessary to determine the completeness, quality, or adequacy of the work.

D. Conduct operating tests and demonstrate that all systems operate satisfactorily in accordance with requirements of Contract Documents. Should a portion of installation fail to meet requirements of Contract Documents, repair or replace items failing to meet requirements until items can be demonstrated to comply.

E. Have instruments available for measuring pressure and temperature. Provide services of qualified technicians familiar with equipment and systems to assist in taking measurements and making tests.

F. Assist the Authority in instruction of operators on the proper operation and maintenance of all systems and equipment under this contract. Provide services of qualified technicians familiar with each item or system.

1.18 FINAL COMPLETION

A. In accordance with Section 01 77 00 - Contract Closeout Procedures, provide notification of completion. Submit all required documents and ensure all conditions have been met.

1.19 WARRANTY

A. In accordance with Section 01 73 00 – Execution Requirements, provide warranties for all systems and equipment.

B. See Division 23 sections that follow for specific equipment warranty requirements. Wherever the Division 23 specifications have more stringent warranty requirements than Division 1, the Division 23 requirements shall prevail.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Provide all equipment and materials required for a complete system.

B. All equipment and materials supplied under this Contract shall be new unless specifically indicated as existing. Where additional or replacement items are required, provide like items by the same manufacturer to the maximum extent practical.

C. Install all material and equipment in accordance with manufacturer's installation instructions and recommendations unless specifically indicated otherwise.

2.2 PAINTING

A. Paint all steel fabrications and tanks as indicated in fabrication details. Sandblast all exterior surfaces in accordance with SSPC-SP-6. Prime and top coat with two coats self-priming epoxy, PPG Amerloc 2 VOC or approved equal, color ANSI 61 Gray.

B. Interior Carbon Steel Pipe - Paint all exposed carbon steel pipe and fittings that is not insulated except for engine exhaust. Wire brush and wipe down with solvent. Prime with one coat of alkyd primer, PPG Multiprime 4160 or approved equal, color gray. Finish with one coat of alkyd enamel, PPG Devguard 4308 or approved equal, color ANSI 61 Gray.

C. Exterior Carbon Steel Pipe - Paint all exposed carbon steel pipe and fittings except for engine exhaust. Wire brush and wipe down with solvent. Prime and finish with two coats of Cold Galvanizing Compound, ZRC or approved equal.

D. Touch-up – finish all cut ends and damaged surfaces of galvanized and zinc plated supports and fasteners with spray on Cold Galvanizing Compound, ZRC or approved equal. Touch up paint on fabricated items to match original.

2.3 PIPE MARKING

A. Install flow arrows on diesel fuel, used oil, cooling, and heat recovery piping. On insulated piping install flow arrows over jackets. Black or white arrows over colored backgrounds, self-adhesive vinyl, Seton arrows on roll or approved equal. Background color scheme to match the colors listed for Specific Function Valve Tags.

2.4 FLASHING AND SEALING

A. Caulking for Piping - Polyurethane-based sealant, Sika Sikaflex 1A, or approved equal. Color gray.

2.5 VALVE TAGS

A. Specific Function Valve Tags – For all valves marked with a specific function, provide tags color coded and worded as indicated on the Schedule on Sheet M1.2.

B. Standard Valve Tags – For all valves not marked with a specific function, provide NO/NC tags as indicated on the schedules. Seton or approved equal.

C. Install all tags as noted.

2.6 SIGNS AND PLACARDS

A. Provide decals and sign boards, color coded and worded as indicated on the Schedule on Sheet M1.2. Install as noted.

PART 3 - EXECUTION

3.1 DRAWINGS

A. The mechanical Drawings are generally diagrammatic and do not necessarily show all features of the required work. Provide all equipment and materials required for a complete system. Complete details of the building which affect the mechanical installation may not be shown. For additional details, see other Drawings which may include electrical, architectural, structural, and civil. Coordinate work under this section with that of all related trades.

B. Contractor shall field verify all dimensions and conditions prior to start of construction. Immediately contact the Authority for clarification of questionable items or apparent conflicts.

3.2 EXAMINATION

A. Check materials for damage that may have occurred during shipment. Repair damaged materials as required or replace with new materials.

3.3 CUTTING, REPAIRING, PATCHING, AND FINISHING

A. Where previously completed building surfaces or other features must be cut, penetrated, or otherwise altered, such work shall be carefully laid out and patched to the original condition. Perform work only with craftsmen skilled in their respective trades.

B. Do not cut, drill, or notch structural members unless specifically approved by the Authority. Minimize penetrations and disruption of building features.

3.4 FLASHING AND SEALING

A. For all penetrations of interior walls and small pipe (less than 2") penetration of exterior walls, seal with polyurethane caulking all around both surfaces.

B. For 2" and larger pipe penetration of exterior walls install flashing as indicated on Drawings.

3.5 INSTALLATION OF EQUIPMENT

A. Unless otherwise indicated, support all equipment and install in accordance with manufacturer's recommendations and approved submittals.

B. Maintain manufacturer's recommended minimum clearances for access and maintenance.

C. Where equipment is to be anchored to structure, provide necessary anchoring and vibration isolation devices.

D. Provide all structural steel, such as angles, channels, beams, etc. required to support all piping, ductwork, equipment and accessories installed under this Division. Use structural supports suitable for equipment specified or as indicated. In all cases, support design will be based upon data contained in manufacturer's catalog.

E. Openings: Arrange for necessary openings in buildings to allow for admittance and reasonable maintenance or replacement of all apparatus furnished.

3.6 VIBRATION ISOLATION

A. All vibrating equipment and the interconnecting pipe and ductwork shall be isolated to eliminate the transmission of objectionable noise and vibration to the structure.

B. Mechanical equipment shall be carefully checked upon delivery for proper mechanical performance, which shall include proper noise and vibration operation.

C. All installed rotating equipment with excessive noise and/or vibration, which cannot be corrected in place, shall be replaced at no cost to the Authority.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Pipe hangers and supports.
2. Hanger rods.
3. Formed steel channel.

1.2 RELATED REQUIREMENTS

A. Section 23 05 00 – Common Work Requirements for Mechanical

B. Section 23 21 13 - Hydronic Piping

C. Section 23 11 13 - Fuel and Lube Oil Piping

D. Section 23 35 16.10 - Engine Exhaust and Crank Vent Piping

E. Section 26 05 29 - Hangers and Supports for Electrical Systems

1.3 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B31.1 - Power Piping.
2. ASME B31.9 - Building Services Piping.

B. ASTM International:

1. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

C. American Welding Society:

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

D. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

1.4 SUBMITTALS

A. Provide submittals for all products and systems under this Section in accordance with Section 23 05 00 - Common Work Results for Mechanical and Division 1.

B. Product Data:

1. Hangers and Supports: Submit manufacturers catalog data including load capacity. Indicate finish for interior and exterior applications.

2. Vise and Accessories: Submit manufacturers catalog data for vise and mounting bracket.

1.5 QUALITY ASSURANCE

A. Division 1 – Quality Control

B. Conform to applicable code for support of piping and equipment.

1.6 QUALIFICATIONS

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

B. Installer: Company specializing in performing Work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

B. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.1 STRUCTURAL STEEL

A. Miscellaneous shapes and plate: ASTM A-36.

B. Rectangular tubing: ASTM A-500 Grade B.

C. Structural Pipe: ASTM A-53 or ASTM A-106B.

D. Paint as indicated.

2.2 PIPE HANGERS AND SUPPORTS

A. Support equipment and raceways on strut, brackets, trapeze hangers, or as detailed. Anvil, B-Line, Grinnell, Unistrut, or approved equal.

2.3 FORMED STEEL CHANNEL

A. Strut: Cold formed mild steel channel strut, pre-galvanized finish and slotted back unless specifically indicated otherwise.

B. Standard Strut: 12 gauge thick steel, 1-5/8” x 1-5/8”, B-line B22-SH-Galv or equal.

C. Double Strut: 12 gauge thick steel, 1-5/8” x 3-1/4”, B-line B22A-SH-Galv or equal.

D. Shallow Strut: 14 gauge thick steel, 1-5/8” x 13/16”, B-line B54-SH-Galv or equal.

E. Where strut is welded to tanks or structures provided plain (unfinished black) solid back strut: 12 gauge thick steel, 1-5/8” x 1-5/8”, B-line B22-PLN or approved equal.

F. On all exterior installations provide hot dip galvanized strut and fittings.

2.4 FITTINGS AND ACCESSORIES

A. Provide fittings, brackets, channel nuts, and accessories designed specifically for use with specified channel strut. Zinc plated carbon steel except for exterior installations provide hot dip galvanized.

B. Pipe Clamps: Two piece pipe clamp designed to support pipe tight to strut, B-line as indicated on the Pipe/Tubing Strut Clamp Schedule on Sheet M1.1 or approved equal. On copper tubing provide copper plated carbon steel clamps with dielectric cushion insert. On interior steel piping provide zinc plated carbon steel clamps. On exterior steel piping provide hot dip galvanized clamps.

C. Pipe Straps: Two-hole steel pipe strap. Zinc plated carbon steel except for exterior installations provide hot dip galvanized.

2.5 FASTENERS

A. All bolts, nuts, and washers to be zinc plated carbon steel except as specifically noted otherwise.

B. On exterior installations provide hot dip galvanized steel bolts, nuts, and washers.

C. On exhaust piping flanges provide plain carbon steel (black) or stainless steel bolts, nuts, and washers. Coat with high temperature anti-seize prior to assembly.

D. Hanger Rods: Continuous threaded rod. Zinc plated carbon steel except for exterior installations provide hot dip galvanized.

E. Provide stainless wood screws and sheet metal screws where specifically indicated on the Drawings.

2.6 VISE

A. Provide heavy duty mechanics vise with 4-point mounting 360 degree swivel base, minimum 4-3/4” throat depth, 8” wide jaws. Wilton Model 748A or approved equal.

B. Provide heavy duty wall mount base for vise with receiver for quick removal. Trick Tools Part # RM3 Combo or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Check materials for damage that may have occurred during shipment. Repair damaged materials as required or replace with new materials.

3.2 PREPARATION

A. Obtain permission from the Authority before drilling or cutting structural members.

3.3 INSTALLATION - EQUIPMENT

A. Support equipment as shown on Drawings using specified supports and fasteners.

B. On all bolted connections install flat washers and lock washers. Double nut connections where indicated.

C. Anchor equipment weighing more than 100 pounds to the building structure to resist lateral earthquake forces.

D. Total lateral (earthquake) force shall be 1.00 times the equipment weight acting laterally in any direction through the equipment center of gravity. Provide adequate backing at structural attachment points to accept the forces involved.

E. Provide equipment supported by flexible isolation mounts with earthquake restraining supports positioned as close to equipment as possible without contact in normal operation (earthquake bumpers). The maximum lateral displacement due to the computed earthquake force from above shall not exceed 1.5 inches.

3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Support piping as shown on Drawings using specified supports and fasteners. If not detailed on Drawings, support from structural members with pipe hangers, clamps or pipe straps specifically intended for the application.

B. Pipe clamps and hangers for steel pipe shall be zinc plated carbon steel except on exterior installations hot dip galvanized.

C. Copper tube shall be isolated from clamps, hangers, and strut with two layers of 10 mil vinyl pipe wrap.

D. Independently support pumps and equipment. Do not support piping from connections to equipment.

E. Support horizontal piping as scheduled.

F. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.

G. Place hangers within 12 inches of each horizontal elbow or as indicated.

H. Use hangers with 1-1/2 inch minimum vertical adjustment.

I. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.

J. Support riser piping independently of connected horizontal piping.

K. Design hangers for pipe movement without disengagement of supported pipe.

L. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 23 07 19.

3.5 SCHEDULES

A. Copper Tube and Steel Pipe Hanger Spacing:

PIPE SIZE Inches	Copper Tube Maximum Hanger Spacing (Ft)	Steel Pipe Maximum Hanger Spacing (Ft)	Copper Tube Hanger Rod Diameter (In)	Steel Pipe Hanger Rod Diameter (In)
1/2 & 3/4	5	7	3/8	3/8
1 & 1-1/4”	6	7	3/8	3/8
1-1/2	8	9	3/8	3/8
2	8	10	3/8	3/8
3	10	10	1/2	½
4	12	10	1/2	5/8

END OF SECTION

SECTION 23 07 19
PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes: Piping and equipment insulation, jackets, and accessories.

1.2 RELATED REQUIREMENTS

A. Section 23 05 00 – Common Work Requirements for Mechanical.

B. Section 23 05 29 - Hangers and Supports for Piping and Equipment.

C. Section 23 21 13 – Hydronic Piping.

D. Section 23 35 16.10 - Engine Exhaust and Crank Vent Piping.

1.3 REFERENCES

A. ASTM International:

1. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
2. ASTM C450 - Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
3. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
4. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
5. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.

1.4 SUBMITTALS

A. Provide submittals for all products and systems under this Section in accordance with Section 23 05 00 - Common Work Results for Mechanical and Division 1.

B. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.

1.5 QUALITY ASSURANCE

A. Division 1 – Quality Control

B. Pipe insulation maximum flame spread index of 25 and maximum smoke developed index of 50 in accordance with ASTM E84.

C. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.

D. Factory fabricated fitting covers manufactured in accordance with ASTM C450.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section.

B. Applicator: Company specializing in performing work specified in this section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.1 HYDRONIC (COOLANT/HEAT RECOVERY) PIPE INSULATION

A. TYPE P-1: ASTM C547, 1” preformed rigid fiberglass pipe insulation. Thermal Conductivity: 0.23 at 75 degrees F. Operating Temperature Range: 0 to 850 degrees F. Vapor Barrier Jacket: ASTM C1136, Type I, factory applied reinforced foil kraft with self-sealing adhesive joints. Jacket Temperature Limit: minus 20 to 150 degrees F. Johns-Manville “Micro-Lok” or approved equal.

2.2 EXHAUST PIPE INSULATION

A. Pipe: TYPE P-2: ASTM C547, 1-1/2” preformed rigid mineral wool fiber insulation made with basalt rock and slag. Thermal Conductivity: 0.25 at 100 degrees F. Maximum Operating Temperature: 1200 degrees F. ROXUL Techton 1200 or approved equal.

B. Wall Penetrations: Where indicated on Drawings install TYPE 1 mineral wool fiber batt insulation. Rockwool Safe-N-Sound or approved equal. Fill entire void with insulation.

C. Flex Connector: Insulate engine exhaust flex connectors from turbo outlet up to and including flanged ends with custom fit high temperature thermal insulation blanket. Provide four layer system with inner stainless steel mesh, 2000°F ceramic blanket, 1000°F fiberglass blanket, and plain weave carmelized fiberglass fabric outer cover. Provide all stainless steel closure system including lacing anchors, washers, and wire. Distribution International or approved equal.

2.3 PIPE INSULATION JACKETS

A. Aluminum Pipe Jacket: ASTM B209. Exterior grade, 0.016 inch thick sheet, embossed finish.

B. Fittings: Pre-formed aluminum covers. ITW Pabco/Childers or approved equal.

2.4 HEAT EXCHANGER INSULATION

A. ASTM C612, 1" preformed rigid fiberglass board type insulation with FSK foil facing one side. Johns-Manville Spin Glas or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Check materials for damage that may have occurred during shipment. Repair damaged materials as required or replace with new materials.

B. Verify piping has been tested before applying insulation materials.

C. Verify surfaces are clean and dry, with foreign material removed.

D. Verify piping has been painted up to areas to be insulated.

3.2 INSTALLATION – HYDRONIC AND EXHAUST PIPE

A. Install insulation where indicated on Drawings.

B. Install pipe insulation in accordance with manufacturer's installation instructions.

C. Cover all hydronic (coolant/heat recovery) and exhaust piping insulation with aluminum jackets. Join with longitudinal slip joints and minimum 2 inch laps.

3.3 INSTALLATION - HEAT EXCHANGER INSULATION

A. Cover all faces of heat exchanger with 1" preformed rigid fiberglass board type insulation. Cut insulation to fit tight all around.

B. Seal all edges, joints, and corners with reinforced foil tape.

3.4 MODULE PREPARATION FOR SHIPPING

A. As part of the module assembly shop work furnish, cut, and fit insulation as indicated on Drawings where pipes through walls will be removed for shipping.

END OF SECTION

SECTION 23 09 00
INSTRUMENTATION AND CONTROL DEVICES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:

1. Instrumentation Equipment
2. Pressure gauges.
3. Differential Pressure gauges.
4. Thermometers and Thermowells.

1.2 RELATED REQUIREMENTS

A. Section 23 05 00 – Common Work Requirements for Mechanical.

B. Section 23 21 16 - Hydronic Equipment and Specialties.

C. Division 26 - Electrical

1.3 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.

B. ASTM International:

1. ASTM E1 - Standard Specification for ASTM Thermometers.
2. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers.

1.4 SUBMITTALS

A. Provide submittals for all products and systems under this Section in accordance with Section 23 05 00 - Common Work Results for Mechanical and Division 1.

B. Product Data:

1. Submit manufacturers catalog literature for all instrumentation items specified herein.
2. Submit manufacturers catalog literature for each item indicated on the Instrumentation Equipment Schedule on Sheet M1.1.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section.

B. Installer: Company specializing in performing Work of this section.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept controls on site in original factory packaging. Inspect for damage.

1.7 COORDINATION

A. Coordinate installation of control components with work of Division 26.

PART 2 PRODUCTS

2.1 PRESSURE GAUGES

A. Dry type stainless steel case, tube, and socket, 1/4" NPT bottom connection, 2-1/2” dial size. Range as indicated on Drawings.

B. Range 0-30 psi: Trerice Model 700SS-25-02-L-A-090 or approved equal.

C. Range 0-100 psi: Trerice Model 700SS-25-02-L-A-110 or approved equal.

2.2 DIFFERENTIAL PRESSURE GAUGES

A. Diaphragm type, brass body, 1/4" FPT in-line connections, 2-1/2” size basic dial, hermetically sealed SPDT switch with terminal strip.

B. 0-15 PSI Range: Orange Research 1516DGS-1E-2.5B-C-0-15PSID or approved equal.

2.3 THERMOMETERS

A. Digital thermometer, solar powered, LCD display, -50 to +300 F range or dual F/C range, 1% of reading accuracy, variable angle display, 3-1/2” stem length.

B. Weiss DVU35 or approved equal.

C. Provide all thermometers with a 3/4" NPT brass thermowell.

PART 3 EXECUTION

3.1 EXAMINATION

A. Check equipment for damage that may have occurred during shipment. Repair damaged equipment as required or replace with new equipment.

B. Verify systems to be controlled are ready to operate.

3.2 INSTALLATION

A. Install instrumentation where indicated on the Drawings in accordance with details and manufacturer’s installation instructions.

B. Install gauges and thermometers in locations where they are clear of valve handles or other obstructions and where they can be easily read from normal operating level. Install with face within 45 degrees of vertical.

C. Adjust gauges and thermometers to final angle, and clean faces.

D. Isolate hydronic pressure gauges during pressure testing.

E. Install conduit and electrical wiring in accordance with Division 26.

3.3 TESTING AND CALIBRATION – TEMPERATURE DEVICES

A. Provide a precision temperature measurement device that has been shop calibrated for use in field calibration of all thermometers and temperature sensors.

B. All thermometers and temperature sensors shall be calibrated within +/- 0.2°F of actual temperature using the precision temperature measurement device. Verify calibration by comparing readings of adjacent thermometers and temperature sensors.

C. Calibrate digital thermometers using the internal control potentiometer.

D. Calibrate coolant and heat recovery piping temperature transmitters (TT) using scaling and offset on the switchgear PLC.

E. Calibrate radiator temperature transmitters (TT) using scaling and offset on the switchgear variable frequency drives (VFD).

F. Calibrate intake air temperature transmitters (TT) using scaling and offset on the switchgear Easygens.

G. Calibrate engine exhaust temperature RTD's using scaling and offset on the switchgear Easygens.

3.4 TESTING AND CALIBRATION – MISCELLANEOUS DEVICES

A. Provide a shop calibrated pressure gauge for use in field calibration of all pressure measuring devices. All pressure gauges and pressure/vacuum instruments shall be calibrated within +/- 5% of actual pressure.

B. All liquid level gauges and probes shall be calibrated within +/- 0.25" of actual level. Verify calibration using a tape or gauging rod.

C. Calibrate air filter vacuum transmitters (TT) using scaling and offset on the switchgear Easygens.

D. Calibrate heat recovery piping pressure transmitter (PT) using scaling and offset on the switchgear PLC.

E. Calibrate glycol level sensor (GLS) using scaling and offset on the switchgear PLC.

F. Input internal dimensions for all fuel and oil tanks on the tank level monitor panel (TLM). Measure actual liquid level in each tank and verify tank level readings from level sensor probes (LSP) using scaling and offset on the TLM.

G. Set heat recovery pumps to speeds or control modes as indicated on the Drawings. With heat recovery system circulating, read flow rate from flow meter and compare to design value. Cycle pump on and off and change speed to confirm proper operation.

END OF SECTION

SECTION 23 11 13
POWER PLANT FUEL-OIL PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: This section applies to all diesel fuel and lube oil piping systems installed above grade at the power plant including interior and exterior piping.

B. Section includes:

1. Fuel oil piping.
2. Lube oil (used oil) piping.
3. Fittings, Valves, and Strainers.

1.2 RELATED REQUIREMENTS

A. Section 23 05 00 – Common Work Requirements for Mechanical.

B. Section 23 05 29 - Hangers and Supports for Piping and Equipment.

C. Section 23 12 13 – Power Plant Fuel-Oil Equipment and Specialties.

D. Section 26 32 13 – Engine Generators.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working-Pressure Rating: Unless otherwise indicated, minimum pressure requirement for fuel and lube oil piping is 150 psig.

1.4 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B31.1 - Power Piping.
2. ASME B31.9 - Building Services Piping.
3. ASME B16.5 Flanges and Flanged Fittings
4. ASME B16.9 Factory-Made Wrought Steel Butt welding Fittings
5. ASME B16.11Forged Fittings, Socket-Welding and Threaded
6. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

B. ASTM International:

1. ASTM A106B – Standard Specification for Seamless Carbon Steel Pipe for High Temperature Services.
2. ASME B16.11Forged Fittings, Socket-Welding and Threaded

1.5 SYSTEM DESCRIPTION

A. Provide piping of material as specified in PART 2.

B. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded connections to valves, equipment.

C. Provide pipe hangers and supports per Drawings and specifications.

1.6 SUBMITTALS

A. Provide submittals for all products and systems under this Section in accordance with Section 23 05 00 - Common Work Results for Mechanical and Division 1.

B. Product Data: Provide submittals for all products and systems described herein.

C. Welder's Certificate: Provide welder's certificate in accordance with Section 23 05 00 – Common Work Requirements for Mechanical.

1.7 QUALITY ASSURANCE

A. Division 1 – Quality Control.

B. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

C. Perform pipe welding with experienced welder with current API or equivalent certification for pipe welding in all positions.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section.

B. Installer: Company specializing in performing Work of this section with current certification.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary end caps and closures on piping and leave in place until installation.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials shall be new unless otherwise specified. All items of the same type shall be of the same manufacturer.

B. Oil pipe shall have welded joints except for threaded connections to equipment and valves as required and shown. Provide flanged joints where indicated on Drawings to allow removal of individual components.

C. Provide butt weld joints for all pipe 2 inches in diameter and larger and on smaller pipe where specifically indicated on Drawings. Provide socket weld or threaded joints for all piping smaller than 2 inches in diameter unless indicated otherwise.

D. Vent piping shall be galvanized pipe with threaded joints.

2.2 PIPE

A. Oil Pipe (DFS, DFR, UOR): ASTM A106B seamless black steel pipe, Schedule 80.

B. Vent Pipe: ASTM A53B ERW welded galvanized steel pipe, Schedule 40.

2.3 PIPE FITTINGS

A. Fittings: ASTM A234 seamless carbon steel butt weld fittings for all pipe 2 inches in diameter and larger and on smaller pipe where specifically indicated on Drawings. Provide socket weld or threaded joints for all piping smaller than 2 inches in diameter using ASTM 105, forged steel fittings, minimum 3000 lb.

B. Flanges: ASTM A105 forged steel, ANSI 150# raised face unless indicated otherwise. Butt or socket weld as indicated.

C. Flange Gaskets: Spiral wound metallic gaskets, Flexitallic CG or approved equal.

D. Flange Bolts: On all exterior piping provide galvanized bolts, nuts, and washers. On interior piping provide zinc plated or galvanized bolts, nuts, and washers.

E. Vent pipe shall have threaded joints with minimum 300# galvanized threaded fittings.

2.4 BALL VALVES

A. Flanged Ball Valves: Carbon steel body, unibody style with reduced port, ANSI 150# raised face flanged ends, stainless steel ball and trim, PTFE seat and seals for NACE MR0175 service, 150 psig minimum working pressure, with lockable handle. Keckley Style BVF1 or approved equal. Note that for a substitute valve to be approved it must be a domestic manufactured high quality industrial valve such as Apollo or Nibco.

B. Threaded Ball Valves: Carbon steel body, seal welded full port body, FPT ends, stainless steel ball and trim, PTFE seat and seals for NACE MR0175 service, 150 psig minimum working pressure, with lockable handle. Keckley Style BVS2 or approved equal. Note that for a substitute valve to be approved it must be a domestic manufactured high quality industrial valve such as Apollo or Nibco.

2.5 CHECK VALVES

A. Threaded Check Valves: Brass or bronze body, threaded ends, swing check style, 150 psig minimum working pressure. Domestic only. Hammond, Milwaukee, Nibco, or approved equal.

2.6 PRESSURE RELIEF VALVES

A. Threaded Pressure Relief Valves: Bronze body, hard seat, MPT inlet by FPT outlet, size and pressure setting as indicated on the Drawings, Kingston 103SS or approved equal.

2.7 FUSIBLE VALVES

A. Fusible Link Valves: Brass body, FPT ends, 165°F fusible head. Beckett Firomatic or approved equal. Size as indicated on Drawings:
1/2" Valve Model #12130
1" Valve Model #12113.

2.8 SOLENOID VALVES

A. Normally Closed Solenoid Valves: Brass body, 1/2" FPT ends, 1/2" NPT conduit connection, 120VAC, stainless steel core, molded epoxy coil enclosure, internal pilot operated, 150 PSI differential opening pressure, liquid tight and full modulation at 0 PSI differential. Asco Catalog No. 8210G94 or approved equal.

B. Normally Open Solenoid Valves: Brass body, 1/2" FPT ends, 1/2" NPT conduit connection, 120VAC, stainless steel core, molded epoxy coil enclosure, internal pilot operated, 150 PSI differential closing pressure, liquid tight and full modulation at 0 PSI differential. Asco Catalog No. 8210G34 or approved equal.

2.9 STRAINERS

A. Threaded Y Strainer: Type Y pattern, bronze body, screwed ends, gasketed cap, 20 mesh stainless steel screen. 200 psig minimum working pressure. Mueller No. 351 or approved equal.

B. Flanged Basket Strainer: Basket type, carbon steel body, ANSI 150# raised face flanged ends 150 PSIG working pressure, quick knob top with O-ring, 0.062 mesh stainless steel screen. Mueller #125F-CS or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Check materials for damage that may have occurred during shipment. Repair damaged materials as required or replace with new materials.

3.2 PREPARATION

A. Ream threaded pipe ends and remove burrs. Remove scale and dirt, on inside and outside, before assembly.

B. Thoroughly coat male pipe ends with Teflon tape and Teflon pipe joint compound prior to assembling.

C. Coat flange gaskets and bolts with anti-seize compound prior to assembling joints.

3.3 INSTALLATION - PIPING

A. Route piping in orderly manner and maintain gradient.

B. Install pipe hangers and supports in accordance with Drawings and Section 23 05 29.

C. Install piping to conserve building space and not interfere with use of space. Group piping whenever practical at common elevations.

D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

E. Install valves with stems upright or horizontal, not inverted. Provide access where valves are not exposed.

F. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

G. Prepare and paint pipe, fittings, supports, and accessories not pre-finished in accordance with Section 23 05 00.

H. Install identification on piping systems in accordance with Section 23 05 00.

3.4 FUEL AND LUBE OIL PIPING TESTING AND REPORTING

A. Division 1 – Quality Control

B. Provide notification and reporting in accordance with Section 23 05 00 – Common Work Requirements for Mechanical.

C. Test all oil piping with minimum 125 psig air. Test 100% of welds visually for leaks with each joint soaked in a foaming soapy water solution, and visually inspect each joint for leaks. Isolate and pressure test each run of piping for a minimum of one hour. Provide blind flanges, threaded caps or plugs at each end of the test section as needed. Do not conceal pipe joints before pressure testing is complete. Isolate equipment and components rated for lesser pressures so as not to damage these items.

D. Pressure test piping system again after all equipment is installed at 50 psi for a minimum of one hour, or the maximum rated pressure of the weakest component, whichever is less.

3.5 SYSTEM STARTUP

A. Prime equipment and piping prior to testing and verify operation as indicated in Section 23 12 13.

END OF SECTION

SECTION 23 12 13

POWER PLANT FUEL-OIL EQUIPMENT AND SPECIALTIES

PART 1 – GENERAL

1.1 SUMMARY

A. Scope: This section applies to all fuel and lube oil piping systems.

B. Section Includes:

1. Fuel and Lube Oil System Equipment.
2. Day Tank, Hopper, and Filter.
3. Hoses and Flexible Connectors.

1.2 RELATED REQUIREMENTS

A. Section 23 05 00 – Common Work Requirements for Mechanical.

B. Section 23 05 29 - Hangers and Supports for Piping and Equipment.

C. Section 23 11 13 – Power Plant Fuel-Oil Piping.

D. Division 26 – Electrical.

1.3 SUBMITTALS

A. Provide submittals for all products and systems under this Section in accordance with Section 23 05 00 - Common Work Results for Mechanical and Division 1.

B. Product Data:

1. Submit manufacturers catalog literature for all items specified herein.
2. Submit manufacturers catalog literature for each item indicated on the Fuel System Equipment Schedule on Sheet M1.1.

C. Shop Drawings: Submit shop drawings for fabrication of day tank, hopper, and filter bank. Note that if all items will be fabricated exactly as indicated on the Drawings, the design Drawings can be submitted in lieu of shop drawings

1.4 CLOSEOUT

A. Division 1 - Closeout Requirements.

B. Operation and Maintenance Data: Submit instructions for calibrating instruments, installation instructions, assembly views, servicing requirements, lubrication instruction, and replacement parts list.

PART 2 – PRODUCTS

2.1 DIESEL FUEL SYSTEM EQUIPMENT

A. Provide pumps, meters, gauges, filters, equipment, and appurtenances as indicated in the Fuel System Equipment Schedule on Sheet M1.1.

B. Filter: Provide spare filter elements, type and quantity as indicated in the Fuel System Equipment Schedule on Sheet M1.1.

2.2 DAY TANK, HOPPER, AND FILTER BANK

A. Day Tank: Rectangular heavy gauge welded steel tank, capacity and configuration as indicated, manufactured in accordance with UL standard 142 and Drawings. Furnish and install all accessories as indicated.

B. Hopper: Welded steel assembly manufactured as shown on Drawings. Furnish and install all accessories as indicated.

C. Filter Bank: Welded steel assembly manufactured as shown on Drawings. Furnish and install all accessories as indicated.

2.3 HOSES

A. Fuel rated hose, Eaton Weatherhead H569, Aeroquip FC300, or approved equal. Sized as indicated on Drawings. Provide re-useable plated steel straight JIC swivel ends with NPT adapters.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Check equipment for damage that may have occurred during shipment. Repair damaged equipment as required or replace with new equipment.

3.2 PREPARATION

A. Protect bright finished shafts, bearing housings, and similar items until in service. No rust will be permitted.

3.3 FABRICATED TANKS TESTING AND REPORTING

A. Division 1 – Quality Control.

B. Provide notification and reporting in accordance with Section 23 05 00 – Common Work Requirements for Mechanical.

C. Pressure test all tanks as indicated on the tank fabrication drawings.

3.4 INSTALLATION

A. Install pumps and associated equipment in accordance with Drawings and manufacturer’s installation instructions.

B. Install fuel oil day tank, hopper, and filter bank as indicated on Drawings.

C. Electrical installation shall be in accordance with Division 26 Specifications.

D. Prior to installing float switches in tanks verify operation for correct orientation (NO/NC) and actuation height.

3.5 SYSTEM STARTUP

A. Prior to starting fuel and oil pumps, prime pump cavities with lube oil then energize momentarily to verify proper rotation.

B. Prime all piping and fill all filters with diesel fuel then bleed off air prior to starting pumps.

C. Verify operation of all day tank and blender controls including timers and level alarms.

D. Upon initial fill of tanks, calibrate manual level gauges and level sensing probes using tape or gauging rod. See Section 23 09 00 - Instrumentation.

END OF SECTION

SECTION 23 21 13
HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: This section applies to all hydronic (glycol) piping systems.

B. Section includes:

1. Coolant (engine cooling) piping.
2. Heat recovery piping.
3. Pipe fittings.
4. Valves and strainers.
5. Engine coolant (ethylene glycol).
6. Heat recovery fluid (propylene glycol).

1.2 RELATED REQUIREMENTS

A. Section 23 05 00 - Common Work Requirements for Mechanical.

B. Section 23 05 29 - Hangers and Supports for Piping and Equipment.

C. Section 23 07 19 - Piping Insulation

D. Section 23 21 16 - Hydronic Equipment and Specialties.

E. Section 26 32 13 - Engine Generators.

1.3 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B16.3 - Malleable Iron Threaded Fittings.
2. ASME B16.4 - Gray Iron Threaded Fittings.
3. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
4. ASME B31.1 - Power Piping.
5. ASME B31.9 - Building Services Piping.
6. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

B. ASTM International:

1. ASTM A53B - Standard Specification for Pipe, Steel, Black and Hot-Dipped.
2. ASTM B88 - Standard Specification for Seamless Copper Water Tube.

C. American Welding Society:

1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
2. AWS D1.1 - Structural Welding Code - Steel.

D. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.

1.4 SYSTEM DESCRIPTION

A. Provide piping system types as indicated on the Drawings.

B. Where copper tubing connects to steel piping provide connections as detailed on Drawings using bronze or brass fittings or valves for transition.

C. Provide flanges, unions, and couplings at locations requiring servicing. Install unions, flanges, and couplings downstream of valves and at equipment connections.

D. Provide pipe hangers and supports in accordance with Drawings and specifications.

E. Use ball valves or butterfly valves for shut-off and to isolate equipment where indicated.

F. Use gauge cock isolation valves to isolate instrumentation and small devices where indicated.

G. Use hose end drain valves with cap for drains and air purge vents where indicated.

H. Flexible Connections: Use flexible connectors and hoses where indicated.

1.5 SUBMITTALS

A. Provide submittals for all products and systems under this Section in accordance with Section 23 05 00 - Common Work Results for Mechanical and Division 1.

B. Product Data:

1. Piping: Submit data on pipe materials, fittings, and accessories.
2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
3. Glycol: Submit manufacturers catalog information for ethylene glycol solution for engine cooling service and propylene glycol solution for heat recovery service.

C. Welder’s Certificate: Provide welder’s certificate in accordance with Section 23 05 00 – Common Work Requirements for Mechanical.

1.6 QUALITY ASSURANCE

A. Division 1 – Quality Control

B. Perform Work in accordance with ASME B31.1 and ASME B31.9 code for installation of piping systems.

C. Perform pipe welding with experienced welder with current API or equivalent certification for pipe welding in all positions.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section.

B. Fabricator or Installer: Company specializing in performing Work of this section with current certification.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary end caps and closures on piping and leave in place until installation.

C. Store glycol solution in sealed containers clearly marked by product type.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.1 COOLANT PIPING

A. Steel Piping: Provide schedule 40 ASTM A106B, seamless black steel pipe with butt weld joints for engine cooling piping as specifically indicated on the Drawings.

1. Fittings: ASTM A234 seamless carbon steel butt weld fittings for all pipe 2 inches in diameter and larger and on smaller pipe where specifically indicated on Drawings. Provide ASTM 105, forged steel fittings, minimum 3000 lb. socket weld or threaded fittings for pipe smaller than 2 inches and for connections as indicated.

2. Flanges: ASTM A105 forged steel, ANSI 150# flat face unless indicated otherwise. Butt or socket weld as indicated.

3. Flange Gaskets: Spiral wound metallic gaskets, Flexitallic CG or approved equal.

4. Flange Bolts: On all exterior piping provide galvanized bolts, nuts, and washers. On interior piping provide zinc plated or galvanized bolts, nuts, and washers.

5. Unions: ASTM A105 forged steel threaded unions, Class 3000 minimum.

B. Copper Piping: Provide ASTM B88, Type L drawn copper tubing with solder or threaded joints for engine cooling piping as specifically indicated on the Drawings.

1. Fittings: ASME B16.22 solder wrought copper.

2. Joints: soldered with 95-5 tin-antimony solder or silver solder except on tee drill connections use copper brazing rod.

3. Flanges: Provide ANSI 150# companion flanges for transition to steel piping or flanged valves and equipment. Flanges to be two-piece with powder coated steel flange and solder copper tube adapter, Nibco 672 or approved equal.

4. Flange Gaskets: Spiral wound metallic gaskets, Flexitallic or approved equal.

5. Flange Bolts: On all exterior piping provide galvanized bolts, nuts, and washers. Bolts, nuts, and washers on interior piping may be zinc plated.

6. Unions: Bronze unions with solder ends except where specifically indicated as threaded.

2.2 HEAT RECOVERY PIPING

A. Provide ASTM B88, Type L drawn copper tubing with solder or threaded joints.

1. Fittings: ASME B16.22 solder wrought copper.
2. Joints: soldered with 95-5 tin-antimony solder or silver solder except on tee drill connections use copper brazing rod.
3. Flanges: Provide ANSI 150# companion flanges for transition to steel piping or flanged valves and equipment. Flanges to be two-piece with powder coated steel flange and solder copper tube adapter, Nibco 672 or approved equal.
4. Flange Gaskets: Spiral wound metallic gaskets, Flexitallic or approved equal.
5. Flange Bolts: On all exterior piping provide galvanized bolts, nuts, and washers. Bolts, nuts, and washers on interior piping may be zinc plated.
6. Unions: Bronze unions with solder ends except where specifically indicated as threaded.

2.3 BUTTERFLY VALVES

A. Lug style ductile or cast iron body, ANSI 150# flange pattern ends, stainless steel stem with bronze bushing, bronze or nylon coated ductile iron disc, EPDM seats, locking handle. Milwaukee ML-233E, Bray Series 31, or approved equal.

2.4 BALL VALVES

A. Threaded or soldered end as indicated and required, bronze body, chrome plated bronze or brass ball, full port, TFE or Viton packing and seat ring, minimum 200 psig WOG rating. Domestic only. Apollo, Hammond, Milwaukee, Nibco, or approved equal.

2.5 CHECK VALVES

A. Threaded or soldered end as indicated and required, bronze body, swing check style, minimum 200 psig WOG rating. Domestic only. Hammond, Milwaukee, Nibco, or approved equal.

2.6 DRAIN VALVES

A. Bronze body, 1/2” or 3/4” size and solder cup or MPT connection to match associated pipe connection, 3/4" male hose end with cap and jack chain. FNW 426D, 426F, 427D, or 427F or approved equal.

2.7 GAUGE COCK ISOLATION VALVE

A. Brass body, MPT by FPT ends, T-handle, Legend Valve item 101-531 (1/4”) or Item 101-532 (3/8”), or approved equal.

B. Install on all pressure gauges, small hose connections, and where indicated on Drawings.

2.8 STRAINERS

A. Type Y pattern, bronze body, solder ends, gasketed cap, 20 mesh stainless steel screen. 200 psig minimum working pressure, Mueller No. 358S or approved equal.

2.9 PRESSURE RELIEF VALVES

A. Threaded ends, bronze body, nonferrous internal components, 3/4" NPT connections, 500 MBH minimum capacity, set point as indicated on Drawings, ASME certified and labeled. Watts 174A or approved equal.

2.10 AUTOMATIC AIR VENT

A. Brass body, self-closing float operated valve, screw on cap, 1/4" NPT connection. Maid-O-Mist Auto Air Vent No. 71 or equal.

2.11 ENGINE COOLANT (ETHYLENE GLYCOL)

A. Glycol Solution for Engine Cooling Service: The glycol shall be extended life (heavy duty) ethylene glycol, Shell Rotella ELC, Chevron Delo ELC, or approved equal. Note that standard life coolant will not be accepted.

B. The solution shall be premixed to a ratio of 50% ethylene glycol to 50% water. The water shall be treated in accordance with glycol manufacturer's recommendations. The mixed solution shall be **dyed bright pink or light red**, no exceptions.

C. The solution shall be packaged in sealed 55 gallon drums and labeled "Ethylene Glycol" with red lettering.

D. For the Napaskiak module furnish 4 each 55 gallon drums of ethylene glycol solution.

E. For the Rampart module furnish 3 each 55 gallon drums of ethylene glycol solution.

2.12 HEAT RECOVERY FLUID (PROPYLENE GLYCOL)

A. Glycol Solution for Heat Recovery Service will be furnished and installed by others under a separate contract for on site construction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Check materials for damage that may have occurred during shipment. Repair damaged materials as required or replace with new materials.

3.2 PREPARATION

A. Ream pipe ends and remove burrs. Remove scale and dirt, on inside and outside, before assembly.

B. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

C. On copper tube and solder fittings mechanically clean to bright metal and flux prior to assembling.

D. On threaded pipe and fittings thoroughly coat male threads with Teflon tape and Teflon based pipe joint compound prior to assembling.

E. Coat flange gaskets and bolts with anti-seize compound prior to assembling joints.

3.3 INSTALLATION

A. Route piping in orderly manner and slope to drain at low points and vent at high points.

B. Install pipe hangers and supports in accordance with Section 23 05 29.

C. Install piping to conserve building space and not interfere with use of space. Group piping whenever practical at common elevations.

D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

E. Install valves with stems upright or horizontal, not inverted. Provide access where valves are not exposed.

F. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

G. Seal interior wall penetrations as indicated on the Drawings.

H. Prepare and paint piping, supports, and accessories not pre-finished in accordance with Section 23 05 00.

I. Insulate piping in accordance with Section 23 07 19.

J. Install identification on piping systems in accordance with Section 23 05 00.

3.4 HYDRONIC PIPING TESTING AND REPORTING - GENERAL

A. Division 1 – Quality Control

B. Provide notification and reporting in accordance with Section 23 05 00 – Common Work Requirements for Mechanical.

3.5 COOLANT PIPING TESTING

A. Isolate engines, radiators, and pressure gauges prior to pressure testing.

B. Hydrostatically test all piping at 100 psig minimum for one hour with no noticeable water leaks or pressure drops except as caused by temperature change.

3.6 COOLANT SYSTEM FLUSHING

A. Provide temporary plate type strainers, Hellan TP, Hendrix TF, or equal. Install a strainer on the inlet to each radiator and install a strainer at flanged joint where return piping from radiators enters the plant.

B. Fill the entire system with potable water and flush. Run all engines long enough with adequate load to get thermostats open and to circulate water through all piping and accessories. To ensure engines are not damaged, do not run under high load or for extended periods of time with potable water.

Drain system completely. Remove temporary strainers and clean out all debris from inside pipe in vicinity of strainer.

3.7 COOLING SYSTEM SHOP FILLING

A. After pressure testing and flushing, fill entire system with ethylene glycol solution. Perform all functional testing of the module required by the Contract Documents. Ensure that engines are operated long enough with adequate load to get thermostats fully open and to circulate glycol through all piping and accessories.

B. Operate control room heating system to ensure it is fully charged with glycol.

C. After the system is up to normal operating temperature verify the glycol level in expansion tank is between 1/2 and 2/3 and the pressure at the hand glycol fill pump is between 8 and 10 PSIG.

D. Verify proper function of all instrumentation and calibrate all devices.

E. Verify fluid level and temperature readings on switchgear SCADA system.

F. All excess glycol solution glycol solution shall be left with the modules in the original drums and sealed for shipping with the module

3.8 HEAT RECOVERY SYSTEM SHOP TESTING AND FLUSHING

A. Install temporary pipe or hose jumper between heat recovery pipe terminations.

B. Hydrostatically test all piping at 100 psig minimum for one hour with no noticeable water leaks or pressure drops except as caused by temperature change.

C. Fill the entire system with potable water and flush thoroughly. Run pumps as required to obtain circulation through the entire system.

D. Operate heat recovery system with engines under load and engine cooling system up to normal temperature. Verify proper function of all instrumentation and calibrate all devices.

E. Perform complete functional testing of the heat recovery system including energy meter. Verify flow, pressure, and temperature readings on switchgear SCADA system.

F. Upon completion of testing allow system to cool down to ambient temperature. Drain system completely. Blow out with air as required to ensure freeze protection.

END OF SECTION

SECTION 23 21 16
HYDRONIC EQUIPMENT AND SPECIALTIES

PART 1 – GENERAL

1.1 SUMMARY

A. Scope: This section applies to all hydronic (glycol) piping systems.

B. Section includes:

1. Engine Cooling System Equipment.
2. Heating Recovery and Plant Heating Equipment.
3. Expansion tank sight gauge and cap.
4. Hoses.

1.2 RELATED REQUIREMENTS

A. Section 23 05 00 – Common Work Requirements for Mechanical.

B. Section 23 05 29 - Hangers and Supports for Piping and Equipment.

C. Section 23 21 13 - Hydronic Piping.

D. Division 26 - Electrical.

1.3 SUBMITTALS

A. Provide submittals for all products and systems under this Section in accordance with Section 23 05 00 - Common Work Results for Mechanical and Division 1.

B. Product Data:

1. Submit manufacturers catalog literature including manufacturer's installation instructions for each item indicated on the Cooling System Equipment Schedule and the Heat Recovery & Plant Heating Equipment Schedule on Sheet M1.1.
2. Submit manufacturer’s catalog information for appurtenances, hoses, hose clamps, and all other items specified herein.

C. Shop Drawings: Submit shop drawings for glycol storage and expansion tank fabrication. Note that if all items will be fabricated exactly as indicated on the Drawings, the design Drawings can be submitted in lieu of shop drawings.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section.

B. Installer: Company specializing in performing Work of this section.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept material on site in shipping containers with labeling in place. Inspect for damage.

B. Protect systems from entry of foreign materials by temporary covers, caps and closures, completing sections of the work, and isolating parts of completed system until installation.

1.6 FIELD MEASUREMENTS

A. Verify field measurements before fabrication.

PART 2 - PRODUCTS

2.1 COOLING SYSTEM EQUIPMENT

A. Provide all equipment and appurtenances as indicated in the Cooling System Equipment Schedule on Sheet M1.1.

B. Glycol Storage and Expansion Tanks - Provide steel assemblies manufactured as shown on Drawings. Furnish and install all accessories as indicated.

2.2 HEAT RECOVERY & PLANT HEATING SYSTEM EQUIPMENT

A. Provide all equipment and appurtenances as indicated in the Heat Recovery & Plant Heating Equipment Schedule on Sheet M1.1.

2.3 LIQUID LEVEL SIGHT GAUGE

A. Borosilicate glass tube, aluminum body, Buna n seals, 1/2" MPT connections, 9” centers. Lube Devices G607-09-A-1-4 or approved equal.

2.4 EXPANSION TANK CAP

A. Fabricated 2" MPT adapter fitting for standard radiator cap with 3/8" hose barb vent. Filler Neck Supply FTA-RN-2, Alaska Rubber Part# IV8017SS3231308, or approved equal. Furnish with 12 PSI pressure cap.

2.5 HOSES

A. Engine Coolant Connections: Wire reinforced corrugated silicone hose. Tusil Radflex, CRP Industries 9200, or approved equal. Size as indicated on the Drawings.

B. Coolant Hand Pump Connections: Heavy duty oil resistant PVC suction hose. Tigerflex ORV or approved equal. Size as indicated on the Drawings.

C. Expansion Tank Vent Discharge: Nylon reinforced silicone heater hose, Flexfab 5526 or approved equal. Size as indicated on the Drawings.

D. Terminations: Terminate on barbed hose (king) nipples with clamps.

E. Hose Clamps: On hoses larger than 1” size install stainless steel T-bolt clamps, Ideal-Tridon 30051 or approved equal. On hoses 1” and smaller install lined stainless steel constant torque clamps, Ideal-Tridon 47 or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Check equipment for damage that may have occurred during shipment. Repair damaged equipment as required or replace with new equipment.

3.2 PREPARATION

A. Protect bright finished shafts, bearing housings, and similar items until in service. No rust will be permitted.

3.3 FABRICATED TANKS TESTING AND REPORTING

A. Division 1 – Quality Control.

B. Provide notification and reporting in accordance with Section 23 05 00 – Common Work Requirements for Mechanical.

C. Pressure test all tanks as indicated on the tank fabrication drawings.

3.4 INSTALLATION

A. Install equipment and accessories in strict compliance with manufacturer's instructions.

B. Install piping system and appurtenances as indicated on Drawings.

3.5 SYSTEM STARTUP

A. Clean and flush glycol piping systems before adding glycol solution. See Section 23 21 13 - Hydronic Piping.

B. Upon initial fill of tanks, calibrate manual level gauges and level sensing probes. See Section 23 09 00 - Instrumentation.

C. Once systems are in operation and up to normal operating temperatures, calibrate thermometers and temperature sensors. See Section 23 09 00 - Instrumentation.

END OF SECTION

SECTION 23 31 13
METAL DUCTS AND VENTILATION EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Duct Materials.
2. Fans.
3. Dampers.
4. Actuators.
5. Filters.

1.2 RELATED REQUIREMENTS

A. Section 23 05 00 – Common Work Requirements for Mechanical.

B. Section 23 05 29 - Hangers and Supports for Piping and Equipment.

C. Division 26 – Electrical.

1.3 REFERENCES

A. ASTM International:

1. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
2. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

B. Air Movement and Control Association International, Inc.: AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

C. National Fire Protection Association: NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

D. Sheet Metal and Air Conditioning Contractors: SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.4 PERFORMANCE REQUIREMENTS

A. Variation of duct configuration or sizes other than those of equivalent or lower loss coefficient is not permitted except by written permission.

1.5 SUBMITTALS

A. Provide submittals for all products and systems under this Section in accordance with Section 23 05 00 - Common Work Results for Mechanical and Division 1.

B. Product Data:

1. Submit data for duct materials and accessories.
2. Submit manufacturers catalog literature for each item indicated on the Ventilation Equipment Schedule on Sheet M1.1.
3. Submit manufacturers catalog literature for dampers, actuators, filters, and all other items specified herein.

C. Shop Drawings: Submit shop drawings for fabrication of ductwork. Note that if ductwork will be fabricated exactly as indicated on the Drawings, the design Drawings can be submitted in lieu of shop drawings.

1.6 CLOSEOUT

A. Division 1 - Closeout Requirements.

B. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.7 QUALITY ASSURANCE

A. Division 1 – Quality Control

B. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and Flexible and International Mechanical Code.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section.

B. Installer: Company specializing in performing work of this section.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not install duct sealant when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures during and after installation of duct sealant.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication as required.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Galvanized Steel: ASTM A653/A653M galvanized steel sheet, lock-forming quality, having zinc coating in conformance with ASTM A90.

B. Aluminum: Type 5052 alloy, minimum 0.090” thick.

C. Fasteners: Rivets, bolts, or sheet metal screws except where indicated as welded.

D. Sealants, Mastics and Tapes: Conform to UL 181A. Provide products bearing appropriate UL 181A markings.

2.2 FABRICATION

A. Fabricate and support rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible and as indicated on the Drawings. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

B. Fabricate assemblies from galvanized steel or aluminum as indicated on the Drawings. Galvanized sheet metal assemblies shall have standard mechanical joints sealed airtight. Aluminum assemblies shall have continuous welded joints. Grind weld joints smooth after fabrication.

C. Exterior Hood Fabrications: Fabricate all exterior hoods from minimum 0.090” thick Type 5052 aluminum using welded joints.

D. Provide stainless steel mesh and frames where indicated on the Drawings.

2.3 CONTROL DAMPER

A. Opposed blade low-leakage control damper, airfoil blades, galvanized steel construction, acetal bearings, stainless steel jamb seals, TPE blade seals. Greenheck VCD-33 or approved equal. See fabrication details on Drawings for sizes.

2.4 ACTUATORS

A. On duct dampers install multi-voltage spring return actuator, Belimo AFBUP or approved equal.

2.5 FILTERS

A. High capacity pleated panel filter, MERV 8 rating. Camfill 30/30 or approved equal. See fabrication details on Drawings for sizes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Check equipment for damage that may have occurred during shipment. Repair damaged equipment as required or replace with new equipment.

B. Verify sizes of equipment connections before fabricating transitions.

3.2 INSTALLATION

A. Fabricate and install ducts as indicated on Drawings and in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. Verify proper rotation and operation of fans.

C. Adjust actuators to achieve damper full open to full close operation.

D. Provide two complete sets of filters for all intake ducts new in boxes and package with modules for field installation by others.

END OF SECTION

SECTION 23 35 17

ENGINE EXHAUST, CRANK VENT, AND CHARGE AIR SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Engine Exhaust Piping and Accessories.
2. Crank Vent Piping and Accessories.
3. Charge Air Tubing and Accessories.

1.2 RELATED REQUIREMENTS

A. Section 23 05 00 – Common Work Requirements for Mechanical.

B. Section 23 05 29 - Hangers and Supports for Piping and Equipment.

C. Section 23 07 19 - Piping Insulation.

D. Section 26 32 13 – Engine Generators.

1.3 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B31.1 –
2. Power Piping.
3. ASME B31.9 - Building Services Piping.
4. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

B. ASTM International:

1. ASTM A53B - Standard Specification for Pipe, Steel, Black and Hot-Dipped.

1.4 SYSTEM DESCRIPTION

A. Provide piping of material as specified in PART 2.

B. Where more than one piping system material is specified, provide compatible system components and joints.

C. Provide flanges or couplings at locations requiring servicing and where indicated. Do not use direct welded connections to equipment.

D. Provide pipe hangers and supports per Drawings and specifications.

E. Flexible Connector: Install at exhaust and charge air piping connections to engine as indicated in Drawings.

1.5 SUBMITTALS

A. Provide submittals for all products and systems under this Section in accordance with Section 23 05 00 - Common Work Results for Mechanical and Division 1.

B. Product Data. Submit manufacturer's catalog information for the following:

1. Exhaust Piping: Both carbon steel and stainless steel as indicated.
2. Crank Vent Piping: Both carbon steel and stainless steel as indicated.
3. Charge Air Piping: Light wall carbon steel tubing.
4. Pipe and Tubing Fittings.
5. Flanges and Gaskets
6. Mufflers.
7. Rain Caps.
8. Charge Air Flex Connectors and Clamps.
9. Crank Vent Hose and Clamps.

C. Shop Drawings: Submit shop drawings for crank vent condensate trap fabrication. Note that if items will be fabricated exactly as indicated on the Drawings, the design Drawings can be submitted in lieu of shop drawings.

D. Welder's Certificate: Provide welder's certificate in accordance with Section 23 05 00 – Common Work Requirements for Mechanical.

1.6 QUALITY ASSURANCE

A. Division 1 – Quality Control

B. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

C. Perform pipe welding with experienced welder with current API or equivalent certification for pipe welding in all positions.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section.

B. Fabricator or Installer: Company specializing in performing Work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary end caps and closures on piping and leave in place until installation.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.1 EXHAUST PIPING

A. Interior Exhaust Pipe (riser from engine to muffler): ASTM A53 welded black steel pipe, Schedule 40, with ASTM A235 seamless carbon steel butt weld fittings and ASTM A105 weld flanges. Note that at Contractors option interior piping may be stainless equivalent to exterior.

B. Exterior Exhaust Pipe(from muffler to rain cap): ASTM A312 Type 304L welded low carbon stainless steel pipe, Schedule 10, with ASTM A403 Type 304L low carbon stainless steel butt weld fittings and ASTM A182 weld flanges.

2.2 CRANK VENT PIPING

A. Interior Crank Vent Pipe: ASTM A106B black steel pipe, Schedule 40, with ASTM A105 socket weld fittings. Note that at Contractors option interior piping may be stainless equivalent to exterior.

B. Exterior Crank Vent Pipe: ASTM A312 Type 304L welded low carbon stainless steel pipe, Schedule 40, with ASTM A403 Type 304L low carbon stainless steel butt weld fittings and ASTM A182 weld flanges.

2.3 CHARGE AIR TUBING

A. Light wall carbon steel O.D. tubing with butt weld joints and fittings. IAC Acoustics or approved equal.

2.4 FLANGED JOINTS

A. Exhaust Flanges: ANSI 150#, flat faced, slip-on weld flanges.

B. Exhaust Flange Bolts: Plain carbon plain carbon steel (black) or stainless steel bolts, nuts, and washers. Coat with high temperature anti-seize prior to assembly.

C. Charge Air Flanges: 1/2” thick steel plate, ANSI 125/150# pattern for O.D. and bolting, I.D. sized for tubing insert connection.

D. Charge Air Flange Bolts: Hot dip galvanized bolts, nuts, and washers. Coat with high temperature anti-seize prior to assembly.

E. Flange Gaskets: Full face, rated for minimum 1000F continuous. Garlock 4122-FC, Metal Tech HT-195, or approved equal.

2.5 MUFFLERS

A. Mufflers to be disc style, bottom center in and side out, ANSI 125# flanges, 2” internal acoustical/thermal wrap, high temperature satin black finish, with four mounting tabs at bottom. Mufflers shall be critical grade with minimum 28db reduction at 125Hz. G.T. Exhaust Systems H1-5, Harco CFH, Miratech DCK, or approved equal. See Drawings for size.

2.6 RAIN CAPS

A. Exhaust rain caps, hinged type, all stainless steel construction, G.T. Exhaust Systems or approved equal. See Drawings for size.

2.7 FLEXIBLE CONNECTORS

A. Exhaust Pipe Flexible Connectors: Furnished with Engine Generator, see Section 26 32 13 – Engine Generators.

B. Charge Air Tubing Flex Connectors: High temperature, double hump, silicone turbo sleeves with rings, 6 inch long, inside diameters as indicated on the Drawings. Flexfab or approved equal.

2.8 CRANK VENT HOSE

A. Crank Vent Hose: Heavy duty oil resistant PVC suction hose. Tigerflex ORV or approved equal. See Drawings for size.

B. Install on barbed hose (king) nipples. Fasten with lined stainless steel constant torque clamps, Ideal-Tridon 47 or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Check materials for damage that may have occurred during shipment. Repair damaged materials as required or replace with new materials.

3.2 PREPARATION

A. Remove scale and dirt, on inside and outside, before assembly.

3.3 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install pipe hangers and supports in accordance with Drawings and specifications. Refer to Section 23 05 29.

B. Support muffler and crank vent condensate trap from structure as indicated on the Drawings.

3.4 INSTALLATION - PIPING

A. Route piping in orderly manner and maintain gradient. Provide weep holes and open ends for condensate drainage as indicated.

B. Install piping to conserve building space and not interfere with use of space.

C. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

E. Insulate interior exhaust piping and flex connector as indicated on the Drawings in accordance with Section 23 07 19.

3.5 INSTALLATION - CHARGE AIR TUBING

A. Roll bead in end of Charge Air tubing at Flex to ensure positive connection. Fasten with lined stainless steel T-bolt clamps, Ideal-Tridon 30051 or approved equal.

3.6 CHARGE AIR TUBING TESTING AND REPORTING

A. Division 1 – Quality Control

B. Provide notification and reporting in accordance with Section 23 05 00 – Common Work Requirements for Mechanical.

C. Isolate engines and coolers prior to pressure testing.

D. Test all Charge Air Tubing with minimum 50 psig air. Test 100% of welds visually for leaks with each joint soaked in a foaming soapy water solution, and visually inspect each joint for leaks. Isolate and pressure test each run of piping. Provide blind flanges, threaded caps, or plugs as needed. Do not conceal pipe joints before pressure testing is complete.

END OF SECTION

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. The work to be included in these and all other electrical subsections shall consist of providing, installing, adjusting and setting into proper operation complete and workable systems for all items shown on the Drawings, described in the specifications or reasonably implied. This shall include the planning and supervision to coordinate the work with other crafts and to maintain a proper time schedule for delivery of materials and installation of the work.

B. Provide the labor, materials, equipment and test equipment necessary to furnish, install, and place into operation the power, motor, lighting, control, alarm, and associated electrical systems of this Contract. Connect motors, meters, panels, sensors, switches, and outlets or any other electrical device installed or provided as part of the project. Mark and identify circuits, terminal boards, equipment, enclosures, etc. with identification numbers, wire numbers, nameplates, and warning signs. Test, adjust and calibrate equipment and start-up all electrical equipment and its associated mechanical attachments as necessary to place the project into operation.

C. See Division 1 of which contain information and requirements that apply to work specified herein.

1.2 RELATED REQUIREMENTS

A. Division 1.

B. All other Division 26 Specifications.

C. See Divisions 21 and 23 which contain information and requirements that apply to work specified herein.

1.3 CODES AND STANDARDS

A. Codes: Perform all work in strict accordance with all applicable national, state, and local codes; including, but not limited to the latest legally enacted editions of the following specifically noted requirements:

1. NFPA 70, National Electric Code – NEC.
2. National Fire Protection Association (NFPA) NFPA 37.
3. ANSI-C2, National Electrical Safety Code – NESC.
4. International Building Code – IBC.
5. International Fire Code – IFC.

B. Standards: Reference to the following standards infers that installation, equipment, and materials shall be within the limits for which it was designed, tested, and

approved, in conformance with the current publications and standards of the following organizations:

1. American National Standards Institute - ANSI;
2. American Society for Testing and Materials - ASTM;
3. American Society of Heating, Refrigerating and Air Conditioning Consultants - ASHRAE (Standard 90-75);
4. Factory Mutual – FM;
5. Institute of Electrical and Electronics Consultants - IEEE;
6. National Electrical Contractors Association - NECA;
7. National Electrical Manufacturers' Association - NEMA;
8. National Fire Protection Association - NFPA, and
9. Underwriters Laboratory - UL

1.4 QUALITY ASSURANCE

A. Division 1 – Quality Control.

B. Perform all work in accordance with above referenced codes and standards which are referenced to establish minimum requirements.

1. If the Contractor observes that the Drawings and/or Specifications are at variance with such codes and regulations, he shall promptly notify the Authority in writing.
2. Should the Contractor perform any work in non-compliance with the above-mentioned codes and regulations without such notice to the Authority, the Contractor shall bear all costs arising therefrom.

C. In addition, perform all work in accordance with the specific requirements of all Division 26 sections which follow. Wherever the specifications require higher grades of material or workmanship than required by the codes the specifications shall prevail.

D. All electrical work shall be performed by Alaska licensed Journeyman Electricians or by licensed Apprentice Electricians under the direct supervision of a licensed Journeyman Electrician. Journeyman and Apprentice Electricians' current cards shall be available on the job site for review upon request.

E. Perform all work in a neat and workmanlike manner using skilled craftsmen who are qualified and experienced in the specific type of work.

F. Test all work as required by the specifications. Document all testing and submit results in accordance with specifications.

1.5 DRAWINGS, SPECIFICATIONS & SYMBOLS

A. The Drawings and Specifications are complementary; what is shown on one is as binding as if called for in both. Do not scale the Drawings. Locations of devices, fixtures, and equipment are approximate unless dimensioned.

B. Drawing symbols used for basic materials, equipment and methods are commonly used by the industry and should be universally understood. Special items are identified by a supplementary list of graphical illustrations, or called for on the Drawings or in the specifications.

1.6 SPECIFIC TERMINOLOGY

A. Streamlining: In many instances, the products, reference standards, and other itemized specifications have been listed without verbiage. In these cases, it is implied that the Contractor shall provide the products and perform in accordance with the references listed.

B. "Furnish" means to purchase material as shown and specified, and cart the material to an approved location at the site or elsewhere as noted or agreed to be installed by supporting crafts.

C. "Install" means to set in place and connect, ready for use and in complete and properly operating finished condition, material that has been furnished.

D. "Provide" means furnish all products, labor, sub-contracts, and appurtenances required and install to a complete and properly operating, finished condition.

E. "Product" is a generic term which includes materials, equipment, fixtures, and any physical item used on the project.

F. "Accessible" means arranged so that an appropriately dressed man 6-foot 2 inches tall, weighing 250 pounds, may approach the area in question with the tools and products necessary for the work intended, and may then position himself to properly perform the task to be accomplished, without disassembly or damage to the surrounding installation.

G. "Serviceable" means arranged so that the component or product in question may be properly removed and replaced without disassembly, destruction, or damage to the surrounding installation.

H. "Rough-in and Connect" means provide an appropriate system connection such as conduit with "J" boxes, wiring, switches, disconnects, etc., and all wiring connections. Equipment furnished is received, uncrated, assembled and set in place under the Division in which it is specified.

1.7 SUBMITTALS – GENERAL REQUIREMENTS

A. Provide submittals for all products and systems described in Division 26 specifications and shown on the Drawings to demonstrate compliance with the requirements of the project. Provide submittals in the manner described herein and in Division 1 with an index following specification format and with item by item identification.

B. Submittal review is for general design and arrangement only and does not relieve the Contractor from any of the requirements of the Contract Documents. Submittals will not be checked for quantity, dimension, fit or proper technical design of manufactured equipment. Where deviations of substitute product or system performance have not been specifically noted in the submittal by the Contractor, provision of a complete and satisfactory working installation of equal quality to system specified is the sole responsibility of the Contractor.

C. Submittals shall demonstrate compliance with the requirements of the project. Furnish all relevant data as appropriate including but not limited to:

1. Manufacturer's name and address, and supplier's name, address, and phone number.
2. Catalog designation or model number with rough-in data and dimensions.
3. Operation characteristics.
4. Complete customized listing of characteristics required. Indicate whether item is "As Specified" or "Proposed Substitution." Indicate any deviations on submittal. Mark out all non- applicable items. The terminology "As Specified" used without this customized listing is not acceptable.
5. Wiring diagrams for the specific system.
6. Coordination data to check protective devices.
7. Shop Drawings.

D. Provide submittals for all materials and equipment in the Division 26 specification sections which follow and submit under that specification section.

1.8 SUBMITTALS UNDER THIS SECTION

A. All materials in the Electrical Equipment Schedule on the Drawings.

B. All materials in the Electrical Conductor Schedule on the Drawings.

1.9 RECEIVING AND HANDLING MATERIAL

A. See General Conditions and Division 1 regarding material handling.

B. Deliver packaged materials to the jobsite in unbroken packaging with manufacturer’s label, and store to facilitate inspection and installation sequence.

C. Protect all materials and equipment during the duration of construction work against contamination and damage. Replace or repair to original manufactured condition any items damaged during construction. Immediately report any items found damaged to the Authority prior to commencing construction.

1.10 TIMELY EXECUTION OF WORK

A. The work must be expedited and close coordination will be required in executing the work. The various trades shall perform their portion of the work at such times as directed so as to meet scheduled completion dates, and to avoid delaying any other trade.

B. The Authority will set up completion dates. Each Contractor shall cooperate in establishing these times and locations and shall process his work so as to ensure the proper execution of it.

1.11 LAYOUT AND COORDINATION OF WORK

A. Drawings are partly diagrammatic and it is not the intent to show in detail all features of work or exact physical arrangement of equipment. The locations of outlets and equipment are approximate unless dimensioned. The exact locations and routing of conduits shall be governed by structural conditions and physical interferences and by the location of electrical terminations on equipment. Equipment shall be located and installed so that it will be readily accessible for operation and maintenance.

B. If conduit is placed incorrectly with respect to equipment connections or if equipment connections are relocated without appropriate changes in the electrical work and the resulting work is not coordinated, the work affected shall be removed and re-installed at the Contractor's expense, even if removal and replacement of portions of work by other trades is necessary.

C. The Contractor shall schedule his work to coordinate through the General Contractor and with all other subcontractors, power and telephone utilities in order to maintain job progress and to avoid conflicts with equipment installation or work done by the various trades.

1.12 COOPERATION AND CLEANING UP

A. The Contractor for the work under each section of the specifications shall coordinate his work with the work described in all other sections of the specifications, and shall carry on his work in such a manner that none of the work under any section of these specifications shall be compromised, hindered, or delayed at any time.

B. At all times during the progress of the work, the Contractor shall keep the premises clean and free of unnecessary materials and debris. The Contractor shall, on direction at any time from the Authority, clear any designated area or areas of materials and debris. On completion of any portion of the work, the Contractor shall remove from the premises all tools and machinery and all debris occasioned by the work, leaving the premises free of all obstructions and hindrances.

1.13 SPECIAL CONDITIONS AND REQUIREMENTS

A. Ensure that the appropriate safety measures are implemented and that all workers are aware of the potential hazards from electrical shock, burn, noise, rotating fans, pulleys, belts, hot piping, etc. associated with working near power generation and related equipment.

B. The Contractor is responsible for maintaining required clearspace. Should the Contractor become aware of a clearspace violation or if the installation of electrical equipment as shown produces a clearspace violation, notify the Authority in writing before proceeding with the installation.

C. If hazardous location boundaries exist, they will be shown on the drawings. Locations for seal-off fittings shall be field determined by the Contractor.

D. Wet Locations: Wet locations shall include all areas underground (below grade), in direct contact with the earth, areas subject to saturation with water or other liquids from splashing, surface water, exposed to the weather and unprotected.

1.14 PROJECT RECORD DRAWINGS

A. In accordance with the requirements of Division 1 maintain record documents at the project site and make available for review by the Authority upon request.

B. Mark up a clean set of drawings as the work progresses to show the dimensioned location and routing of all mechanical work which will become permanently concealed. Show routing of work in concealed below grade or in blind spaces within the building.

C. At completion of project, deliver record documents in accordance with Division 1.

1.15 ELECTRICAL SYSTEMS TESTING AND REPORTING REQUIREMENTS

A. Division 1 - Closeout Requirements.

B. In addition to field testing, the Contractor shall perform all shop tests for fabricated items such as switchgear and engine-generators as required by the Division 26 specification sections which follow.

C. Field testing shall include but not be limited to:

1. Continuity of all circuits.
2. Correct phase rotation.
3. Megger test of all conductors size #2AWG and larger.
4. Proper function of all switches and devices.
5. Proper function of all control systems.

D. Note that final field testing and commissioning of the switchgear and engine-generators will be performed by the Authority after substantial completion.

E. Notify the Authority in writing seven (7) days in advance of tests. The Authority shall have the option to be present at all testing.

F. Provide written documentation of all tests. The Contractor may use their own test forms or upon request the Authority can provide forms for common tests. Test reports shall include at a minimum the following information: item or system identification, air temperature, time, date, signature of person performing test, and photographs of testing in progress.

G. Where tests disclose problem areas, retest after the defect has been corrected. Retesting after the repair of defects shall be performed at no cost to the Authority.

H. Submit completed results of final successful tests along with photographs to the Authority for approval prior to Substantial Completion.

1.16 ELECTRICAL DEVICE CALIBRATION REQUIREMENTS

A. Division 1 – Quality Control.

B. Division 23.

C. Calibrate all electrical and electronic measuring devices as indicated on the Drawings and in the Division 26 sections that follow.

D. Support other trades as required with calibration of electronic devices furnished under Division 23.

1.17 SUBSTANTIAL COMPLETION

A. In accordance with Section 01 77 00 - Contract Closeout Procedures, provide advance written notice to the Authority to schedule substantial completion inspection. Submit all required documents and ensure all conditions have been met.

B. Provide Authority access to the site. Provide on-site transportation, ladders, lifts, etc. for inspection and testing of the work.

C. Cooperate with the Authority and provide assistance at all times for the inspection of the electrical work performed under this Contract. Remove covers, operate machinery, or perform any reasonable work which, in the opinion of the Authority, will be necessary to determine the completeness, quality, or adequacy of the work.

D. Conduct operating tests and demonstrate that all systems operate satisfactorily in accordance with requirements of Contract Documents. Should a portion of installation fail to meet requirements of Contract Documents, repair or replace items failing to meet requirements until items can be demonstrated to comply.

E. Have instruments available for measuring voltage and current values and for demonstration of continuity, ground, or open circuit conditions. Provide services of qualified technicians familiar with equipment and systems to assist in taking measurements and making tests.

F. Assist the Authority in instruction of operators on the proper operation and maintenance of all systems and equipment under this contract. Provide services of qualified technicians familiar with each item or system.

1.18 FINAL COMPLETION

A. In accordance with Section 01 77 00 - Contract Closeout Procedures, provide notification of completion. Submit all required documents and ensure all conditions have been met.

1.19 WARRANTY

A. In accordance with Section 01 73 00 – Execution Requirements, provide warranties for all systems and equipment.

B. See Division 26 sections that follow for specific equipment warranty requirements. Wherever the Division 26 specifications have more stringent warranty requirements than Division 1, the Division 26 requirements shall prevail.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 26 05 02

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. This Section describes specific requirements, products, and methods of execution which are typical throughout the Electrical Work of this Project. Additional requirements for the specific systems will be found in the Division specifying those systems.

1.2 RELATED REQUIREMENTS

A. This section applies to all Division 26 work.

B. See Divisions 21 and 23 which contain information and requirements that apply to work specified herein.

1.3 COORDINATION

A. Layout all the work in advance and avoid conflict with other Work in progress. Physical dimensions shall be determined from Drawings and field measurements. Verify locations for junction boxes, disconnect switches, stub-ups, etc., for connection to equipment furnished by others, or in other Divisions of this Work.

1.4 SERVICEABILITY OF PRODUCTS

A. Furnish all products to provide the proper orientation of serviceable components to access space provided.

B. Coordinate installation of all products to allow proper service areas for any items requiring periodic maintenance inspection or replacement.

C. Replace or relocate all products incorrectly ordered or installed.

1.5 ACCESSIBILITY OF PRODUCTS

A. Arrange all work to provide access to all serviceable and/or operable products. Layout work to optimize net usable access space within confines of space available. Advise the Authority, in a timely manner, of areas where proper access or required clearspace cannot be maintained. Furnish Layout Drawings to verify this claim, if requested.

B. Provide access doors in ceilings, walls, floors, etc., for access to j-boxes, automatic devices, and all serviceable or operable equipment in concealed spaces.

PART 2 – PRODUCTS

2.1 PRODUCTS FURNISHED IN DIVISION 26

A. All products furnished and installed in permanent construction shall be new, full-weight, standard in every way, and in first class condition.

B. All equipment furnished by the Contractor shall be listed by and shall bear the label of Underwriters' Laboratories, Incorporated (UL) or equivalent independent testing laboratory.

C. All products of similar class or service shall be of one manufacturer.

D. Capacities, sizes, and dimensions given are minimum unless otherwise indicated. All systems and products shall be subject to review for adequacy and compliance with Contract Documents.

2.2 PRODUCTS FURNISHED IN OTHER DIVISIONS

A. Controls, including conduit, wiring, and control devices required for the operation of systems furnished in other Divisions shall be installed in accordance with Division 26 Specifications.

B. All equipment furnished by the Contractor shall be listed by and shall bear the label of Underwriters' Laboratories, Incorporated (UL) or equivalent independent testing laboratory.

C. Provide complete power connections to equipment including but not limited to feeders, connections, disconnects and motor running overcurrent protection. Where starters are provided as part of a packaged product, overcurrent devices shall be provided.

2.3 IDENTIFICATION

A. Equipment Nameplates:

1. Provide rigid engraved nameplates of laminated plastic 1/16-inch thick with white letters on a black or gray background. Nameplates for emergency equipment shall be red with white letters.

    a. Securely attach nameplates with two screws, minimum.

    b. Temporary markings not permitted on equipment. Repaint trims housings, etc., where markings cannot be readily removed. Refinish defaced surfaces.

    c. No labeling abbreviations will be permitted without prior approval.

2. Nameplate Locations:

    a. Provide 1/2-inch minimum height letters on following equipment:

        1) Service disconnects (red background).

        2) Secondary feeder breakers in distribution equipment. Designation as required by load served.

        3) Special equipment housed in cabinets, as designated on Drawings, on outside of door.

    b. Provide 1/4-inch minimum height letters on:

1) Disconnects and starters for motors or fixed appliances - (include item designation and branch feeder circuit number); and

2) Designated electrical equipment.

B. Branch Circuit Panelboard Schedules: Provide neatly typed schedule (odd numbered circuits on left side or top, even on right side or bottom) under plastic jacket or protective cover to protect the schedule from damage or dirt. Securely mount on inside face of panelboard door. Define briefly, but accurately, nature of connected load (i.e., Lighting, interior; receptacles, work bench; etc.) as approved.

C. Conduit Labeling: Unless a conduit is completely exposed and the purpose is clearly obvious, all conduits shall be permanently marked using a label maker.

1. Conduits Entering Panels: All conduits entering panels shall be labeled with the circuit numbers of the circuits contained inside.

2. Concealed Conduits: Conduits that are concealed inside building structure or below grade shall be marked at each with the designation of the opposite end.

3. For interior conduits the label shall be applied directly to the conduit. For exterior conduits the label shall be applied inside the junction box or conduit body where the conduit terminates.

D. Junction Boxes: All junction boxes with steel covers shall be permanently marked using a label maker with the circuit numbers of wiring inside. For interior locations the label shall be applied on the outside and for exterior locations the label shall be applied inside the junction box.

E. Conductors:

1. Conductors shall be color coded as indicated on the Electrical Conductor Schedule on the Drawings.

2. Control and alarm circuit conductors

a. Field conductors shall be identified by destination panel and terminal block designations.

b. Internal (Control Panel) numbering system shall be provided by the Contractor or panel Fabricator. The numbering system shall assign each logical conductor set a unique identification number that will be reflected on the as-built drawings.

PART 3 – EXECUTION

3.1 STORAGE AND HANDLING

A. Division 1 – Material and Equipment.

B. All items shall be delivered and stored in original containers, which shall indicate manufacturer's name, the brand, and the identifying number.

C. Items subject to moisture and/or thermal damage shall be stored in a dry, heated place.

D. All items shall be covered and protected against dirt, water, chemical and/or mechanical damage.

3.2 PROTECTION OF PRODUCTS

A. The Contractor shall be held responsible for products to be installed under this Contract.

B. The Contractor will be required to make good, at his own cost, any injury or damage which said products may sustain before Final Acceptance.

3.3 INSTALLATION

A. All products shall be installed by skilled craftsmen. The norms for execution of the work shall be in conformity with NEC Chapter 3 and the NECA "Standards of Installation," which herewith is made part of these Specifications.

B. Provide working space in accordance with NEC 110.26 to permit ready and safe operation and maintenance of equipment.

C. Installation of all equipment shall be in accordance with manufacturer's instructions.

3.4 SUPPORT SYSTEMS

A. All interior materials used shall be galvanized or zinc plated.

B. All exterior materials used shall be hot dip galvanized. Where support elements are field cut, exposed metal shall be coated with spray-on cold galvanizing.

C. Support from structure or as specifically detailed on the Drawings.

D. Conduits shown to be run at grade shall be supported by sleepers as shown on the drawings. Conduits may share fuel piping sleepers if installed such that neither system will require removal during maintenance or replacement.

3.5 MOUNTING HEIGHTS

A. Mounting heights shall be above finished floor (AFF) or above finished grade as noted below, unless otherwise shown or indicated.

1. Lighting Switches, 48 inches to center

2. Receptacles shall be mounted as indicated on the Drawings.

B. Other mounting heights are indicated on the Drawings by detail.

3.6 CUTTING AND PATCHING

A. Where previously completed building surfaces or other features must be cut, penetrated, or otherwise altered, such work shall be carefully laid out and patched in a neat and workmanlike manner to the original condition. Perform work only with craftsmen skilled in their respective trades.

B. Do not cut, drill, or notch structural members unless specifically approved by the Authority. Minimize penetrations and disruption of building features

3.7 FLASHING AND SEALING

A. Seal all interior and exterior wall penetrations with polyurethane caulking. Seal both sides of walls where accessible.

3.8 PROTECTIVE FINISHES

A. Take care not to scratch or deface factory finish on electrical apparatus and devices. Repaint all marred or scratched surfaces.

B. Provide hot dip galvanized components for ferrous materials installed in exterior locations.

3.9 CLEAN-UP AND COMMISSIONING

A. Throughout the Work, the Contractor shall keep the work area neat and orderly by periodic clean-ups.

B. As independent parts of the installation are completed, they may be placed in service and utilized during construction.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. This section describes general requirements, products, and methods of execution relating to the furnishing and installation of a complete grounding system as required for this project.

1.2 RELATED REQUIREMENTS

A. Section 26 05 00 Common Work Results for Electrical.

B. Section 26 05 02 Basic Materials and Methods.

1.3 MINIMUM REQUIREMENTS

A. The minimum requirement for the system shall conform to Article 250 of the NEC.

1.4 SUBMITTALS

A. Product Data: Provide in accordance with Section 26 05 00 Common Work Results for Electrical and Division 1.

PART 2 – PRODUCTS

2.1 GENERAL

A. Install types indicated and of sizes and ratings to comply with NEC. Where types, sizes, ratings, and quantities indicated are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications shall govern.

B. Material: Copper only. Aluminum is not acceptable for use in any location.

2.2 WIRE AND CABLE CONDUCTORS

A. Ground Grid or Grounding Electrode Conductors shall be bare copper conductors conforming to the following:

1. Solid Conductors: ASTM B-3.
2. Stranded Conductors: ASTM B-8.
3. Tinned Conductors: ASTM B-33.

B. Station Service Circuit Grounding Conductor: General use conductors in accordance with the conductor schedule, green insulated. Minimum No. 12 AWG.

C. Generator and Feeder Circuit Grounding Conductor: Equivalent to the phase conductors in accordance with the conductor schedule, size as indicated.

2.3 MISCELLANEOUS CONDUCTORS

A. Ground Bus: Bare annealed copper bars of rectangular cross section.

B. Braided Bonding Jumpers: Copper tape, braided No. 30 gauge bare copper wire, terminated with copper ferrules.

C. Bonding Strap Conductor/Connectors: Soft copper, 0.05-inch-thick and 2 inches wide, except as indicated

2.4 GROUND CONNECTIONS

A. Grounding conductor connections to building structure and to equipment skids shall be made with mechanical lugs or compression lugs as indicated. Drill and tap steel structure and equipment and fasten with stainless steel bolts for positive bond to clean bare steel threads.

PART 3 – EXECUTION

3.1 SERVICE AND STRUCTURE GROUND

A. Create a Grounding Electrode System (GES) for this project by connecting the following:

1. Generators, switchgear, and transformers grounded as shown on the Drawings.
2. Building structure and equipment skids as shown on the Drawings.
3. Other items or equipment grounded as indicated on the Drawings.
4. The neutral conductors grounded only where specifically indicated on the Drawings.

B. Current carrying capacity of the grounding and bonding conductors shall be in conformity with Tables 250.66 and 250.122 of the NEC.

3.2 EQUIPMENT GROUND

A. The raceway system shall be bonded in conformity with NEC requirements to provide a continuous ground path. Where required by code or where called for on the Drawings, an additional grounding conductor shall be sized in conformity with Table 250.122 of the NEC.

B. Provide a separate copper equipment grounding conductor for each feeder and for each branch circuit indicated. Install the grounding conductor in the same raceway with the related phase and neutral conductors, and connect the grounding conductor to pull boxes or outlet boxes at intervals of 100 feet or less. Where paralleled conductors in separate raceways occur, provide a grounding conductor in each raceway. Connect all grounding conductors to bare grounding bars in panel boards, and to ground buses in service equipment to the end that there will be an uninterrupted grounding circuit from the point of a ground fault back to the point of connection of the equipment ground and system neutral. All grounding conductors shall be sized in conformity with Table 250.122 of the NEC.

C. Provide separate grounding conductor securely bonded and effectively grounded to both ends of all non-metallic raceways and all flexible conduit.

D. If non-metallic enclosures are provided, all metal conduits terminating or entering the enclosure shall be bonded together with approved bonding bushings and minimum #6 AWG copper cable.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. Support and align raceways, cabinets, boxes, fixtures, etc., in an approved manner and as specified.

1.2 RELATED REQUIREMENTS

A. Section 26 05 00 Common Work Results for Electrical.

B. Section 26 05 02 Basic Materials and Methods.

C. Section 26 05 33 Raceway and Boxes for Electrical Systems.

1.3 SUBMITTALS

A. Shop Drawings and Product Data: Provide in accordance with Section 26 05 00 Common Work Results for Electrical and Division 1.

PART 2 – PRODUCTS

2.1 HANGERS AND SUPPORTS

A. Support equipment and raceways on strut, brackets, trapeze hangers, or as detailed. Anvil, B-Line, Grinnell, Unistrut, or approved equal.

2.2 FORMED STEEL CHANNEL

A. Strut: Cold formed mild steel channel strut, pre-galvanized finish and slotted back unless specifically indicated otherwise.

B. Standard Strut: 12 gauge thick steel, 1-5/8” x 1-5/8”, B-line B22-SH-Galv or approved equal.

C. Double Strut: 12 gauge thick steel, 1-5/8” x 3-1/4”, B-line B22A-SH-Galv or approved equal.

D. Shallow Strut: 14 gauge thick steel, 1-5/8” x 13/16”, B-line B54-SH-Galv or approved equal.

E. On all exterior installations provide hot dip galvanized strut and fittings.

2.3 FITTINGS AND ACCESSORIES

A. Hanger Rods: Continuous threaded rod. Zinc plated carbon steel except for exterior installations provide hot dip galvanized.

B. Provide fittings, brackets, channel nuts, and accessories designed specifically for use with specified channel strut. Zinc plated carbon steel except for exterior installations provide hot dip galvanized.

C. Pipe Clamps: Two piece pipe clamp designed to support pipe tight to strut, B-line B20##, or approved equal. Zinc plated carbon steel except for exterior installations provide hot dip galvanized

D. Fasteners: All bolts, nuts, and washers to be zinc plated carbon steel except on exterior installations provide hot dip galvanized or stainless steel.

2.4 FASTENERS

A. All bolts, nuts, and washers to be zinc plated carbon steel except as specifically noted otherwise.

B. On exterior installations provide hot dip galvanized steel bolts, nuts, and washers.

C. Hanger Rods: Continuous threaded rod. Zinc plated carbon steel except for exterior installations provide hot dip galvanized.

D. Rod Anchors: Where specifically indicated on the Drawings provide wood screw by threaded rod anchors, Buildex Sammy Screws or approved equal.

E. Provide stainless wood screws and sheet metal screws where specifically indicated on the Drawings.

2.5 EARTHQUAKE ANCHORAGE

A. Anchor equipment weighing more than 100 pounds to the building structure to resist lateral earthquake forces.

B. Total lateral (earthquake) force shall be 1.00 times the equipment weight acting laterally in any direction through the equipment center of gravity. Provide adequate backing at structural attachment points to accept the forces involved.

C. Provide equipment supported by flexible isolation mounts with earthquake restraining supports positioned as close to equipment as possible without contact in normal operation (earthquake bumpers). The maximum lateral displacement due to the computed earthquake force from above shall not exceed 1.5 inches.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Conduits and equipment shall be mounted using strut or similar supports unless otherwise noted.

B. Support material shall be cut square and smooth using a floor mounted bandsaw or chop saw. Hacksaws shall not be used to cut support material.

C. Do not strap conduits to piping except where specifically detailed on the Drawings. When run in parallel with piping maintain adequate separation to allow maintenance to take place on either piping or conduit system so that the other does not have to be removed when maintenance is required.

D. Conduits shown to be run at grade shall be supported by sleepers as shown on the drawings. Conduits may share fuel piping sleepers if installed such that neither system will require removal during maintenance or replacement.

END OF SECTION

SECTION 26 05 33

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. This section describes specific requirements, products, and methods of execution relating to conduit and conduit fittings approved for use on this project. Type, size and installation methods shall be as shown on the Plans, required by Code and specified in these specifications.

1.2 RELATED REQUIREMENTS

A. Section 21 13 29 Fire Suppression.

B. Section 26 05 00 Common Work Results for Electrical.

C. Section 26 05 02 Basic Materials and Methods.

D. Section 26 05 26 Grounding and Bonding for Electrical Systems.

E. Section 26 05 29 - Hangers and Supports for Electrical Systems.

1.3 QUALITY ASSURANCE

A. Conduit and conduit fittings shall be standard types and sizes as manufactured by a nationally recognized manufacturer of this type of materials and be in conformity with applicable standards and UL listings.

1.4 SUBMITTALS

A. Shop Drawings and Product Data: Provide in accordance with Section 26 05 00 Common Work Results for Electrical and Division 1.

PART 2 – PRODUCTS

2.1 GALVANIZED RIGID CONDUIT (GRC)

A. Galvanized rigid conduit shall be mild steel with continuous welded seam, hot-dip galvanized complying with ANSI C80.1 and shall be UL listed.

B. Elbows, bends, and fittings shall be made of full weight materials complying with the above and shall be coated and threaded the same as conduit.

C. Threads for conduit shall be tapered and clean cut. All threads shall be hot dip galvanized after cutting.

D. Conduit shall be 1/2-inch trade size or larger.

2.2 ELECTRICAL METALLIC TUBING (EMT)

A. Steel tubing, galvanized outside and provided with a slick corrosion resistant interior coating; UL listed and labeled according to Standard 797; conforming to ANSI Standard C80.3.

2.3 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Liquidtight flexible conduit shall be manufactured from galvanized steel strip, sealed with a polyvinyl outer jacket and shall be UL listed.

B. Fittings shall be designed for use with liquidtight flexible conduit and shall maintain electrical continuity throughout fittings and conduit.

C. Liquidtight flexible metal conduit shall be 1/2-inch trade size or larger and shall be manufactured by O-Z/Gedney Co., Southwire Co., or approved equal.

2.4 WIREWAY

A. Interior Use: UL listed; NEMA 1, enamel finished; hinged covers except where indicated otherwise. Furnish complete with all fittings, couplings, and accessories; Hoffman, B-Line, or approved equal.

2.5 FITTINGS

A. Conduit bodies shall be factory made with threaded hub connections and weather tight screw type covers. For all exterior locations provide malleable iron conduit bodies with hot dipped galvanized finish.

B. Fittings utilized with rigid steel shall be galvanized steel. Conduit bushings shall be of the insulated type. Where grounding bushings are required, insulated grounding bushings with pressure type lugs shall be provided. Lock rings shall be of the sealing gland type. Provide conduit bushings on all penetrations without hubs.

C. Couplings and Terminations for Electrical Metallic Tubing (EMT): Join lengths of EMT with steel compression type couplings and connectors. The connectors shall have insulated throats or a smooth interior so as not to damage the insulation during pulling operations.

D. Fittings for liquid-tight flexible conduit shall be steel or malleable iron, of a type incorporating a threaded grounding cone, nylon or plastic compression ring, and a tightening gland, providing a low resistance ground connection. All throats shall be insulated.

2.6 JUNCTION BOXES AND ENCLOSURES

A. Metallic device/junction boxes for interior use with Electrical Metallic Tubing (EMT) shall be minimum .0625” thick SAE 1008 pressed steel with galvanized finish, 2-1/8” deep welded or drawn construction with 1/2” and 3/4” knockouts. Provide with 1/2” raised face metal covers.

B. For interior electrical junction boxes larger than 4” square provide NEMA 1 steel wall mount screw cover enclosures. Minimum 12-gauge steel with color ANSI 61 gray powder coated finish. Hoffman, B-Line, or approved equal. Provide with plated or stainless-steel cover screws.

C. Weatherproof gang boxes for exterior use and where specifically indicated shall be die cast zinc metal with powder coated finish and threaded hubs. Provide with matching weatherproof gasketed covers and mounting hardware.

PART 3 – EXECUTION

3.1 CONDUIT USAGE

A. INTERIOR - All interior locations shall be electrical metallic tubing (EMT) except where specifically indicated as wireway or GRC.

B. FIRE SUPPRESSION - All raceways for fire suppression shall be equivalent to INTERIOR previously specified except that all raceways, junction boxes, pull boxes, and cover plates shall be painted red.

C. EXTERIOR - All exterior above grade locations shall be galvanized rigid conduit (GRC).

D. Liquidtight flexible metal conduit shall be used in lengths of 18 to 24 inches for connections to motors or equipment subject to vibration and where indicated on the Drawings. Longer lengths may be used for equipment connection if grounding conductor is installed through conduit.

3.2 CONDUIT INSTALLATION, GENERAL

A. Conduit field joints shall be cut square and reamed smooth. Threads shall be cleanly cut and joints drawn up tight. Running threads shall not be permitted.

B. After cutting and threading exterior GRC, threads shall be cleaned and degreased and shall receive two coats of cold galvanizing compound.

C. Offsets and bends shall be made carefully, without reducing cross sectional area, and shall not be less than the radius of standard elbows.

D. Convenience outlets, switches, and other devices located on walls shall be serviced from above, unless otherwise indicated.

E. Raceways penetrating vapor barriers or traversing from warm to cold areas shall be sealed (at the penetration point) with a non-hardening duct sealing compound to prevent the accumulation of moisture.

F. Provide seal off fittings when crossing hazardous boundaries into non-hazardous locations and at enclosures where required by Code. Not all locations where these fittings are required are shown.

G. All metal conduits shall have insulating bushings and shall have locknuts inside and outside of enclosure box, etc. Conduits smaller than 1-1/4-inch trade size shall be equipped with bushings and shall have locknuts inside and outside of enclosure.

H. All conduit runs shall be grounded in an effective and approved manner at point of origin and shall maintain a continuous ground throughout all runs, cabinets, pull boxes, and fittings from point of service to all outlets.

I. Conduit Supports:

1. Support conduits by wall brackets, pipe straps and strut sections, or trapeze hangers spaced not more than 10 feet on center.

2. Conduits shall be supported from the structural system. Provide additional support as required for junction and pull boxes.

J. All conduit runs shall be completed and cleaned free from foreign matter inside before conductors are drawn in. After installation conduit ends shall be plugged or capped to prevent the entrance of foreign materials.

K. All conduits and junction boxes shall be permanently labeled in accordance with Section 26 05 02.

L. All conduits not used by this Contract shall have a pull wire installed and securely tied off at each end for future conductor installation.

END OF SECTION

LIST OF ABBREVIATIONS

CAC: Charger Air Cooler
CPU: Central Processor Unit
CT: Current Transformer
ECU: Engine Control Unit
EULA: End User License Agreement
FPR: Feeder Protection Relay
GC: Genset Controller
GPH: Gallons per Hour
HMI: Human Machine Interface
kWh: kilowatt hour
LAN: Local Area Network
O&M: Operations & Maintenance
OIU: Operator Interface Unit
PLC: Programmable Logic Controller
PT: Potential Transformer
PSI: Pounds per Square Inch
RPM: Revolutions per Minute
SCADA: Supervisory Control and Data Acquisition
SMS: System Mode Switch
UL: Underwriters Laboratory
VAC: Volts, AC
VDC: Volts, DC
VFD: Variable Frequency Drive

SECTION 26 23 00

PRIME POWER LOW-VOLTAGE SWITCHGEAR

PART 1 - GENERAL

1.1 SCOPE

A. The Work shall consist of, but not be limited to, designing, fabricating, testing and providing complete and fully functional switchgear to parallel diesel generating units for prime power generation as indicated on the project design drawings and as specified herein.

B. The specifications and project design drawings are complementary. What is shown on one is binding whether or not it is shown or specified in the other.

C. Provide a complete and operational system as specified herein. The components identified shall not be construed to be the complete list of components required for the successful operation of the system as specified. Provide all components and design required for the complete and successful operation of the system, conforming to all the requirements specified herein, whether the components are identified or not. Ensure all devices are installed and operate within their intended purposes. Check all catalog numbers indicated and coordinate all devices installed.

D. The word "Contractor" as used in this section shall mean the Electrical Contractor responsible for field installation, testing, and commissioning of the system. The word "Fabricator" as used in this section shall mean the company responsible for assembly, wiring, and programming of control equipment and systems.

E. The paralleling switchgear shall be capable of unattended automatic and manual operation as described herein. The switchgear controls shall be a fully coordinated system that provides the functions and features as specified herein.

F. The automatic control and overall sequencing, starting, and stopping of the generators shall be performed by a Programmable Logic Controller (PLC). Failure of the PLC shall not inhibit manual operation, paralleling, and control of the individual engine generators.

G. Automatic start/stop and demand control shall be accomplished through the Genset Controllers (GC). Each generator shall have an electrically operated circuit breaker to perform the normal online/offline paralleling functions of the generator which will be controlled by the GC.

H. The distribution feeder shall have an electrically operated circuit breaker to perform the normal online/offline functions.

I. Variable frequency drives shall be provided in the switchgear for radiator and charge air cooler fan control as indicated.

J. The switchgear shall be factory tested separately from the engine generators and field tested with the engine generators as specified herein.

1.2 RELATED REQUIREMENTS

A. Section 26 05 00 – Common Work Results for Electrical

B. Section 26 05 02 – Basic Materials and Methods

C. Section 26 23 05 – SCADA System for Switchgear Upgrades

D. Section 26 32 13 – Engine Generators

1.3 SUBMITTALS

A. Provide in accordance with Section 26 05 00 Common Work Results for Electrical and Division 1.

B. Provide a bill of material for all equipment or material provided as part of the switchgear.

C. Provide manufacturer's catalog literature for all accessories and equipment. Literature shall be limited to only the items furnished and shall not include entire sections of catalogs or data sheets for items not used. Items shall be marked electronically such that it is clear which item is for what purpose.

D. Provide complete and accurate shop drawings of the equipment as specified herein. The current revision, issue number, and date shall be indicated on all drawings and other descriptive data. Provide all drawing files in Adobe PDF format. Upon request, provide drawing files in AutoCAD 2016 format; include all title blocks, external references, special fonts, and plot configuration files such that when plotted the AutoCAD file appears like the PDF file.

1. All drawings submitted shall be drawn to accurate scale on sheets not less than 11" x 17"; except for actual pattern or template type drawings, the maximum sheet size shall not exceed 24" x 36". The preferable sheet size is 22" x 34". Indicate the name of the firm that prepared each shop drawing and provide appropriate project identification in the title block. Do not reproduce contract documents or copy standard printed information as the basis of shop drawings.

2. All drawings shall use standard ANSI symbols.

3. Provide dimensioned drawings showing enclosure construction and arrangement. In addition, show the locations of all major face mounted devices such as meters, GC, OIU, FPR, VFDs, Breakers, etc. and all major internal components such as barriers, bus bars, CT, PT, etc.

4. Provide a one-line diagram, and three-line diagrams for all AC power circuits. The one-line diagram shall show at a minimum: breakers including frame size and trip setting; CT's CPT's, and PT's; protective devices; meters; control devices; and the size and temperature rating of all power conductors. The three-line diagrams shall show additional detail including wire terminations, CT shorting terminals, etc.

5. Provide schematics of all controls. Provide AC three line and DC control schematic diagrams for each generator, feeder, VFD, and master controls. Provide feeder and generator breaker control schematic diagram. Provide

24VDC control power schematic diagrams. Provide 120VAC control power, utility power convenience receptacle, and fan control schematic diagram. Schematics shall be in ladder diagram format and shall show all control devices, and wire and external terminal block numbers.

6. Provide a Point I/O communication network schematic diagram showing device level ring, Point I/O modules and Ethernet I/O ETAP. Identify device location in switchgear. Include Node Addresses.

7. Provide a communication network (LAN) schematic diagram showing all switches, meters, GC's, OIU, FPR, VFDs, Data Storage Server, PLC, device level ring Ethernet I/O ETAP, Serial to Ethernet servers and external I/O devices. Identify device location in switchgear. Include IP Address for all devices.

8. Provide a communication network schematic diagram showing CANbus connection to GC's, and J1939 connection to IKD-1 digital I/O expansion modules and engine ECU's. Identify device location in switchgear.

9. Provide drawings showing terminal block layouts and interconnecting wiring. The drawings shall show the physical layout of the terminal blocks with their appropriate designations and all connections between terminal blocks, auxiliary switch contacts, control devices, instrumentation, protection devices, etc.

10. Provide drawings of control switches showing all terminals with numbers, including terminals not used. Identify the use of the terminals.

11. Provide drawings that show annunciator layouts and nameplate engraving.

12. Provide the following PLC information: a complete ladder diagram showing all address numbers, rung reference numbers, and all preset register values. Include detailed narrative describing the purpose of each rung. Provide complete tables or schedules listing all utilized I/O addresses, internal relay addresses, and timer, counter, and register addresses and values. Include the latest revision date.

13. Clearly identify all shipping splits. Provide wiring harnesses for any control wiring required to connect between shipping splits. Drawings shall clearly indicate the wiring harness and connections. Provide terminal blocks between the shipping splits for ease of wiring in the field.

E. Provide proposed settings for review for each GC and Feeder Protection Relay as specified in the sections that follow.

F. Upon completion of factory testing and prior to shipping, provide test reports documenting compliance with the testing requirements under Part 3.

1.4 QUALITY ASSURANCE

A. Equipment provided under this section shall not have been in service any time prior to delivery, except as required by testing.

B. Solid-state circuitry shall meet or exceed the Transient Overvoltage Withstand Test per NEMA ICS1-109 and the Surge Withstand Capability Test (SWC) per IEEE Standard 472 (ANSI C37.90A). In addition, where UL or equivalent standards exist for components, devices, and/or assemblies, such standards shall apply.

C. Perform all work with skilled craftsman specializing in said work. Install all materials in a neat, orderly, and secure fashion as required by the specifications and commonly recognized standards of good workmanship.

D. The switchgear shall comply with the requirements of the National Electrical Code for Essential Electrical Systems and shall also comply with applicable standards of NEC, ANSI, IEEE and NEMA.

E. The switchgear shall also be designed, assembled and tested in strict accordance with UL 891 Standard For Switchboards and UL 508A Standard For Industrial Control Panels or equivalent. The entire switchgear assembly including all accessories shall be listed and labeled as an assembly under UL 891 or equivalent independent testing laboratory standard recognized by the State of Alaska. A nameplate indicating the listing shall be permanently affixed to each section of the switchgear.

1.5 FABRICATOR QUALIFICATIONS

A. The switchgear shall be designed, assembled, and tested by a qualified fabricator (Fabricator) who is regularly engaged in the business of providing generation switchgear. A list of five prior projects that key staff have worked on may be requested by the Authority after the bid opening and prior to award to verify Fabricator qualifications. The list shall include installation date, description of installation, and a reference contact for each installation.

B. At the time of bid submittal, the Fabricator shall have current authorization from a third-party listing agency to provide listed switchgear as required by the specifications. Evidence of authorization may be requested by the Authority after the bid opening to verify Fabricator qualifications.

1.6 FABRICATOR WARRANTIES

A. The Fabricator shall warrant the work for a period of not less than one-year. The warranty period shall commence upon acceptance by AEA of field testing with the engine generators and final commissioning of the equipment.

B. Provide a nametag on each piece of equipment that clearly identifies the party responsible for the warranty. Nametag shall include the name, address, and phone number, and shop order or Fabricator's serial number.

C. In the event of a failure of equipment or components or a failure of the system to perform all specified functions during the warranty period, the Fabricator shall repair or replace such defective equipment or components and revise programming and settings as required to achieve full system function. The Fabricator shall assist the Authority as directed to determine the cause of failure

and pursue manufacturer's warranties to the extent necessary to obtain replacement equipment and provide proof of action taken upon request.

D. The Fabricator shall provide up to an additional eight (8) hours of programming assistance and technical support to modify the system programming as requested by the Authority or its Designee(s). These hours are in addition to any technical requirements specified for programming, start-up, and commissioning efforts, and shall be included in the Fabricator's bid price. The programming assistance and technical support may be required to be provided at a single event or may be spread out over the year as directed by the Authority or its Designee(s), and will be performed remotely from the Fabricator's office and not at the Utility location.

1.7 OPERATION AND MAINTENANCE MANUALS

A. Provide operation and maintenance (O&M) manuals for all equipment provided under this contract.

B. The O&M manuals shall be in addition to any instructions or parts list packed with or attached to the equipment when delivered, or any information submitted for review.

C. The O&M manuals shall include at a minimum the following information:

1. Sequence of operation of the switchgear system.
2. Documentation and operating description of SCADA system.
3. A complete tag list of all input/output devices including, but not limited to, the PLC, GC, and all monitored and controlled devices.
4. Bill of material for all equipment or material provided as part of the switchgear as previously indicated under Submittals.
5. Manufacturer's catalog literature for all accessories and equipment as previously indicated under Submittals.
6. Complete shop drawings as previously indicated under Submittals, revised to reflect as-built conditions of final construction.
7. Complete test reports documenting all factory tests performed in accordance with requirements of PART 3.

D. The O&M manuals shall consist of a single Adobe Acrobat PDF file and shall be complete with all revisions and as-built data to reflect the actual equipment and material installed. The O&M manual shall be organized as follows:

1. Provide chapters to separate the different components into logical groupings, i.e. sequence of operation, warranty, bill of material, breakers, enclosures, battery system, meters, etc. At the beginning of each chapter, provide a page with the chapter number.
2. Provide subchapters for each individual switchgear item. Bookmark each chapter and subchapter such that each component can be navigated to directly from the bookmark.

3. Near the front of the PDF file, provide the Bill of Material organized so that each item is identified with the chapter or subchapter where the documentation is located.

4. At the end of the PDF file, provide all drawings, inserted horizontally. Provide a chapter for the drawings and individually bookmark each drawing.

E. Email download link for the final O&M file to the Authority and provide a copy to the Authority on a USB thumb drive.

PART 2 - PRODUCTS AND ASSEMBLY

2.1 GENERAL

A. All equipment and material furnished shall be new. Equipment furnished and installed under this section shall be fabricated and assembled in full conformity with the project design drawings, specifications, engineering data, instructions, and applicable standards.

2.2 ACCEPTABLE MANUFACTURERS OF SWITCHGEAR COMPONENTS

A. Specific parts manufacturer and model have been specified in the following paragraphs not only to meet performance function but also to coordinate and interface with other devices and systems. Approved equal substitutions will be allowed only by Authority's approval. To obtain approval, submittals shall clearly demonstrate how substitute item meets or exceeds specified item quality and performance characteristics and also complies with electrical connections and physical layout requirements.

B. The following products are specified by brand and part number to maintain commonality for programming and service with similar switchgear used in other rural Alaskan communities. Substitutes will not be allowed for the following components:

1. Programmable Logic Controller (PLC): Allen-Bradley.

2. Genset Controller (GC): Woodward or ComAp.

3. Metering Equipment: Shark 250.

4. Feeder Protection Relay (FPR): Schweitzer Engineering Laboratories. Inc.

C. Acceptable manufacturers of all components not otherwise indicated shall be ABB, Allen-Bradley, Eaton, IDEC, or Square D.

2.3 SWITCHGEAR ENCLOSURE

The following paragraphs describe general fabrication requirements for the switchgear enclosure.

A. Provide a freestanding enclosure that is factory built, wired, and tested by the switchgear fabricator. Hinged front-opening doors shall provide required access to all components.

B. The switchgear shall be front access for all control devices. Provide warning labels and source voltage labels.

C. All switchgear sections shall be dead front type NEMA 1A construction and labeled in accordance with UL-891, or equivalent. The enclosure shall be divided into individual sections and the maximum dimension of each section shall be as indicated on the project design drawings. All sections shall be of equal depth and front aligned. Each switchgear section shall be a completely self-supporting structure and shall be capable of being rolled, moved or lifted into the installation position and bolted directly to the floor without the addition of floor sills. Individual sections shall be bolted together to form the required arrangement.

D. The enclosure frame shall be die formed 12-gauge steel with reinforcing corner gussets internal and external to the structure members. Alternatively, a 2”x 2”x 3/16” steel angle frame may be used. Bolt-on side, top and rear covers shall be steel of minimum gauge required by listing standard.

E. Provide each section with an individual hinged door with latches and concealed hinge construction. Latches shall be one of the following.

1. One three-point single handle operated latch.

2. Multiple single-point latches consisting of captive knurled handle quarter-turn cam fasteners. Doors which are 36 inches or less in height shall have a minimum of two single-point latches; doors which are greater than 36 inches in height shall have three single-point latches.

F. Provide each section with back and side pans as required for mounting equipment and wiring. Mounting attachments shall be welded studs or other approved methods. No bolts, screws, or other attachment hardware shall be visible from the exterior.

G. For each generator section provide separate cubicles for control and power using interior barrier panels to ensure isolation of equipment for safety to personnel during service and maintenance or cable pulling. The upper cubicle shall contain the low voltage (120V max) controls. The lower portion shall contain 480V power equipment and ancillary devices.

H. Power and control cables shall enter from the top. Provide a cable area behind the controls cubicle of each generator section for routing power cables. Provide isolation barriers between each cable area such that each section is completely isolated from any adjacent section. Provide a removable cover plate on top of the cable area large enough to terminate a minimum of 3 each 3” rigid conduits with locknuts and conduit bushings. The removable cover plate shall cover the entire cable area.

I. The switchgear shall have one master section. The master section door shall swing so the door front is visible from the generator sections. See the enclosure layout on the project design drawings.

J. The switchgear shall have one feeder/VFD section or multiple sections as indicated.

K. Where the main bus is not isolated by barrier plates, provide a glastic cover for isolation over the entire length of the bus.

L. Overall nameplate. Provide an overall nameplate that provides the following information:

1. Fabricator's name, address, and phone number.
2. Fabricator's serial number or project identification.
3. Year of manufacture.
4. Third party listing identification.
5. Rated maximum voltage.
6. Rated bus ampacity.
7. Rated bus interrupting capacity.

2.4 PAINTING

A. Steel and iron surfaces shall be protected by suitable paint or coatings. Surfaces that will be inaccessible after assembly shall be protected for the life of the equipment.

B. Surfaces shall be cleaned, prepared and coated in the shop. All mill scale, oxides, and other coatings shall be removed. All metal enclosure parts shall be phosphatized to ensure that the metal is properly degreased and cleaned.

C. Exposed surfaces shall be finished smooth, thoroughly cleaned and filled as necessary to provide a smooth uniform base for painting and painted with one or more coats of primer and two or more finish coats of alkyd resin machinery enamel or lacquer as required to produce a smooth hard durable finish.

D. Provide a premium painting system throughout the painting process from initial cleaning to final assembly to assure a superior paint finish. All coatings shall be applied using an electrostatic paint system.

E. The color of the exterior panel finish coats shall be ANSI 61 light gray. The color of the interior back and side pans shall be white.

2.5 CONTROL WIRING

A. All control wiring for the switchgear shall be minimum 600-volt, copper 16-gauge, strand type SIS wire or equivalent. The Fabricator shall be responsible for sizing the appropriate wire for each component and circuit. Current transformer wiring shall be 12-gauge wire.

B. Terminate all wiring on terminal blocks or devices. No more than two wires shall be connected to a termination point. Terminal blocks for control wiring shall be 20 amp, 600 volt. Provide all terminal blocks and exposed relays located in the controls compartment with a plastic safety cover. Terminal blocks for DC circuits shall be separated from terminal blocks for 120VAC.

C. Wiring shall be installed in a neat and orderly manner in horizontal and vertical wiring troughs or channels with removable covers for easy accessibility. Wire

bundles, when required shall not exceed one (1) inch in diameter. Adhesive backed Ty-Rap bases shall not be used to support bundles. All wiring bases shall be securely attached with metal screws.

D. Extra flexible stranding wires shall be used in areas subject to flexing, such as areas where hinged brackets or swing racks/doors are used.

E. Only one wire shall be inserted into a lug. Install lugs with a ratcheting type crimping tool. Tag all wires with wire markers at both ends.

F. Splicing of control, CT, or PT wires is not allowed.

G. All control wiring landing on screw terminals shall have solderless terminals, ABB Sta-Kon or approved equal. Solderless terminals for current transformer leads shall be insulated ring-tongue type, all others shall be insulated fork-tongue type. All lugs and solderless terminals shall be tin-plated copper.

H. Wire current transformer leads to shorting type terminal blocks. Shorting pins shall be provided with storage locations for the shorting pins.

I. Provide terminal blocks for control wires that run between the switchgear and external equipment and devices. Clearly label terminal blocks to match the designation shown on the Fabricator's drawings. Provide a separate terminal strip for interconnection with each generator. The generator terminal strip shall be arranged and numbered exactly as shown on the project design drawings.

J. Both ends of each wire shall be identified per the marking and numbering shown on the wiring drawings with heat shrink or wrap-around adhesive labels.

K. All ground wires shall have green insulation. Note that wires larger than #6 may be marked with green tape.

2.6 BUS BAR

A. Provide silver-plated copper main bus bars. Size the main bus to meet the ampacity indicated on the project design drawings. If the actual ampacity of the bus installed exceeds the design value, the switchgear bus shall be rated as indicated on the project design drawings.

B. The main bus shall be well braced to meet the short circuit ratings of the generators. Minimum bus bracing shall be 30,000 amperes symmetrical, unless indicated otherwise on the project design drawings. The main bus shall be installed on insulators to provide proper clearances between phases and phase to ground.

C. Provide an isolated copper neutral bus rated the same as the main bus. The neutral bus shall have a single removable connection to the ground bus. The connection shall be accessible in the feeder section.

D. Provide a bonded copper ground bus minimum size 2" x 1/4", or as required for the bus ampacity.

E. Horizontal bus joints between each section shall be silver-plated copper. Bus joints shall be bolted with high tensile steel bolts with spring loaded Belleville type washers.

F. A-B-C type bus arrangement (left-to-right, top-to-bottom, front-to-back) shall be used throughout to assure convenient and safe testing and maintenance.

G. Provide termination bars on the load side of the feeder breaker and on the line side of the generator breakers for termination of field wiring. Provide holes in the termination bars for field connection of lugs suitable for termination of #4/0 AWG cables, minimum 2 for each phase. Provide additional holes where specifically indicated.

H. The feeder, generator, VFD, and station service circuit breakers shall be connected to the main bus by cables. All cables and connections shall be rated for the full ampacity of the circuit breaker frame.

2.7 GENERATOR AND DISTRIBUTION CIRCUIT BREAKERS

A. Provide each generator and distribution feeder with an electrically operated stationary mount type circuit breaker. Circuit breakers shall be ABB SACE E-Max, Eaton Magnum DS, Square D Masterpact NT, or approved equal.

B. Circuit breakers shall be designed for continuous operation at 100% of the circuit breaker rating. Circuit breakers shall be suitable for power flow in either direction through the breaker.

C. Minimum interrupting rating of breakers shall be 50,000 amperes symmetrical.

D. Provide breaker frame size as indicated on the project design drawings.

E. A protective trip element is not required, as protection will be provided by the GC for the generator breakers and by the FPR for the distribution feeder breaker.

F. Provide circuit breakers with the following features:

1. Three-pole stationary mount.
2. Remote open/close.
3. Shunt trip.
4. 24V DC control voltage.
5. 120V AC spring charging motor for automatic recharging of the breaker stored energy mechanism. The stored energy mechanism shall be capable of an open-close-open cycle without recharging.
6. Anti-pumping feature.
7. Manual spring charging mechanism.
8. Mechanical operation counter.
9. Auxiliary switch module.
10. Lockable push button cover

2.8 SWITCHGEAR DEVICES

A. Nameplates. All nameplates shall be black with white core type. Nameplates shall have beveled edges and shall be secured with a minimum of two mounting screws. Provide nameplates for each device on the front of the switchgear and

inside the switchgear. Inside the switchgear compartments, all relays, control switches, lights, etc. to which control or instrument transformer wiring connects, shall be marked by nameplates, with designations corresponding to the same device designations used on the wiring drawings and approved by the Authority. Nameplates inside the switchgear located on the front doors may be attached using adhesive epoxy.

Relays shall have the nameplates installed separate from the relay such that the relay can be removed without affecting the nameplate. Route all wiring such that it does not inhibit the visibility of the nameplate or interfere with the removal of the relay.

B. Selector Switches. Selector switches shall be heavy-duty type. Contacts shall have silver butting or sliding contacts, rated 10 amperes continuous at 120 volts AC. Contact configuration shall be as required for the application. Legends shall be engraved on the switch nameplate. Unless otherwise specified, all selector switches located on the front of the enclosure shall be Electroswitch Series 24 or approved equal.

1. System Mode Switch. AUTO/MAN ISOCH, Two-position lever operated maintained contact. Electroswitch 24201C or approved equal.

2. Feeder Breaker Control Switch. TRIP/ /CLOSE Three-position lever operated momentary contact spring return to center, Electroswitch 2438D or approved equal.

C. Generator Lockout Switch (GLS). Key operated maintained contact OFF/RUN switch with normally closed contact. Allen Bradley 800FM-KM21 with metal latch 800F-ALM, Eaton Series 10250, or approved equal.

D. Reset/Test Buttons. Push type momentary contact, normally open, 22 mm, non-illuminated, flush mount with metal latch. Allen Bradley Series 800, Eaton Series 10250, or approved equal.

E. Emergency Stop Button. Red push/pull maintained contact with guard and yellow stop ring. Allen Bradley 800T-FX6D4 or approved equal.

F. Annunciator Lights. LED cluster type panel mount lamps, 24 VDC. IDEC Corp. Series SLC40, or approved equal.

G. LED panel illumination kit with motion sensor, 24-56VDC. Rittal 2500320 or approved equal.

H. Convenience receptacle. 120 volt duplex receptacle, din rail mount, 15 ampere rating, GFI. Phoenix Contact 5600462, or approved equal.

I. Control Relays/Time Delays. Relays and timers for control operations or isolation shall be of the plug-in socket base type with dustproof plastic enclosures unless noted otherwise. Relays and timers shall be UL recognized, have 120-volt AC or 24-volt DC coils, depending on the application. Relays shall not have less than double-pole, double-throw contacts. Control circuit relays shall have silver-cadmium oxide contacts rated for 10 amperes at 120 volts AC. Electronic switching duty relays shall have gold-plated or gold alloy contacts suitable for use

with low-level signals. Relays utilized for PLC input, alarm input or indicating light service shall have contacts rated not less than 3 amperes. Provide all relays and timers with indicating lights. IDEC Corp. or approved equal.

1. Relays for use on 24-volt DC circuits shall be provided with different bases than those for use on 120-volt AC circuits to prevent inadvertent swapping of relays.
2. Auxiliary power relays shall be Allen-Bradley series 700, minimum 20A rated, or approved equal.
3. Dead bus relay shall be IDEC RR3BUL-AC120V with SR3B-05 base, or approved equal.

J. Circuit Breakers.

1. Protective devices shall be resettable circuit breakers for all AC and DC circuits in the switchgear. Replaceable fuse type devices are not acceptable.
2. Circuit breakers shall be molded case type of the amperage, voltage, short circuit capacity, and number of poles required for the application or as indicated on the one-line diagram.
3. Provide manually operated molded case circuit breakers to protect the branch power circuits of the variable frequency drives (VFDs). The breakers shall be sized and connected as indicated on the one-line diagram on the project design drawings, and as specified herein. Provide each breaker with a shunt trip.
4. Provide manually operated molded case circuit breakers to protect the station service transformer and other branch circuits as indicated on the one-line diagram on the project design drawings. The breakers shall be sized and connected as indicated, and as specified herein. Mount the breakers in the face of the switchgear with a protective guard and provide auxiliary contacts to indicate position. Wire the closed position contact to the PLC to provide alarm indication any time the breaker is not closed (either tripped or manually opened).

K. Current Transformers. Instrument current transformers shall be specifically designed for installation in switchgear. The design shall coordinate the thermal, mechanical, and insulation limits of the current transformers with those of the breakers and bus of the switchgear. Provide current transformers of the wound or window type, with silver-plated primary terminals. Insulation shall be suitable for 600 volt service.

1. Current transformers for relay service - minimum C20 accuracy class with a rating factor of 2.0.
2. Current transformers for meters - metering class with a minimum 0.3% accuracy, a rating factor of 1.5, and a burden rating such that they will not saturate up to the nominal rating.

3. Multi-ratio Current transformers - provide ratio as indicated with the accuracy specified at full distributed windings.

4. The CT burden shall be suitable for the devices attached without saturating.

5. All CT's shall be provided with shorting type terminal blocks complete with shorting pins.

L. Potential Transformers. Provide instrument rated potential transformers in the quantity and ratio as indicated on the project design drawings. Provide primary and secondary protection using circuit breakers.

M. Control Power Transformers. Provide control power transformers for circuit breaker trip mechanism charging in the quantity and ratio as indicated on the project design drawings. Provide primary and secondary protection using circuit breakers.

N. Ambient Air Temperature Sensors. Provide moderate temperature range, 2-wire, platinum RTD, 100 ohms +/- 0.15%, @ 0°C tolerance. Pyrocom RLB73203E10S, or approved equal.

2.9 GENSET CONTROL PACKAGE

The basis of design is the Easygen as specified below. The only acceptable substitute is a ComAp InteliGen 500. If using the ComAp, furnish equivalent modules and accessories as required to provide all features and perform all functions as specified for the Easygen.

A. Genset Controller (GC). Door mounted style with display face, Woodward Easygen Model 3200XT-P1, Part Number 8440-2082, or ComAp InteliGen 500.

B. Easygen IKD-1 digital I/O expansion module, 8 inputs, 8 outputs. DIN rail mounting, 24V DC. Woodward 8440-2028, or ComAp equal.

C. Signal Converter. Multi-input, 4-20mA Output, 2 programmable relay outputs. Provide for isolation protection of Easygen analog inputs. Prosense SCU-1600 or approved equal. Provide minimum one (1) Signal Converter Programming/Display Module SCU-PDM1 or equal.

D. Additional items, components, or wiring that may be required for a complete and operational system as specified herein.

2.10 PROGRAMMABLE LOGIC CONTROLLER

A. Programmable Logic Controller. Allen-Bradley, CompactLogix 1769, no substitutes. Provide the following:

1. 24VDC power supply. Allen-Bradley 1769-PB4.

2. CPU (2 Mb Memory, Ethernet). Allen-Bradley 1769-L33ER.

3. ModBus TCP/IP Communications Module. Pro-Soft MVI69E-MBTCP.

4. Right End Cap/Terminator. 1769-ECR.

5. Point I/O Modules, 24VDC, as required which may include the following:

a. 8 point digital input module, sinking. Allen-Bradley 1734-IB8.

b. 8 point digital output module, sourcing. Allen-Bradley 1734-OB8.

c. 2 point analog input module, 4-20mA. Allen-Bradley 1734-IE2C.

d. 2 point analog output module, 4-20mA. Allen-Bradley 1734-OE2C.

e. 2 point RTD input module. Allen-Bradley 1734-IR2.

f. PLC to Ring I/O ETAP. Allen-Bradley 1783-ETAP.

g. 2 Port Ethernet/IP adapter, redundant. 24VDC power. Allen-Bradley 1734-AENTR.

h. 24VDC power extension module. Allen Bradley 1734-EP24DC.

6. Provide additional items as may be indicated on the project design drawings or required for the proper and complete operation of the system as specified.

B. Provide cables, connectors, and interface devices as required for a complete and operational system.

C. All I/O devices shall be connected in a single ethernet ring.

2.11 OPERATOR INTERFACE UNIT

A. Operator Interface Unit (OIU). A human machine interface (HMI) referred to herein as OIU shall be installed on the front of the switchgear master section door. The OIU shall be an integrated touch screen display computer with solid state drives, Logic Supply CV-115C-P1001, or approved equal. The OIU shall meet the following minimum requirements:

1. 15” display with minimum of 1024 x 768 pixel resolution.

2. LCD Color: 16.2M, Pixel Pitch (mm): 0.297 (H) x 0.297 (V).

3. Projected Capacitive Touch.

4. Intel Atom Processor E3845 Quad Core. 2 GB SO-DIMM DDR3L 1066/1333MHz memory, 40 GB SATA Solid State Hard Drive, Compact Flash Drive.

5. 3 USB 2.0 Ports, 1 USB 3.0 port, 10/100M Ethernet Port, serial port.

6. 24VDC power supply.

7. Windows 10 Professional, 64 bit.

8. Passive cooling without fan.

2.12 FEEDER PROTECTION RELAY

A. Feeder protection shall be provided by the Feeder Protection Relay. Feeder protection relay (FPR) shall be Schweitzer Engineering Laboratories, Inc. model SEL-751A, no substitutes. The Fabricator shall determine complete FPR settings for each feeder in accordance with the Feeder Sequence of Operation that follows.

Fabricator shall develop the actual configuration part number to provide a relay that meets all requirements as follows.

1. Under/over frequency.
2. Under/over voltage.
3. Instantaneous overcurrent (phase/neutral).
4. Time overcurrent (phase/neutral).
5. Residual instantaneous overcurrent.
6. Residual time overcurrent.
7. Neutral instantaneous overcurrent.
8. Neutral time overcurrent.
9. The FPR shall also be provided with the following additional features:
    a. EIA-232 Rear, Single 10/100BASE-T Ethernet, Modbus TCP, IEC 61850.
    b. 24V DC power supply and input.
    c. DI/DO as required to meet the requirements of the specifications.
    d. Three-phase voltage and current input. Five amp current.
    e. Synchronism check element.
    f. Metering to include the following:
        - Voltage, L-L and L-N.
        - Current; three phase and neutral.
        - Percent voltage imbalance.
        - Apparent power (kVA).
        - Real power (kW).
        - Reactive power (kVAR), positive or negative.
        - Power factor.

2.13 METERING EQUIPMENT

A. Bus Meter. Class 10 current inputs, 120VAC input, 18-60VDC power supply. Provide with Ethernet communications port, panel mount remote display module, cable, and optional 4-20mA I/O card. SHARK 250-60-10-V2-D-INP100S-20mAOS, no substitutes.

B. Station Service Meter. The station service meter shall be identical to the bus meter except without the optional 4-20mA I/O card. SHARK 250-60-10-V2-D-INP100S-X, no substitutes.

C. Provide all cables, connectors, and other devices including CT shorting terminal blocks as required for a complete and operational metering system.

2.14 DATA STORAGE SERVER

A. An industrial fanless mini PC shall be installed in the switchgear master section. The mini PC shall be as follows:

1. Processor: Intel Core i7-1165G7 up to 4.7GHz
2. Ram: 16 GB, SO-DIMM DDR4 3200MHz (non-ECC)
3. Hard drive: minimum 512 GB M.2 NVMe SSD
4. Auto Power On
5. Dust Filter for Small Form Factor
6. Windows 10 Professional, 64 bit
7. DIN Rail Mounting Kit or Mounting as required
8. 60W 12VDC Power Supply
9. OnLogic ML100G-53, or approved equal.

B. Furnish and install all cables and interface devices required for a complete and operational system plus any additional devices that may be required to be fully functional and meet the requirements of these specifications.

2.15 LOCAL AND REMOTE ACCESS

A. Provide the switchgear with an Ethernet connection for access to the switchgear LAN via high speed internet. See Summary of Work, Section 01 11 13, for internet service requirements.

B. Industrial Ethernet Switch. 16 port, Unmanaged, 10/100 MBPS, 24VDC Ethernet switch, N-Tron 116TX or approved equal. All equipment shall be connected to provide seamless communication between the PLC, LAN devices and the Ethernet connection to the Internet. Provide multiple switches for systems requiring more than 16 ports.

C. Secure Serial to Ethernet Server. Configured to support RS-232, RS-422, and RS-485 with two pin power terminal connector. NetBurner SB800EX-TDD-IR or approved equal with DIN 200 mounting bracket. Install industrial SD card.

D. The data storage server shall store historical and real time data from the PLC and Bus and Station Service Meters, and shall provide the primary means for remote access via LogMeIn for data retrieval, remote monitoring, and device programming access.

E. All devices on the switchgear LAN shall be remotely accessible via the internet for system monitoring, data acquisition, and troubleshooting. Remote access shall allow a technician in another location to modify and/or view all operational screens and all logic in the PLC, as well as the GCs, FPR, VFDs, Serial to Ethernet Server(s), metering equipment and LAN Router.

F. Provide communications connections as required for the proper operation and control of the systems.

2.16 CONTROL POWER

A. Control power for the switchgear shall be 24VDC, except where specifically indicated otherwise. All meters and other components requiring auxiliary power to operate shall operate from the 24VDC control power source, unless otherwise specified. All control circuits shall be 24VDC.

B. Provide a complete 24VDC power supply with redundant secondary backup. Include all items described below plus all other components required for a complete system. The primary source shall be a 120VAC to 24VDC power supply using 120VAC station service power. The secondary source shall be from a 24VDC-24VDC battery buffer module using power from 24VDC engine batteries. The two power supplies shall be coordinated to automatically switch from the 120VAC source to the 24VDC source upon loss of AC power and automatically switch back when the AC power is restored. The system shall provide continuous power without interruption. The 24VDC control power system shall include the following major equipment:

1. Primary Power Supply. 100-240VAC primary input, minimum 20 amp, 24VDC output at 45°C. PULS CP20.241-S1, or approved equal. Install in the master section. Set output to 26 VDC to ensure it operates as the primary source when AC power is available.

2. Battery Buffer Module. 22-29VDC input, minimum 15 amp, 24VDC output. The module shall include capacitors to buffer power during engine crank cycles with a minimum capacity of 15A for 9 seconds. Siemens 6EP1933-2EC51, or approved equal. Install module in the master section.

C. The DC power from the engine batteries shall enter in the respective generator section. A 20A circuit breaker shall be installed on the battery power supply.

D. The 24VDC outputs from each generator section shall be connected to the 24VDC input on the battery buffer module in the master section through a power bridge rectifier, minimum 35A, rated, Powersem PSB-35/08 or approved equal. Provide multiple rectifiers as required for the quantity of inputs.

E. The 24VDC outputs from the Primary Power Supply and the Battery Buffer Module shall be connected together in the master section through a power bridge rectifier, minimum 35A, rated, Powersem PSB-35/08 or approved equal.

F. The 24VDC power supply to each switchgear section (master, generator, and feeder/VFD) shall be isolated through a 15A circuit breaker in each respective section.

G. Each major device or meter shall be individually protected by circuit breakers. Clearly mark each circuit breaker for the intended service.

H. 120VAC Circuit Breaker Charging - Power for the distribution feeder circuit breaker spring charging motor(s) shall be derived from a control power transformer connected to the main bus. Power for the generator circuit breaker spring charging motors shall be derived from a control power transformer connected on the generator side of the circuit breaker.

I. 120VAC Control and Utility Power – Provide 2 sets of terminals for connection of incoming 120VAC power, 20A, single phase. One shall be for utility power and one for control power as indicated. The 120VAC system shall include:

1. Utility Power – One circuit shall provide power for ventilation fans and convenience receptacle.
2. Control Power - One circuit shall provide power to the UPS and to the 120VAC to 24VDC power supply. No other devices shall be connected to this circuit. Provide a 15A circuit breaker to serve the UPS and a 10A circuit breaker to serve the power supply.
3. UPS – The UPS shall be complete with a sealed leak-proof maintenance free lead acid battery. It shall be 120V, 60Hz, 15A input and 120V, 60Hz, 1500VA output. APC SMT 1500C or approved equal.
4. The UPS shall be installed in the master section and shall be connected to provide 120VAC power to the data storage server.

2.17 VARIABLE FREQUENCY DRIVES

A. Provide the following VFD section components:

1. Main circuit breaker. Manually operated molded case circuit breaker, 15A, 3 pole. Allen Bradley 1489-M3D150, or approved equal. Furnish with auxiliary contacts and shunt trip.
2. VFD Selector Switch. Three-position lever operated maintained contact switch to select between VFD/BYPASS/OFF operating modes. The switch shall be rated for occasional switching of motors of the size and voltage indicated, Salzer Part # H216-71322-013V1 or approved equal. Furnish with a minimum of 4 each auxiliary contacts.
3. Variable Frequency Drive. Square D Altivar ATV320U40N4B, or approved equal, complete with the following features and accessories:
    a. UL listed.
    b. Sized for continuous operation of 5 hp motor.
    c. Ramp regulation, flying start, and step logic.
    d. Built-in PID control using 4-20 mA signal as the control variable.
    e. Sensorless vector slip compensation.
    f. Motor protection including overload protection, short circuit protection, ground fault protection, and under & over voltage protection.
    g. 1:100 speed range.
    h. RS-485, ModBus protocol.
    i. 4-20 mA analog input.
    j. Four assignable logic inputs.

k. Two relay logic outputs.

l. Remote Graphic Display Terminal. Square D VW3A1101, or approved equal.

m. Remote Graphic Display Mounting Kit. Square D VW3A1102, or approved equal.

n. Modbus TCP/IP Ethernet communications card. Square D VW3A3616, or approved equal.

o. Cables and connectors as required.

4. Contactor for normal run operation. VFD isolation contactor, 3-pole, 600V, 23A with 24VDC coil. Allen-Bradley model 100-C23EJ10, or approved equal. Furnish with one normally open auxiliary contact.

5. Adjustable solid-state overload relay, 480-volt, 3-phase, adjustable range. Allen-Bradley model 193, or approved equal, complete with din rail adapter.

a. For motor sizes 2 HP and smaller provide 1.0-5.0A trip range.

b. For motor sizes 3 HP and 5 HP provide 3.2-16A trip range.

6. Cooling fan, with filter and grille, sized to keep the VFD operating within its temperature limitations based on a 100° F ambient temperature.

2.18 ENGINE/GENERATOR SECTION ASSEMBLY

A. Provide the following components for each generator section as required to allow automatic or manual operation and control of each generator.

1. Genset Controller (GC). The GC shall communicate to the PLC via Modbus TCP and Point I/O blocks. The top of the GC screen shall not exceed 60” above the bottom of the switchgear.

a. Signal Converter. Provide a signal converter on Analog Inputs 1 thru 3, to provide isolation and protection

b. EasYgen IKD-1 digital I/O expansion module. Provide as needed to meet the functional requirements of the system.

2. Generator Lockout Switch. Provide a key operated OFF/RUN switch mounted in each generator control section door. All switches for the entire project shall utilize a common key. Provide two keys for each generator section.

3. Alarm Reset. Provide an Alarm Reset push button that resets all GC alarms after the alarm condition has been corrected.

4. Service Hours Reset. Provide a Service Hours Reset push button that resets the timer for engine service (oil change) intervals.

5. Generator Circuit Breaker.

6. Control power transformer for spring charging motor, size as indicated on the project design drawings.

7. Potential Transformers, quantity and ratio as indicated on the project design drawings.
8. Current Transformers for relaying, quantity and size as indicated on project design drawings. Provide with shorting terminal blocks.
9. 24VDC 15A circuit breaker for control power.
10. LED panel illumination kit, complete with motion sensor.
11. Provide Terminal Blocks, Relays, Timers, Bases, as needed.
12. Generator breaker Status Annunciation LEDs (mount immediately above generator breaker control switch):
    a. Generator "#" Breaker Closed (red)
    b. Generator "#" Breaker Open (green).
13. Provide annunciation LED's, mount near top of cabinet, left to right:

    Top Row

    1) Engine Running (green).
    2) Alarm/Lockout (red).
    3) Low Oil Pressure (red).
    4) Oil Level (red).
    5) High Coolant Temperature (red).
    6) Over Speed (red).
    7) Over Crank (red).
    8) Running Timeout (red).
    9) Battery Charger Failure (red).
    10) Air Filter Plugged (red)
    11) High Exhaust Temperature (red).
    12) Spare or High Intake Air Temperature (red), see note 2.

    Second Row

    1) Lead Engine (green). Note that this is only for units with two or more identical size engines. See Note 1.
    2) Normal Stop (amber).
    3) Not in Auto (red).
    4) Service Engine (red).
    5) Fail to Synchronize (red).
    6) Over Current (red).
    7) Under Voltage (red).

8) Over Voltage (red).

9) Under Frequency (red).

10) Over Frequency (red).

11) Reverse Power (red).

12) Spare or Charge Air VFD Failure (red), see note 2.

Note 1: For sections that do not require a specific lamp such as Lead Engine provide spare lamp with blank nameplate.

Note 2: Provide High Intake Air Temperature and Charge Air VFD Failure on engines with charge air cooler. Provide Spare on all other engines.

2.19 MASTER SECTION ASSEMBLY

A. Provide the following components in the master section:

1. PLC.
2. OIU.
3. Bus Meter.
4. Station Service Meter.
5. Data Storage Server.
6. Control Power Supply, 120VAC / 24VDC.
7. Battery Buffer Module.
8. Uninterruptable Power System (UPS)
9. Secure Serial to Ethernet Server.
10. Dead bus relay.
11. Industrial Ethernet Switch, minimum quantity two.
12. System Mode Switch, AUTO / MAN ISOCH.
13. Emergency Stop Button.
14. A single RESET push button that manually resets all master section alarms.
15. A single LAMP TEST push button that tests all master section and engine generator section annunciation LEDs simultaneously. Note that this includes all master and generator section lamps but does not include VFD lamps.
16. Terminals and circuit breakers for switchgear control and utility power.
17. LED panel illumination kit, complete with motion sensor.
18. Convenience receptacle, 120 volt duplex GFI receptacle, din rail mount, 15 ampere rating.
19. Terminal Blocks, Relays, Timers, Bases, as required.

20. Spare Input: Provide a minimum of 2 spare PLC discreet input pairs wired to terminal blocks.

21. Spare Output: Provide a minimum of 2 spare two-pole relays wired to terminal blocks and controlled by PLC.

22. Master annunciation LED's, mount near top of cabinet, left to right:

Top Row

1) Fire Alarm (red).
2) Emergency Stop (red).
3) Low Coolant Level (red).
4) Fuel Level (red).
5) PLC/ Point I/O Failure (red).
6) System Not In Auto (amber).
7) Station Service Breaker Open (red).
8) VFD Main Breaker Open (red).
9) Feeder Breaker Trip (red).
10) Feeder Fail To Close (red).

Second Row

1) Spare (red).
2) Spare (red).
3) Spare (red).
4) No Load On Heat Recovery (amber).
5) Heat Recovery Loss Of Pressure (amber).
6) Heat Recovery Loss Of Flow (amber).
7) High Coolant Return Temp (red).
8) Spare (red).
9) Spare (red).
10) Spare (red).

B. Provide two ambient air temperature sensors, one for outside air temperature and one for inside air temperature. Temporarily secure in the master section for shipping. Final field installation shall be outside the switchgear.

2.20 DISTRIBUTION FEEDER/VFD SECTION ASSEMBLY

A. Provide the following feeder components:

1. Feeder Circuit Breaker.

2. Feeder breaker Status LED indicating lights (mount immediately above feeder breaker control switch):
   a. Feeder Breaker Open (green).
   b. Feeder Breaker Closed (red).
3. Control power transformer for spring charging motor, size as indicated on the project design drawings.
4. Feeder protection relay (FPR).
5. Feeder breaker manual control switch, open/close spring return to center.
6. Current Transformers, quantity and size as indicated on the project design drawings. Provide with shorting terminal blocks.
7. Potential Transformers, quantity and ratio as indicated on the project design drawings.
8. 24V DC 15A circuit breaker for control power.
9. LED panel illumination kit, complete with motion detector.
10. Circuit breakers for station service and VFD branch circuits, manually operated, with auxiliary contact, sized as indicated on the project design drawings.

B. Provide the following VFD components. Locate the variable frequency drives (VFD's) above the feeder breaker section(s) as indicated on the project design drawings.

1. Circuit breaker. Manually operated molded case circuit breaker, 15A, 3 pole. Furnish with auxiliary contacts and shunt trip. Auxiliary contacts shall indicate breaker position. Wire the closed position contact to the PLC to provide alarm indication any time the breaker is not closed (either tripped or manually opened). Wire the shunt trip to the overload.
2. VFD Selector Switch. Three-position VFD/BYPASS/OFF.
3. VFD.
4. Contactor for normal run operation. Connect to the load side of the VFD.
5. Overload relay. Connect to function in both VFD and Bypass modes. Wire into breaker shunt trip.
6. Nameplate on the door above the indicator lights identifying the VFD for Radiator No. 1, etc.
7. LED indicating lights, left to right.

   Top Row
   1) VFD Mode (green).
   2) VFD Running (green).
   3) Bypass Mode (amber).

   Second Row

1) VFD Fault (red).

2) VFD Breaker Open (red).

3) Spare (amber).

8. Cooling fan, with filter and grille. When more than one VFD is installed in a common enclosure install a minimum of two fans. Mount fan(s) at top or bottom of enclosure and provide an exhaust grille in the opposite location, on the front of the enclosure. Fan(s) shall run continuously.

9. Provide a single control wiring harness for control from the master section. Provide a single cable connection for VFD power from the bus through the VFD main circuit breaker.

10. LED panel illumination kit, complete with motion detector.

11. Install terminal blocks in a single location near the top of the VFD enclosure for field connection of all external control and power wiring for all VFD's. Use shielded wiring or separate routing for conductors on the load side of all VFDs.

12. Provide power for radiator control and temperature sensors from the 24VDC switchgear control power.

13. Provide ambient air temperature sensor permanently installed within the VFD section. For systems with more than one VFD section, provided one sensor in each section.

PART 3 - PROGRAMMING, TESTING AND PACKAGING

3.1 SYSTEM PROGRAMMING AND SOFTWARE INSTALLATION

A. The Fabricator shall furnish and install the following software on the Data Storage Server. All licenses shall be in the name of the Alaska Energy Authority

1. AB Studio 5000 Mini Edition EN License (PLC programming software).

2. Woodward Toolkit Easygen (GC configuration software) or ComAp equal.

3. Schweitzer AcSELerator. (FPR software, latest version).

4. Square D (SOMOVE). Or software for VFD provided.

5. SHARK metering software (latest version).

6. LogMeIn (AEA will provide installation credentials)

7. Any other devices installed in the switchgear that have custom software.

B. The Fabricator shall provide all PLC and GC programming as required to meet the requirements and intent of this specification.

C. The Fabricator shall prepare a complete tag list of all input/output devices including, but not limited to, the PLC, GC, and all monitored and controlled devices. The Tag List shall be in the form of a spreadsheet. If additional I/O or tags are requested by the Authority the Fabricator shall provide that information.

The tag list shall be used in the development of the SCADA system. A copy of the final tag list shall be included in the O&M Manual.

D. The Fabricator shall install the SCADA software as specified in 26 23 05.

E. The Authority will provide a list of usernames and passwords for the Fabricator to install on the system.

F. Upon completion of testing, archive at a minimum the following files on the server:

1. The original licensed copy of each software package.
2. The End User License Agreement (EULA).
3. Final setup files for the CG (Woodward wset), FPR (Schweitzer AcSELerator QuickSet), VFD, and Meters.
4. Final PLC programming.
5. Final Tag list.

G. Provide an identical copy of all archived files on a USB thumb drive.

3.2 INSPECTION AND WITNESS TESTING

A. The Authority shall have the right to inspect, at the factory, all equipment covered by these specifications any time during manufacture and assembly and to be present during any equipment tests.

B. The Authority may visit the manufacturing facility for final performance testing. The Fabricator shall make a technician available to the Authority to assist in the inspection and witness test of the switchgear. The technician shall instruct the Authority in all functions of the equipment.

C. The Fabricator shall notify the Authority two weeks in advance of the scheduled test date. Fabricator shall not ship equipment without approval by the Authority of the shop test reports. If the Fabricator ships the equipment without allowing the Authority to witness testing of the equipment, or before the Authority accepts the equipment test, the Authority reserves the right to have a third party test the equipment in Anchorage, Alaska or at the F.O.B. destination. All costs associated with a third-party test shall be deducted from the final payment. If the switchgear fails any test, the Fabricator shall be responsible for correction of all deficiencies, retesting, and proving the switchgear operates as specified and meets the requirements of these specifications with no increase in the contract price.

3.3 FACTORY TESTING

A. Prior to shipping, the Fabricator shall perform factory tests at the shop where the switchgear is assembled. Provide certified copies of all manufacturers' test data and results. Test procedures shall conform to ASME, IEEE, and ANSI standards, and NEMA standard practices section on testing, as appropriate and applicable.

B. The Fabricator shall provide all required equipment and measuring and indicating devices required to perform the tests indicated. All devices shall be certified correct or correction data furnished for the device.

C. The Fabricator shall calibrate and set all protective devices.

D. Tests shall indicate satisfactory operation of specified performance. If the Authority elects to witness the testing, prior to actual witness testing by the Authority, the Fabricator shall conduct sufficient tests and provide the test reports to the Authority to ensure that when the witness test is performed, the equipment will operate as specified.

E. Prior to factory testing the SCADA system shall be fully functional as specified in Section 26 23 05. The switchgear control system shall be fully tested using the SCADA system as specified herein. The OIU shall be fully functional and the switchgear shall be fully tested using the OIU. All alarm and control functions specified shall be available and indicated on the OIU.

F. At a minimum, perform the following operational tests:

1. Verify that the system performs the sequence of operations as specified.
2. Verify that the equipment performs each task as specified.
3. Verify all engine and generator protection functions for each GC.
4. Verify all feeder protection functions for the FPR.
5. Verify that the PLC starts and stops each generator based on the requirements of the demand table specified herein.
6. Verify that each annunciation point operates correctly. For external alarms, simulate the alarm.
7. Verify that all screens on the SCADA display correct data. Use an external computer to verify remote access for SCADA.
8. Test each VFD. Impress a 4-20 mA signal and verify the output of the VFD. Bench test completed unit. Provide a 3-phase motor of the size indicated and verify that the motor operates based on the 4-20 mA input signal.
9. Disconnect 120-volt AC control power in the master section to verify that the system continues to operate without interruption from the 24VDC source and that the server continues to operate from the UPS. Briefly turn off the 24VDC source and verify function of the battery buffer module.

G. Feeder Breaker Testing. Perform functional tests to prove correct wiring and operation of equipment. The tests shall include but not limited to the following:

1. Input 3-phase AC signal voltage to all external terminal blocks where potential transformer connections shall be made. Verify with a voltmeter and phase angle meter that the correct voltage is present at all points indicated.
2. Input 3-phase AC signal current to all external terminal blocks where current transformer connections shall be made. Verify with an ammeter, current test plug, and phase angle meter, where possible, that the correct current is present at all points indicated. Currents through devices not provided with current test jacks may be verified with a clamp-on ammeter.

3. Using the Schweitzer AcSELerator QuickSet software, verify the values input into the relay are the actual values displayed by the relay. Verify that the voltages and currents are in the correct phase relationship and that the phase rotation is correct. Make any corrections necessary.
4. Operate each control switch and selector switch in all positions to verify that all control circuits operate as shown on the schematic diagrams.
5. Verify proper operation of all blocking, closing, and tripping contacts of the FPR.
6. Simulate remote contacts and switches by jumpers at the appropriate external terminal blocks to verify proper circuit operation.
7. Visually verify that all indicating lights operate properly.

H. The switchgear equipment and circuit breakers shall receive the following tests:
1. Equipment.
   a. Low frequency dielectric test.
   b. Grounding of instrument cases.
   c. Control wiring and device functional test.
   d. Polarity verification.
   e. Sequence test.
   f. Low frequency withstand voltage test on major insulation components.
   g. Low frequency withstand test on secondary control wiring.
2. Main Bus: Megger test at 1000 volts each bus to ground and phase-to-phase.
3. Contactors:
   a. Coil check test.
   b. Clearance and mechanical adjustment.
   c. 300 Electrical and mechanical operation test.
   d. Conductivity of current path test.

I. Tests that are provided by the manufacturer of the equipment need not be duplicated. Provide documentation that the manufacturer's test was performed and passed.

J. Perform multiple repetitions of individual operations as required by the Authority to adequately demonstrate satisfactory operation of all functions.

K. Provide test reports documenting completion of factory testing prior to shipping.

L. Include complete test reports in the Operation & Maintenance Manual documenting all factory tests performed.

3.4 FIELD TESTING

A. Upon completion of field installation the Contractor shall fully test the switchgear.

B. Prior to field testing the SCADA system shall be fully functional as specified in Section 26 23 05. The switchgear control system shall be fully tested using the SCADA system as specified herein. The OIU shall be fully functional and the switchgear shall be fully tested using the OIU. All alarm and control functions specified shall be available and indicated on the OIU.

C. Test procedures shall conform to ASME, IEEE, and ANSI standards, and NEMA standard practices section on testing, as appropriate and applicable. The Contractor shall provide all required equipment and measuring and indicating devices required to perform the tests indicated. All devices shall be certified correct or correction data furnished for the device.

D. Field Testing and Commissioning shall coincide with Substantial Completion. Provide written notice to the Authority in accordance with 01 77 00 Contract Closeout. The Authority reserves the right to witness all tests.

E. Prior to performing tests verify that all field assembly is complete, all sections have been fastened to floor, all shipping splits and bus connections have been torqued to manufacturer's recommendations, and all interconnecting wiring has been connected and secured.

F. Perform adequate tests prior to Substantial Completion to verify that the switchgear is fully functioning. At a minimum, provide the following operational tests:

1. Verify that the system performs the sequence of operations as specified under Part 4.
2. Verify all protective relay functions for the FPR and GC.
3. Verify all engine and generator protection functions for each GC.
4. Verify all feeder protection functions for the FPR.
5. Verify that the PLC starts and stops each generator based on the demand table requirements specified under Part 4.
6. Verify that each VFD operates properly.
7. Verify that each annunciation point operates correctly. For external alarms, simulate the alarm.
8. Verify that all screens on the SCADA display correct data. Use an external computer to verify remote access for SCADA.
9. Verify that all trending functions are operational and are being archived on the data storage server.
10. Disconnect 120-volt AC control power in the master section to verify that the system continues to operate without interruption from the 24VDC source and that the server continues to operate from the UPS.

G. Repeat tests during Substantial Completion as required by the Authority to adequately demonstrate satisfactory operation of all functions.

3.5 PACKAGING

A. Shipping splits shall be provided in the switchgear for ease of handling in the field. The switchgear shall be shipped in splits as indicated on the project design drawings or as required for field installation.

B. The switchgear shipping splits shall be individually shrink wrapped, packed, crated and rigidly braced to protect from damage during shipment, handling and storage. Each section shall be crated so that it can be shipped upright or placed flat on the backside of the panel. The packaging shall be waterproof. Moisture absorbent packages shall be placed in each compartment to ensure that moisture does not condense inside the switchgear.

C. All other included components (spare parts, loose items, etc.) shall be packaged individually in waterproof wrapping. Each individual component package shall then be packed in a box or crate, and each box/crate wrapped in waterproof wrapping to prevent corrosion to the components during extended periods of outside storage. All boxes or crates shall be palletized onto the minimum number of pallets, as required for the quantity and size of the boxes/crates.

D. Suitable attachments shall be provided on the bottom of the shipping assemblies for lifting or moving the equipment to final location. Provisions shall not necessitate disassembly of the equipment. Instructions for lifting the switchgear shall be provided. Additionally, the weight and center of gravity shall be provided.

E. Exterior of crating shall be clearly marked with the community name and the contents identification (e.g. “Community” Gen #2).

F. Two copies of the packing slip identifying the quantity of pallets, the crates/boxes on each pallet, and the listing of component packages within each box/crate shall be provided to the Owner.

PART 4 - MONITORING, CONTROL, AND SEQUENCE OF OPERATION

4.1 ENGINE MONITORING

A. The GC shall monitor temperatures, alarms and status of the following engine devices:

1. Monitor engine speed, jacket water temperature, lubricating oil pressure, and fuel flow rate from the engine ECU via J1939.

2. Engine Runtime. Log and maintain engine runtime. Time shall be expressed in hours. Note that when the engine ECU is off, the SCADA shall continue to display the Engine Hours at the time the engine stopped.

3. Hours until Engine Service. Using the engine runtime from the GC, the PLC will log and maintain hours until engine service required. Time shall be expressed in hours.

4. Generator Lockout Switch. Connect key switch to GC Discrete Input 5.

5. Oil Level Switch. Monitor status of engine-mounted oil level switch through GC Discrete Input 3 and 4. A normally open switch closes when the oil level drops below or rises above a pre-determined level.

6. Exhaust Gas Temperature. Monitor exhaust temperature through GC Analog Input 1 via a 4-20mA signal converter. The exhaust gas temperature sensor is a 2-wire 100 ohm RTD or Type K thermocouple.

7. Air Filter Vacuum. Monitor air vacuum through GC Analog Input 2 via a 4-20mA signal converter. The air filter vacuum transmitter is 4-20mA, -408" H2O to 0" H2O range. Power supply for the signal converter shall be provided from the GC power supply.

8. Intake Air Temperature. For engines with a charge air cooler, monitor intake air temperature through GC Analog Input 3 via a 4-20mA signal converter. The intake air temperature transmitter is 4-20 mA, 20°F to 240°F range. Power supply for the signal converter shall be provided from the GC power supply. Signal shall be series looped through the GC and the engine charge air cooler VFD.

4.2 AMBIENT AIR TEMPERATURE MONITORING

A. The PLC shall monitor through RTD input module the following air temperatures.

1. Outside air temperature.

2. Inside air temperature.

3. VFD section temperature.

4.3 FUEL AND OIL SYSTEM MONITORING

A. The PLC shall monitor and provide the following:

1. Plant Total Fuel Consumption and Last Day Tank Fill Cycle Quantity. The PLC shall calculate the total plant fuel consumption and the last day tank fill cycle quantity from the day tank supply meter. Monitor daytank meter pulser through digital input module. The day tank meter pulser provides one pulse per each gallon of fuel.

2. Plant Fuel Efficiency. The PLC shall calculate the overall plant fuel efficiency (kWh/gallon). At the end of each day tank fill cycle, divide the total kWh generated since the end of the last fill cycle (from bus power meter) by the gallons of fuel pumped into the day tank during the latest fill cycle.

3. Low Fuel Level Alarm. Monitor daytank low level switch status through digital input module. A normally closed contact on the day tank control panel will open when the fuel level in the day tank drops below a preset level.

4. Generator Fuel Consumption. The PLC shall read the instantaneous fuel flow rate (gallons per hour) and the total fuel consumption (gallons) from the engine ECU via J1939.
5. Using remote I/O monitor status of the day tank including:
    a. Fuel Filter Water Indication
    b. Day Tank Pump P-DF1 Run.
    c. Day Tank Control Power.
    d. Day Tank Low Level Alarm.
    e. Day Tank Overfill Alarm.
    f. Day Tank Pump P-DF1 Time Out Alarm.
    g. Remote Actuator Valve Open.
6. Using remote I/O monitor status of the used oil blender including:
    a. Blender Pump P-DF2 Run.
    b. Blender Pump P-UO2 Run.
    c. Blender Control Power.
    d. Blender Filter #1 Plugged.
    e. Blender Filter #2 Plugged.
    f. Blender Hopper Low Oil Level.
7. Using the EVO 200 level monitoring system monitor the level and temperature of the fluid in the day tank and the used oil hopper. Where specifically indicated, monitor the level in the intermediate fuel tank.
8. Plant Total Used Oil Blending System Consumption, Last Oil Blend Cycle Quantity and Overall Blended Oil Percentage. The PLC shall calculate the total used-oil use, the last blend cycle quantity, and the overall percentage of blended oil in the fuel supply. The data for these calculations comes from the day tank meter pulser (at one pulse per each gallon of fuel) and the EVO 200 level monitor.

4.4 COOLING SYSTEM MONITORING

A. The PLC shall monitor the following:

1. Low Coolant Alarm. Monitor low coolant level switch status through digital input module. A normally closed switch in the coolant piping will open when the coolant drops below a preset level.
2. Engine Coolant Return Temperature. Monitor engine coolant return temperature through analog input module via a 4-20 mA, 20°F to 240°F range temperature transmitter. Power supply for the transmitter shall be provided from the switchgear 24VDC power supply.

3. Coolant Level Sensor. Monitor coolant level through analog input module via a 4-20 mA, 0% to 100% range signal conditioner. Power supply for the signal conditioner shall be provided from the switchgear 24VDC power supply.

4.5 HEAT RECOVERY SYSTEM MONITORING

A. The PLC shall monitor through analog input module the following:

1. Heat Recovery Supply Temperature. Monitor heat recovery supply temperature via a 4-20 mA, 20°F to 240°F range temperature transmitter. Power supply for the transmitter shall be provided from the switchgear 24VDC power supply.

2. Heat Recovery Return Temperature. Monitor heat recovery return temperature via a 4-20 mA, 20°F to 240°F range temperature transmitter. Power supply for the transmitter shall be provided from the switchgear 24VDC power supply.

3. Heat Recovery Pressure. Monitor heat recovery fluid pressure via a 4-20 mA, 0 to 60 PSIG range pressure transmitter. Power supply for the transmitter shall be provided from the switchgear 24VDC power supply.

4. Heat Recovery Flow Rate. Monitor heat recovery fluid flow rate via a 4-20 mA, 0 to 100 GPM range flow meter. Power supply shall be provided from the switchgear 24VDC power supply.

4.6 OIU DISPLAY

The OIU shall provide the operator local access to the demand system setup parameters and shall display all screens required for system monitoring. The OIU shall communicate with the PLC via Ethernet/IP for tag information. The OIU programming and development of all display screens shall be provided by the Fabricator, see SCADA specification 26 23 05. The Fabricator shall program the following functions and display the following data. All multiplication factors or other proportional scaling of the raw data shall be provided by the Fabricator so the data provided will not need to be modified.

A. Demand Control – Generator kW rating (overload level), raise level set point, raise level time duration, lower level set point, lower level time duration.

B. Generator Control – Amount of time each generator will run off-line before it is shut down (cooldown duration). Enable/disable droop unloading and the kW load or amount of time before going offline. Where two generators are identical, provide Lead/Lag selection. Where all generators are identical, provide Prioritization selection.

C. Engine/Generator Data:

1. Alarms – All engine/generator alarm conditions.

2. Status of the breaker (open or closed).

3. Phases A, B, and C voltage, current, and power factor.

4. Generator Frequency (Hz).

5. Engine Speed (RPM).
6. Engine Run Time (hours).
7. Hours until Engine Service (hours).
8. Engine Water Jacket Temperature (°F).
9. Engine Exhaust Temperature (°F).
10. Engine Oil Pressure (PSI).
11. Engine Air Cleaner Vacuum (in-H2O).
12. Engine Fuel Flow Rate (GPH).
13. Fuel Efficiency (kWh/Gal).
14. Total kWh Generated.
15. Lead Engine - where two engines are the same capacity.
16. Priority – where all engines are the same capacity.
17. Intake Air Temperature - for engines with a charge air cooler.

D. Bus/Station Service Power Data:
1. Bus Phases A, B, and C voltage and current.
2. Bus frequency, kVAR, kW and power factor, total kWh and peak demand.
3. Station service Phases A, B, and C current.
4. Station service kW and total kWh.
5. Trip indication for station service breaker.

E. Feeder Data:
1. Position indication for each feeder breaker.
2. Trip indication for each feeder breaker.
3. Feeder Monitoring kW and total kWh. Calculate the feeder kW and kWh by subtracting the station service readings from the bus meter readings.

F. Ethernet I/O Device Level Ring Status.

G. Fuel/Oil System Data
1. Fuel level & temperature in day tank, used oil hopper, and intermediate tank (where specifically indicated).
2. Plant total fuel use.
3. Plant total fuel efficiency.
4. Plant previous 30 minute fuel efficiency.
5. Day tank last fill quantity.
6. Fuel filter water indication.
7. Day tank pump P-DF1 run.

8. Day tank control power.
9. Day tank low level alarm.
10. Day tank overfill alarm.
11. Day tank pump P-DF1 time out alarm.
12. Remote actuator valve open.
13. Last oil blend quantity.
14. Overall oil blend percentage.
15. Plant total used oil blended.
16. Blender pump P-DF2 run.
17. Blender pump P-UO2 run.
18. Blender Control Power.
19. Blender filter #1 plugged.
20. Blender filter #2 plugged.
21. Blender used oil hopper low alarm.

H. Ambient Temperature Data:
1. Outside Air Temperature.
2. Inside Air Temperature.
3. VFD Section Temperature(s).

I. Engine Coolant Data:
1. Low coolant level alarm.
2. Coolant return temperature.
3. Coolant level.

J. VFD Data – All data available from each variable frequency drive, quantity as indicated on the communication diagram of the project design drawings.
1. Radiator coolant temperature.
2. Intake air temperature - for engines with a charge air cooler.
3. VFD breaker open.
4. VFD frequency.
5. VFD status (On, Off, Bypass, Running, Fault).

K. Heat Recovery System Data:
1. Supply Temperature.
2. Supply Temperature Signal Lost.
3. Return Temperature.

4. Return Temperature Signal Lost.
5. System Pressure.
6. Flow Rate.
7. No Load Warning.
8. Loss of Pressure.
9. Loss of Flow.
10. Recovered Heat Output.
11. Total Recovered Heat Delivered.

4.7 GENERAL CONTROL SPECIFICATIONS

A. The switchgear shall automatically and manually connect and parallel all generators to the switchgear main bus.

B. The PLC shall control the automatic load demand system and overall sequencing, starting, and stopping of the engine generators. The SCADA on the OIU shall provide operator access to the demand system and shall display the current demand system status.

C. The GC shall control all functions and features of the generator under both automatic and manual control. The GC shall start, stop, synchronize, and provide load sharing of the generator. All GC's shall communicate via CANbus for load sharing. If the communications bus is disabled, each GC shall be fully capable of operating the individual generator without the aid of the PLC.

D. The Fabricator shall review all project design drawings and information provided and shall incorporate all required engine and generator safety functions into the GC.

4.8 GENERATION SEQUENCE OF OPERATION.

A. A complete and successfully operating system shall be provided for starting, stopping, and paralleling, both automatically and manually, all engine generators. The following paragraphs describe the basic functional requirements of the system. The Fabricator shall be responsible for the detailed design to provide a safe and satisfactorily functioning system.

B. The PLC shall monitor the system load and status and shall control automatic start and stop of each unit. Time delays shall be incorporated in the PLC that shall be adjustable through the OIU Use relays in conjunction with PLC logic for automatic start/stop. Failure of the automatic control system shall not prevent the manual operation of the system to start, stop, or synchronize any one, or all, of the generating units.

C. The GC shall be configured according to the parameters indicated in Attachment A, Genset Controller Settings Table, which is appended at the end of this Section.

D. The GC shall control engine speed, voltage compensation, synchronization, and generator breaker operation.

1. The GC shall perform all engine and generator safety functions. Provide annunciation through the PLC via Point I/O blocks.
2. The GC shall perform the cranking and disconnecting of the starter.
3. The GC shall turn on the run signal to the ECU then have a 5 second delay before cranking the starter to ensure fuel is up to pressure. During the delay the GC shall display a banner indicating pre-start mode.
4. The GC shall make up to 4 attempts to start an engine with a pre-set cranking time of 10 seconds and a 10 second pause between each attempt. If the engine does not start after the fourth time, the OVERCRANK and ENGINE ALARM lamp will illuminate and a FAIL TO START message will appear on the monitoring screen.
5. The GC shall control the engine speed using 0.5-4.5 VDC signal to the engine ECU.
6. The GC shall control the voltage regulator through the voltage regulator auxiliary voltage bias input.
7. Generator Lockout Switch. When in the OFF position the switch shall disable the GC and prevent engine starting.

E. Upon activation of the dead bus relay the feeder breaker shall open. This function shall be independent of the PLC and shall operate in all modes.

F. Automatic Operating Conditions.

1. With the System Mode Switch in the “AUTO” position and each GC in “AUTO” mode, the following sequences of operation shall be performed:
    a. Dead-Bus Startup: All available generators shall start and come up to rated speed. The generators shall be started sequentially in order of generator number with a 15 second delay between each start signal. The first unit to stabilize will close to the dead bus. The remaining units shall auto-synchronize to that unit and close to the bus in sequence. After 15 second delay after the last generator comes on line, the PLC shall close the feeder breaker and energize the feeder. On systems with two feeder breakers the PLC shall close feeder breaker #1 and then after an additional time delay of 15 seconds, the PLC shall close feeder breaker #2. If available, a minimum of two units shall be running and synchronized prior to energizing the feeder. If only one generator is available for operation, the PLC shall use that unit to energize the feeder.
    b. With all available units operating and all GC's in “AUTO” mode, the PLC shall monitor the bus load and determine which unit best fits the demand load. The PLC shall signal the GC to unload and shut down any unit not needed to meet the load.
    c. When the load exceeds a preset percentage of the prime power rating of a unit, the PLC shall signal the GC to automatically start, synchronize, and connect to the bus another unit. Predetermined

demand level set points in the PLC shall determine which unit should be placed online. If that unit is not available, the PLC shall automatically switch to another unit. The PLC shall continue to monitor load and signal the appropriate GC to start, synchronize, unload, and stop as required, to match the appropriate unit to the load.

d. Provide lead/lag control for multiple generators of the same capacity.

e. When any GC is not in "AUTO" mode, the PLC shall skip that unit and switch to the next available unit. Any time a unit's GC is switched from "STOP" or "MAN" to "AUTO" mode, the PLC shall compare the unit with the operating unit and load to determine which unit is more appropriate for the load. If the new unit is more appropriate, the PLC shall send a command signal to the GC to start, synchronize, and connect the unit to the bus and unload and shut down the other.

f. When one unit is operating and is dropped from the bus, for any reason, the PLC shall signal all GC's to automatically start all remaining available units and perform a dead bus start up sequence as previously specified. After the bus is stabilized, the PLC shall resume normal demand level control operation and signal the GC's to shut down units not required to carry the load.

g. When two units are operating and one of the units is dropped from the bus for any reason, the PLC shall check the raise level and overload level of the unit operating. When the system demand exceeds the raise level of the operating unit, the PLC shall signal the GC to start the next unit and place it in service after the raise level time delay times out. When the system demand exceeds the overload level of the operating unit, the PLC shall immediately signal the GC to start the next unit available under the automatic demand system and place it in service within 10 seconds.

h. The GC shall provide a programmable cool down period for each unit prior to engine shut down. Each unit shall operate at rated speed for 3 minutes, and then automatically stop the engine.

i. When the GC of an operating unit is switched to "MAN" mode, the PLC shall signal the GC to start another unit, as specified above. The unit placed in "MAN" mode will continue to run until the GC is switched to "STOP" or placed in "AUTO".

j. When the GC of an operating unit is switched to "STOP" mode, the GC will check to see if any other generators are online. If there is another unit on-line, the GC will shed the load to the other unit, open the generator breaker, and shut off the engine after a cool-down period. If there is no other unit on-line, the generator breaker will open and the engine will shut off after a cool-down period.

k. Upon normal shut down of a unit, all parameters shall be automatically reset to allow the unit to be operated again, either manually or automatically, without further reset action.

2. When the System Mode Switch is switched from the “AUTO” position to the “MAN” position while units are operating in automatic mode, the system shall continue to operate in the present state. If the Mode Switch is moved back to the “AUTO” position, the PLC shall revert to operation in the automatic demand mode.

3. Demand Control: The automatic Demand Control System shall provide 2 levels of starting control and 1 level of stopping control.

The 2nd level of starting control is considered the “overload” level and it shall be equal to the generator prime power rating. When the load equals or exceeds the “overload” level the system shall immediately go to the next higher demand level.

The 1st level of starting control is considered the “raise” level and it shall normally be equal to 90% of the generator prime power rating. When the load equals or exceeds the “raise” level for 20 seconds, adjustable, the system shall go to the next higher demand level.

The stopping control is considered the “lower” level and it shall normally be equal to 80% of the generator prime power rating. When the load is less than the “lower” level for 120 seconds, adjustable, the system shall go to the next lower demand level.

The Demand Control System shall have multiple demand levels. The highest demand level will command all units to start and go on-line.

See project design drawings for demand control settings.

G. Manual Operating Condition. When the System Mode Switch is in the "MAN" position each generator GC shall control the respective generator in isochronous mode. The GC must be placed in MAN mode to start, stop, and control the generator. All functions shall be manually executed through the GC. If multiple generators are placed online the GC’s shall proportionally share load.

H. Engine and Generation Alarm Conditions and Sequences. Note that these apply to both Auto and Manual operation.

1. Provide the following types of alarm sequences for each condition listed below:

a. Type 1 (Engine Alarm Soft Shutdown):

Upon alarm condition bring another generator on line, unload the first generator, open the generator breaker, run engine through a cool down cycle, shut down engine, and illuminate “Alarm/Lockout” light and associated alarm annunciation light. Alarm light shall remain illuminated until the problem is corrected and the GC is manually reset. Note that this a Class B Easygen

alarm with PLC assist to first start another generator and then take the first offline.

b. Type 2 (Engine Alarm Hard Shutdown):

Upon alarm, immediately open the generator breaker and shut down without going through a cool down cycle. Illuminate "Alarm/Lockout" light and associated alarm annunciation light. Unit shall be locked out and alarm light shall remain illuminated until the problem is corrected and the GC is manually reset. Note that this a Class F Easygen alarm.

c. Type 3 (Generation Alarm):

Upon alarm, immediately open the generator breaker, run engine through a cool down cycle, shut down engine, and illuminate "Alarm/Lockout" light and associated alarm annunciation light. Unit shall be locked out and alarm light shall remain illuminated until the problem is corrected and the GC is manually reset. Note that this a Class D Easygen alarm.

2. For the following engine/generator alarm conditions perform the sequence indicated and illuminate the associated alarm light. See Attachment A, Genset Controller Settings Table, for specific alarm and shut down setpoints and time delays.

a. Low Oil Pressure - Provide a Type 1 soft shutdown when the oil pressure drops to the Alarm level and stays below that level for 5 seconds, or if the pressure transducer signal is lost. Provide a Type 2 hard shutdown when the oil pressure drops to the Shut Down level and stays below that level for 5 seconds.

b. Oil Level - Provide a Type 1 soft shutdown when the oil level switch closes.

c. High Coolant Temperature - Provide a Type 1 soft shutdown when the jacket water temperature reaches the Alarm level and stays above that level for 30 seconds or if the temperature transducer signal is lost. Provide a Type 2 hard shutdown when the jacket water temperature reaches the Shut Down level and stays above that level for 30 seconds.

d. Over Speed - Provide a Type 2 hard shutdown when the engine speed reaches the Shut Down level.

e. Over Crank – Lock out engine if a unit fails to start when the over crank time delay has expired.

f. Running Timeout - Shut down the engine and lock it out if the engine runs without being placed online for 5 minutes, adjustable.

g. Battery Charger Failure – Illuminate the appropriate alarm light when an alarm is received from the battery charger. Note this alarm is for indication only and not shutdown.

h. Air Filter Plugged - Provide a Type 1 soft shutdown when the vacuum on the air filter reaches the Alarm level and stays above that level for 60 seconds or if the vacuum signal is lost. Provide a Type 2 shut down when the vacuum on the air filter reaches the Shut Down level and stays above that level for 30 seconds.

i. High Intake Air Temperature - Provide Type 1 soft shutdown when the intake air temperature reaches the Alarm level and stays above that level for 30 seconds or if the temperature signal is lost. Provide a Type 2 shut down when the intake air temperature reaches Shut Down level and stays above that level for 30 seconds. Note that this only applies to engines with a charge air cooler.

j. High Exhaust Temperature – Illuminate the associated alarm light when the exhaust temperature reaches the Alarm level and stays above that level for 30 seconds or if the temperature signal is lost. Note this alarm is for indication only and not shutdown.

k. Fail to Synchronize - Provide a Type 3 shutdown if a unit fails to synchronize after the preset time delay.

l. Over Current - Provide a Type 3 shutdown on operation of an overcurrent element. See the project design drawings for the trip setpoint for each generator.

m. Under Voltage - Provide a Type 3 shutdown when the voltage reaches the Shut Down level and stays below that level for 5 seconds.

n. Over Voltage - Provide a Type 3 shutdown when the voltage reaches the Shut Down level and stays above that level for 5 seconds.

o. Under Frequency - Provide a Type 3 shutdown when the frequency reaches the Shut Down level and stays below that level for 5 seconds.

p. Over Frequency - Provide a Type 3 shutdown when the frequency reaches the Shut Down level and stays above that level for 5 seconds.

q. Reverse Power - Provide a Type 3 shutdown when the reverse power reaches the Shut Down level and stays above that level for 5 seconds.

r. Charge Air VFD Failure - If an alarm is received from the charge air cooler VFD (either VFD fault or circuit breaker open), illuminate the associated alarm light. Do not shut down or lock out the unit. Note that this only applies to engines with a charge air cooler.

3. For the following system alarm conditions perform the sequence indicated and illuminate the associated alarm light:

a. Fire Alarm - Upon receipt of a contact closure from the fire suppression system, all engines shall be shut down immediately without going through a cool down sequence. The system shall remain in a lockout condition and no units shall be started either manually or automatically until the alarm is cleared.

b. Emergency Stop - Upon receipt of a contact closure from the Emergency Stop Pushbutton, all engines shall be shut down immediately without going through a cool down sequence. The system shall remain in a lockout condition and no units shall be started either manually or automatically until the alarm is cleared.

c. Low Coolant Level – Opening of the low coolant alarm contact on the system low coolant level switch, all engines shall be shut down immediately without going through a cool down sequence. The system shall remain in a lockout condition and no units shall be started either manually or automatically until the alarm is cleared.

d. Low Fuel Level - Opening of the low fuel alarm contact on the day tank control panel (separate external panel) indicates a low fuel level condition. The low fuel level indication shall start a time delay relay, 2 hours, adjustable, and illuminate the alarm lamp. If the fuel level has not been corrected by the end of the timed interval all engines shall go through a Type 1 soft shutdown and the alarm lamp shall remain illuminated. The manual alarm reset button on the front of the switchgear master section will reset the timer relay for another interval and place the engines back in service if timed out. The reset function shall work any time during or after expiration of the timed interval.

e. PLC/ Point I/O Failure - Upon failure of the PLC or the Point I/O ring, the alarm light shall remain illuminated until the system is back in acceptable service.

f. System Not In Auto – When the System Mode Switch is changed from Auto to Manual the alarm lamp shall illuminate. The alarm lamp shall remain illuminated until the Mode Switch is switched back to Auto.

g. Feeder Breaker Trip – Upon over current, the feeder breaker shall immediately trip and the alarm lamp shall illuminate. The generator shall continue to operate at rated speed.

I. Engine Service Alarm Conditions and Sequences. Note that this applies to Auto operation.

1. When an engine exceeds 300 service hours perform the sequence indicated below:

a. The Engine “Alarm/Lockout” annunciator is illuminated.

b. The “Service Engine” annunciator is illuminated

c. Demand control starts the next available engine, syncs it to the bus, closes the breaker, and transfers load.

d. A Type 1 shutdown is performed on the engine with service overdue.

e. Upon completion of the required engine service the operator shall press and hold the Service Hours Reset pushbutton for 10 seconds to reset the service interval to 300 hours. The operator shall then press the Alarm Reset pushbutton to clear the engine alarm. Once the service is complete and the alarm is cleared the operator shall put the engine back into Auto mode.

f. Note: If the required engine service is performed manually prior to the Engine Service Alarm condition, the operator shall follow the procedure above without alarm condition in order to reset the service interval to 300 hours and place the engine back in service.

4.9 FEEDER BREAKER SEQUENCE OF OPERATION

A. Automatic Operation - When the System Mode Switch is in the “AUTO” position the feeder breaker shall operate under control of the PLC. The feeder breaker can be opened at any time by rotating the feeder control knob to the OPEN position. The PLC shall then perform a dead bus start sequence (start all available generators) and re-close the feeder breaker after the pre-set time delay.

B. Manual Operation - When the System Mode Switch is in the “MAN ISOCH” position and the bus is energized, the feeder breaker will operate under manual control. The feeder breaker shall close when the feeder control knob is rotated to the CLOSE position and open when the feeder control knob is rotated to the OPEN position.

C. The Feeder Protection Relay (FPR) shall provide protection for the feeder breaker in both Automatic and Manual modes. The FPR settings shall be set to the values on the project design drawings and shall be adjustable.

4.10 VFD SEQUENCE OF OPERATION

A. General VFD Sequence of Operation. Each variable frequency drive shall operate as follows:

1. When the VFD main circuit breaker is closed and the selector switch is in either the “VFD” or “BYPASS” position, power shall be provided to all control devices. Time delay shall be incorporated into the fault alarm such that there is no alarm due to initial powering up of the VFD.

2. When the VFD main circuit breaker is open, the red “VFD Breaker Open” lamp shall illuminate and remote indication shall be provided to the PLC.

3. When the 3-position selector switch is in the "OFF" position, the motor will not operate and power to all control devices will be off.

4. When the 3-position selector switch is in the "Bypass" position, the motor shall operate at full speed and the "Bypass Mode" light shall be on. The

VFD will not be in service and the contactor will be open. Provide remote indication that the VFD is in bypass mode from an auxiliary contact as indicated.

5. When the 3-position selector switch is in the "VFD" position, the motor shall operate under control of the VFD and the "VFD Mode" light shall be on. Upon receipt of a run signal the contactor shall close, the motor shall operate, and the “VFD Running” light shall be on.

6. Upon a fault of the VFD the red “VFD Fault” lamp shall illuminate and remote indication shall be provided to the PLC. Placing the selector switch in the “OFF” position shall clear the fault alarm indication.

7. Upon activation of the thermal overload, the VFD main circuit breaker shall trip, the red “VFD Breaker Open” lamp shall illuminate and remote indication shall be provided to the PLC.

8. Engine Coolant Return High Temperature Alarm. When the engine coolant return temperature rises above 190°F for a minimum of 2 minutes, the “HIGH COOLANT RETURN TEMPERATURE” lamp shall illuminate. Lamp shall remain on until master reset button is pressed

B. Radiator Sequence of Operation. Each variable frequency drive for glycol coolant radiators shall operate as follows:

1. The remote temperature sensor will sense Coolant Return Temperature and send a 4-20mA signal to the VFD where 20°F equals 4 mA and 240°F equals 20 mA. The operating temperature setpoints shall be adjustable through the OIU and scaled to display in °F.

2. When the Coolant Return Temperature reaches the PID Reference Temperature setpoint the motor will start at minimum speed and ramp up to the required speed.

3. Using its internal PID control, the VFD will modulate the fan speed as required to maintain Coolant Return Temperature at the PID Reference Temperature setpoint. As the Coolant Return Temperature rises, the VFD will increase the speed of the fan motor up to 100%. Once the fan reaches the Minimum Speed, the VFD will maintain that speed until the Low Speed Time Out expires.

4. When the Low Speed Time Out expires the motor will stop. The motor will remain off until the Coolant Return Temperature rises to the Wake Up Temperature setpoint.

5. Configure the OIU to display the fan speed in percentage and the PID Reference Temperature and Coolant Return Temperature in °F.

6. The operating settings shall be set to the values on the project design drawings and shall be adjustable.

C. Charge Air Cooler Sequence of Operation. Each variable frequency drive for charge air coolers shall operate as follows:

1. The VFD shall operate the charge air cooler fan motor any time the respective engine is operating. Connect a contact from the respective GC to the VFD run relay as indicated.
2. The remote temperature sensor will sense intake manifold air temperature and send a 4-20mA signal to the VFD where 20°F equals 4 mA and 240°F equals 20 mA. The PID Reference Temperature shall be adjustable through the OIU and scaled to display in °F. The 4-20 mA signal from the sensor shall be looped from the respective engine GCP through the analog input on the VFD. The GCP shall be configured to provide a readout that displays actual air intake manifold temperature in °F.
3. Upon startup, the fan motor shall run for 30 seconds at full speed and then switch to minimum speed and ramp up to the required speed.
4. Using its internal proportional control, the VFD shall modulate the fan speed as required to maintain temperature in the intake manifold at the PID Reference Temperature. Once the fan speed reaches a minimum speed of 10%, the VFD shall maintain that speed as long as the signal from the remote temperature sensor is below the PID Reference Temperature. As the intake manifold air temperature rises, the VFD shall increase the speed of the fan motor up to 100%.
5. If the temperature is below the PID Reference Temperature, the motor shall operate at a minimum speed of 6 Hz as long as the run signal is on.
6. Configure the OIU to display the fan speed in percentage and the setpoint temperature and intake manifold air temperature in °F.
7. The operating settings shall be set to the values on the project design drawings and shall be adjustable.

4.11 HEAT RECOVERY SEQUENCE OF OPERATION

A. The PLC shall perform the following functions. Note that all heat recovery alarms shall be tied to the dead bus signal to prevent alarm indication when the power system is off-line:

1. Heat Recovery No Load Warning. When the heat recovery return temperature is greater than the heat recovery supply temperature for a minimum of 1 hour, the “NO LOAD ON HEAT RECOVERY” lamp shall illuminate. When the heat recovery supply temperature is a minimum of 1°F greater than the heat recovery return temperature the lamp shall turn off.
2. Signal Loss. If either the supply temperature or the return temperature signal is lost, the system shall provide the following message on the OIU “HEAT RECOVERY SUPPLY TEMPERATURE SIGNAL LOST” or “HEAT RECOVERY RETURN TEMPERATURE SIGNAL LOST”.
3. Heat Recovery Loss of Pressure Alarm. When the heat recovery system pressure drops below 15 PSIG for a minimum of 15 minutes, the “HEAT

RECOVERY LOSS OF PRESSURE" lamp shall illuminate. When the pressure rises above 18 PSIG the lamp shall turn off.

4. Heat Recovery Loss of Flow Alarm. When the heat recovery system flow rate drops below 10 GPM for a minimum of 15 minutes, the "HEAT RECOVERY LOSS OF FLOW" lamp shall illuminate. When the flow rate rises above 15 GPM the lamp shall turn off.
5. Recovered Heat Output. The PLC shall calculate the instantaneous rate of energy delivered based on the supply temperature, return temperature, and flow rate. A specific heat of 450 BTUH/GPM-F shall be used for the fluid.
6. Total Recovered Heat Delivered. The PLC shall calculate the total energy delivered in units of 100,000 BTU with no decimal places.
7. History. The PLC shall maintain a running total of energy delivered.

SEE ATTACHMENT A, GENSET CONTROLLER SETTINGS TABLE

Alarm Classes	Type 1 = Class B (Warning)								**NOTES:**
	Type 2 = Class F (Open GCB & Immediate Shutdown)								
	Type 3 = Class D (open GCB & cool down)								
Home Screen data: Engine	RPM, Engine Hours, Oil Pressure, Battery Voltage, Coolant Temperature								
: Generator	Volts, Power (kW), Freq, PF, AMPS - L1, L2, L3								
Custom Screen 1									Custom Program or Turn off button
Custom Screen 2									Custom Program or Turn off button
Configure general engine	**Time**	**Ign delay**	**Vlv delay**	**S/S mode**	**Pre-mode**				
Preglow	5	5	5	Diesel	ALWAYS				powers up ECM 5 seconds before cranking to prime fuel system
Configure Analog Inputs	**Input**	**Type**	**Value**	**Sender**	**Self Ackn**	**Unit**	**Class***		* Monitor Wire Break/Signal Loss
Exhaust Temp	1	Linear	70-1400	0-20mA	No	F	B		sender value 4-20mA
Air Filter	2	Linear	-408 - 0	0-20mA	No	IWC	B		sender value 4-20mA
Intake Air Temp	3	Linear	20-240	0-20mA	No	F	B		sender value 4-20mA
Configure Analog OUTputs	**Type**	**Filter**	**Src Min**	**Src Max**	**Min Lvl**	**Max Lvl**	**PWM lvl**		
Speed Bias	V	Off	0	100	0.5	4.5	10V		
Voltage Bias	V	Off	0	100	-3	3	10V		Verify actual Regulator Min/Max levels
Configure Discrete Inputs	**Input**	**Delay**	**Contact**	**Class**	**Enabled**	**Self Ackn**			
E-Stop	1	0.2	N.O.	F	Always	No			
Start in Auto	2	0.5	N.O.	Control	Always	No			
Oil Level Switch (Alarm)	3	5	N.O.	B	Always	No			
Oil Level Switch (SD)	4	100	N.O.	F	Always	No			
Stop Mode Lockout Switch	5	0.5	N.O.	F	Always	Yes			
Idle Mode / Spare / VFD Fault	6	0.5	N.O.	Class B	Always	No			
MCB Open Reply	7	0.5	N.O.	Control	Always	No			DI7 Jumpered for Islanded System
GCB Open Reply	8			-					non configurable
Remote Acknowledge	9	0.2	N.O.	Control	Always	No			
~~Running Timeout~~	~~10~~	~~0.2~~	~~N.O.~~	~~F~~	~~Always~~	~~No~~			spare, use Flexible Limit 11 for Running Timeout
PLC E-Stop / Master Shutdown	11	0.2	N.O.	F	Always	No			DI11 triggers the "Master Shutdown" alarm in the EasyGen, indicating shutdown was from the Master Control section
Run w/o Load or spare	12	0.2	N.O.	Control	Always	No			DI12 keeps the generator from going on line if the bus is dead and the System mode switch is not in auto
Configure Discr Outputs (relays)		**Relays Use Program Logic**							refer to attached easygen terminal diagram for function
Configure external discrete Inputs		**Delay**	**Contact**	**Class**	**Enabled**	**Self Ackn**			typically used when door-mounted pushbuttons provide easygen input
Configure Measurement									
Busbar / configure transformer		480V	10%	200V	480V				
Engine		1800 rpm							Set 1752 and 1758 (kW/kVar) based on Generator Prime Rating
Generator		**See Notes**		L1 L2 L3	480V				1754 (rated current) set based on Breaker Trip Setpoint
Configure transformer		200V	480V	**See Notes**					Coord Primary Rated Current with CT ratings
Mains		**See Notes**		Phase L1	480V				Set rated kvar, kW & rated current = sum of Gen Prime Ratings
Configure transformer		200V	480V	**See Notes**					Coord Primary Rated Current with CT ratings

Configure Monitoring		Monitor	Class	Atmp/Ack	Time	Limit	Enabled		
Configure GCB		ON	B	5 tries	2s	--	--		
Configure MCB		OFF							
Configure Synch GCB		ON	D	No	60s	--	--		
Engine/Overspeed Level 2		ON	F	No	0.5s	1900rpm	Always		
Engine/Speed Detection		ON	E	No	1s	--	Eng.mon		
Engine/Start/Stop/SD malfunction		ON	F	No	30s	--	--		
Engine/Start/Stop/Start Fail		ON	F	No	--	--	--		
Engine/Start/Stop/Unintended stop		ON	F	No	--	--	--		

Config Monitoring Flexible Limits	Intput	Monitor	Class	Self Ackn	Enabled	Monitor	Limit	Delay	setpoints may be either Metric or ANSI units
Exhaust Temp SD	1	OFF	F	No	Always	Overrun	950F	30	spare, Not Used Currenlty
Exhaust Temp Alarm	2	ON	A	No	Always	Overrun	900F / 482C	30	
Air Filter Restriction SD	3	ON	F	No	Always	Underrun	-20" WC / -1.47" Hg	30	
Air Filter Restriction Alarm	4	ON	B	No	Always	Underrun	-15" WC / -1.10" Hg	60	
High Intake Air SD (CAC)	5	ON	F	No	Eng.mon	Overrun	150	30	used for CAC engines, or spare
High Intake Air Alarm (CAC)	6	ON	B	No	Eng.mon	Overrun	140	30	used for CAC engines, or spare
Low Oil Pressure SD	7	ON	F	No	Eng.mon	Underrun	10PSI/69kPa	5	
Low Oil Pressure Alarm	8	ON	B	No	Eng.mon	Underrun	14.5PSI/100kPa	5	
High Coolant Temp SD	9	ON	F	No	Always	Overrun	215F / 102C	30	
High Coolant Temp Alarm	10	ON	B	No	Always	Overrun	210F / 99C	30	
Running Timeout	11	ON	F	No	Always	Overrun	300s	1	

Config Monitoring Generator		Monitor	Class	Self Ackn	Enabled	Limit	Delay (sec)	Rest / Hyst	
Current/OC Level 1	--	ON	D	No	Always	100%	3	No	
Current/OC Level 2	--	ON	D	No	Always	120%	1	No	
Current/OC Level 3	--	ON	D	No	Always	250%	0.4	No	
Frequency/OF Level 2	--	ON	D	No	Always	103%	5	--	
Frequency/UF Level 2	--	ON	D	No	Eng.mon	97%	5	--	
Operating Ranges	--	OFF	--	--	--	--	--	--	
Other Monitoring/Phase rotation	--	ON	F	No	Always	--	--	CW	
Other Monitoring/Power factor	--	OFF	--	--	--	--	--	--	
Power/Load Share	--	OFF	--	--	--	--	--	--	
Power/Overload	--	OFF	--	--	--	--	--	--	
Power/Power Mismatch	--	ON	B	No		5%	30	--	used when genset is in Baseload
Power/Gen Unloading mismatch	--	ON	B	No		5%	60	--	60s min delay, 180s max delay
Power/Rev / Reverse power level 2	--	ON	D	No	Always	-10%	5	--	
Power/Unbal Load	--	OFF	--	--	--	--	--	--	
Power/Volt/OV Level 2	--	ON	D	No	Always	110%	5	--	
Power/Volt/UV Level 2	--	ON	D	No	Eng.mon	90%	5	--	

Miscellaneous/Free Alarms	Alarm	Class	Self Ackn	Enabled	Monitor	Delay			
Oil Level AL	1	B	No	Always	Disc Inp 3	5			input from DI3
Oil Level SD	2	F	No	Always	Disc Inp 3	100			input from DI3

Interfaces		Monitor	Class	Self Ackn	Enabled	Delay			
CAN Interface 2	--	ON	B	Yes	Always	0.2			
J1939 Amber Alarm	--	ON	A	No	Always	2			
J1939 DM1 alarms	--	ON	--	Yes	--	--			
J1939 Interface (Device 1-3)	--	OFF	--	--	--	--			
J1939 Red Alarm	--	ON	F	No	Always	2			

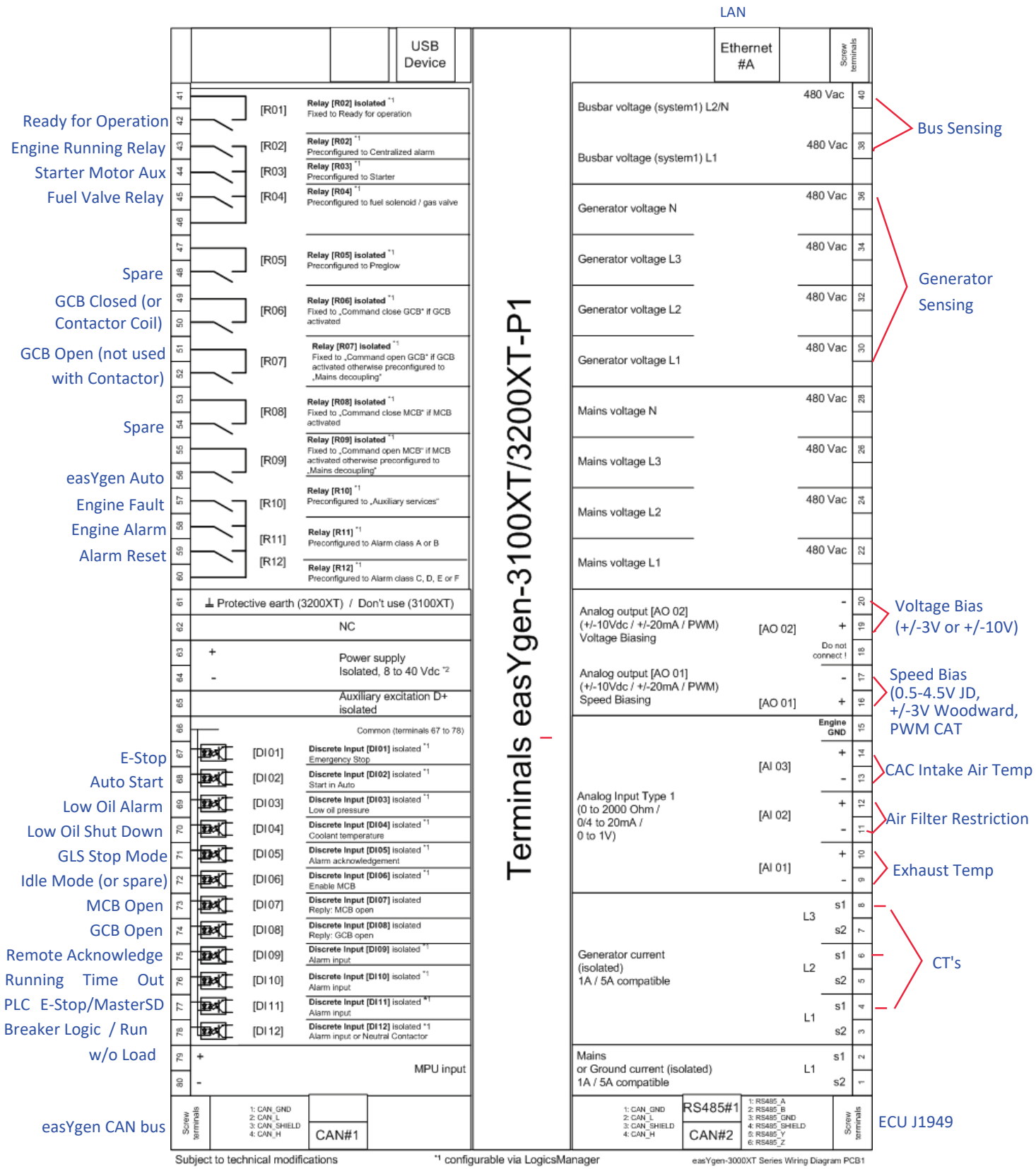


Fig. 21: Wiring diagram easYgen-3100XT-P1/3200XT-P1(-LT)

1) Configurable by LogicsManager
2) V_{nom} = 12/24 V SELV

END OF SECTION

SECTION 26 23 05

SCADA SYSTEM FOR PRIME POWER SWITCHGEAR

PART 1 - GENERAL

1.1 SCOPE

A. The Work consists of providing a complete and operational Supervisory Control and Data Acquisition (SCADA) system, as specified herein. The SCADA system shall be provided by an experienced programmer, referred to as Developer.

B. The Developer shall develop the SCADA system and programming for the Human Machine Interface (HMI), referred to herein as Operator Interface Unit (OIU), data storage server, and local and remote devices. The SCADA system shall include Supervisory and Trending application software, custom project software file(s), and other software and files required to make a complete and fully functional system.

C. The Developer shall provide all labor, equipment, incidentals and resources as specified and needed to furnish, install, calibrate, test, start-up and place into service a complete SCADA system, as indicated herein.

D. The Authority and Utility, herein referred to as Designee(s), shall maintain ownership and use of all custom project software files and documentation developed to meet the requirements of this solicitation. All SCADA Supervisory and Trending application software licenses provided under this solicitation shall include the legal right for the Authority and its Designee(s) to use the software for an indefinite period of time. The Authority and its Designee(s) shall have unlimited rights to install and operate the SCADA Supervisory and Trending application software, up to the number of software licenses issued, and to install, operate and modify the custom project files as needed, without the requirement to commit to on-going maintenance or service agreements.

E. The Developer shall fully test the SCADA system with the switchgear and generating equipment as specified herein and in Section 26 23 00 - Prime Power Switchgear.

1.2 RELATED REQUIREMENTS

A. Section 26 05 00 Common Work Results for Electrical

B. Section 26 05 02 Basic Electrical Materials and Methods

C. Section 26 23 00 Prime Power Switchgear

1.3 SUBMITTALS

A. Provide submittals in accordance with Section 26 05 00 Common Work Results for Electrical and Division 1.

B. Submit data sheets and catalog data showing all supplied features, options and configurations of the SCADA Supervisory and Trending application software.

C. Submit specific software operating system and version, and quantity of licenses for each of the following: OIU, data storage server, Secure Serial to Ethernet Server, SCADA Supervisory and Trending applications.

D. Provide a written narrative that describes the purpose and function of each device and the method of communication, i.e., LAN/EtherNet/Modbus TCP/CAN BUS/etc.

E. Provide a written narrative that describes the methods/protocols available to access the SCADA system both on the local area network (LAN) and remotely via the internet wide area network (WAN), and how many users may simultaneously access the SCADA system (LAN and WAN).

F. Provide a written description of the SCADA system security encryption and authentication protocol.

G. Submit screen shots of the proposed OIU screen custom project file(s). Provide a Tag list and narrative operating description of the project file(s).

1.4 SCADA SYSTEM SOFTWARE

A. All SCADA Supervisory and Trending application software licenses and custom project files, as well as upgrades and maintenance described in the Warranty herein, shall be included in the Developer's bid price.

For the purpose of this solicitation the SCADA Supervisory application software is defined as:

- Machine-readable object code used for the supervision, control and monitoring of the programmable logic controller (PLC) and other switchgear and field devices. The Supervisory application software interacts with custom project file(s) that are configured and customized to display and control tags from the PLC and devices, as indicated in Section 26 23 00 - Prime Power Switchgear.

For the purposes of this solicitation the SCADA Trending application software is defined as:

- Software that provides the functions as described in Paragraph 2.2 - Trending

B. For the SCADA system to function both the Supervisory application software and custom project files shall be installed on a client device. A client device shall include, but not be limited to, devices that operate on Windows 10, and excludes any Windows-based Server.

C. The Authority and its Designee(s) shall be able to upgrade the Supervisory and Trending application software and to edit, modify, change, and manipulate the custom project files to fit their requirements.

D. The Authority shall own outright all other software applications and files developed under this solicitation by the Developer without license and shall have full rights to the files and programming code and may distribute, modify, or install it on any number of computers that may be owned by the Authority or its Designee(s) without additional costs or fees.

E. For the purposes of this contract "other software applications and files" shall include but may not be limited to:

- Customized screens and parameters developed for use with the Supervisory and Trending application software. (i.e., custom project files).
- Any other software and interfaces developed between the Supervisory and Trending application software, custom project files, and other application software and files related to collecting and reporting power plant data via the SCADA system.

1.5 QUALITY ASSURANCE

A. The Developer is responsible for quality assurance and completion of all work identified in these specifications. All work shall be subject to evaluation and inspection by the Authority at all times to assure satisfactory progress, and to verify that work is being performed in accordance with the specifications.

B. The SCADA system shall be furnished by a single Developer who shall assume all responsibility for providing a complete and integrated SCADA system.

1.6 DEVELOPER QUALIFICATIONS

A. The SCADA system shall be the product of a Developer who can demonstrate at least five (5) years of continuous satisfactory experience in designing, implementing, furnishing and installing comparable SCADA systems for remote installations.

B. The Developer shall have a thorough working knowledge of remote, off-grid prime power electric power plant controls and operating practices.

C. A list of five prior projects that key staff have worked on may be requested by the Authority after the bid opening and prior to award in order to verify Developer qualifications. The list shall include installation date, description of installation, and a reference contact for each installation.

1.7 DEVELOPER WARRANTY

A. The Developer shall warrant the work for a period of not less than one-year. The warranty period shall commence upon acceptance by AEA of field testing with the engine generators and final commissioning of the equipment.

B. In the event of a failure of the system to perform all specified functions during the warranty period, the Developer shall promptly repair or replace any defective components and revise programming and settings as required to achieve full system function. The Developer shall assist the Authority as directed in determining causes of deficiency or failure.

C. In addition to the specified requirements for SCADA system programming, testing, commissioning, and warranty work, during the one-year warranty period the Developer shall provide an additional twelve (12) hours of programming assistance and technical support to modify the SCADA as requested by the Authority or its Designee(s). These hours are in addition to any technical requirements specified for programming, start-up and commissioning efforts, and shall be included in the Developer's bid price. The programming assistance and technical support may be

required to be provided at a single event or may be spread out over the year as directed by the Authority or its Designee(s), and will be performed remotely from the Developer's office and not at the Utility location.

1.8 OPERATION AND MAINTENANCE MANUALS

A. See Section 26 23 00 - Prime Power Switchgear.

PART 2 - PRODUCTS

2.1 GENERAL

A. The Developer shall provide a fully functional SCADA system as specified herein and to meet the requirements of Section 26 23 00 - Prime Power Switchgear.

B. The SCADA system shall be compatible with the switchgear hardware.

C. The SCADA system shall not require or depend on external hardware for activation, or internet access to function properly.

D. The Supervisory system shall operate on either the specified Data Storage Server or Secure Serial to Ethernet Server and read information directly from the PLC, switchgear, and power plant devices via the power plant LAN.

E. The Supervisory system shall not be dependent on connectivity to the internet or any Windows-based server to function properly.

F. The SCADA system shall be accessible via remote and local devices operating on Microsoft Windows 10 or 11 operating systems.

G. The Supervisory and Trending software may be separate and distinct programs.

H. Multiple applications of the SCADA system shall run concurrently. The OIU screens, alarms and monitoring points shall be identical for all SCADA applications, regardless if accessed locally or remotely via the internet. The Developer shall provide a sufficient quantity of SCADA and Trending application software licenses such that all devices in the power plant, and no less than six (6) additional remote (via WAN) or local (via LAN) devices, shall be authorized to access the SCADA system concurrently.

I. The Supervisory and Trending application software and custom project file(s) shall be relatively small in size and have a simple installation routine. The SCADA system and software installation shall tolerate low throughput and high latency connections, down to as low as 56kbs and 500ms delay without dropping.

J. The OIU graphic interface shall be user friendly and have the capability without modification or setup to allow personnel with large fingers to use the touch screen without a mouse or keyboard.

K. The Supervisory system shall start and stop engines, reset alarms, change demand levels and have a confirm action dialog box for critical functions, as well as maintain an alarm log for Type 1 alarms separately from the Master and Type 2&3 alarms (refer to 3.3.H – Alarm History Screens).

L. The Developer shall maintain a secure FTP or web site with custom project files. Tag lists, installation and operating instructions, and other files necessary to install and operate the SCADA system, readily available to be downloaded and installed.

M. The Developer shall provide comments in the code that describe the function of each parameter for ease of future maintenance and changes.

N. The SCADA system installation, setup and modification shall be capable of being performed remotely via low bandwidth internet access.

O. Provide secure encryption with password protection.

2.2 TRENDING

A. The Developer shall provide, configure, test and implement a historical database on the switchgear data storage server for historical data archiving, analysis, reporting, trending and system back-up of all data presented by the SCADA system. All historical data shall be fully synchronized and time-stamped, using a single time series (clock), so that historical data from all monitored devices are compared to a single time series. The time and date shall be displayed on the SCADA Status tab.

B. The SCADA system shall include features for the management of historical data. The SCADA system shall record historical values of analog variables on a periodic basis and values of digital variables on an event basis (change of state). The historical database must be capable of storing a minimum of one (1) year of historical data. All historical data shall be recorded on the switchgear data storage server. Historical files more than one (1) year old shall be automatically deleted.

C. Trending data from the historical database shall be accessible and exportable both locally and remotely. The section of the trend to be exported shall be selectable by clicking and dragging the mouse across the trend. Any portion of the historical database shall be exportable. Data shall be exported to CSV or TXT formatted files, or similar file system as approved by the Authority. Exported files shall be of a manageable size compatible with the internet requirements of Paragraph 2.1. Exported trend data shall be readily capable of being printed or plotted to Adobe pdf format or to a designated printer.

D. Refer to Paragraph 3.4, Trending Application Tags, for representative example of historical data to be archived and available for trending.

2.3 SECURITY

A. Password Protection. Provide at a minimum the following access password protection:

1. Viewing only. In this level of access the viewer will be able to view the SCADA system but will not be able to modify any file or setpoint. Note remote WAN access shall be limited to Viewing only.

2. Local Operator. This level of access is for the local power plant operator. The operator will be able to change the demand levels and timers, change the lead generators, remote start and stop engines, and perform other functions as directed by the Authority. Note local Operator access shall be

restricted to LAN access only. The Local Operator password shall be automatically entered each time the OIU/SCADA starts/reboots.

3. Administrator. This level of access is for SCADA Programming, the viewer will be able to control and change all SCADA features and functions.

B. The Developer shall provide a description of the SCADA system security encryption and authentication protocol for review and approval.

PART 3 - EXECUTION

3.1 FACTORY TESTS

A. Prior to factory testing of the switchgear, the SCADA Supervisory system shall be fully functional as specified in Section 26 23 00 - Prime Power Switchgear.

B. The switchgear control system shall be fully tested using the SCADA Supervisory system as specified herein.

C. The OIU shall be fully functional and the switchgear shall be fully tested using the OIU. All alarm, indication, and control functions specified shall be available and indicated on the OIU.

D. The SCADA Trending application shall be factory tested to the extent practicable. Refer to Section 01 11 13 – Summary of Work for functional testing and commissioning requirements.

3.2 CUSTOMER TRAINING

A. The Developer shall provide a minimum of 8 hours of training for the Authority and Utility personnel. Training shall be provided separately for each Utility.

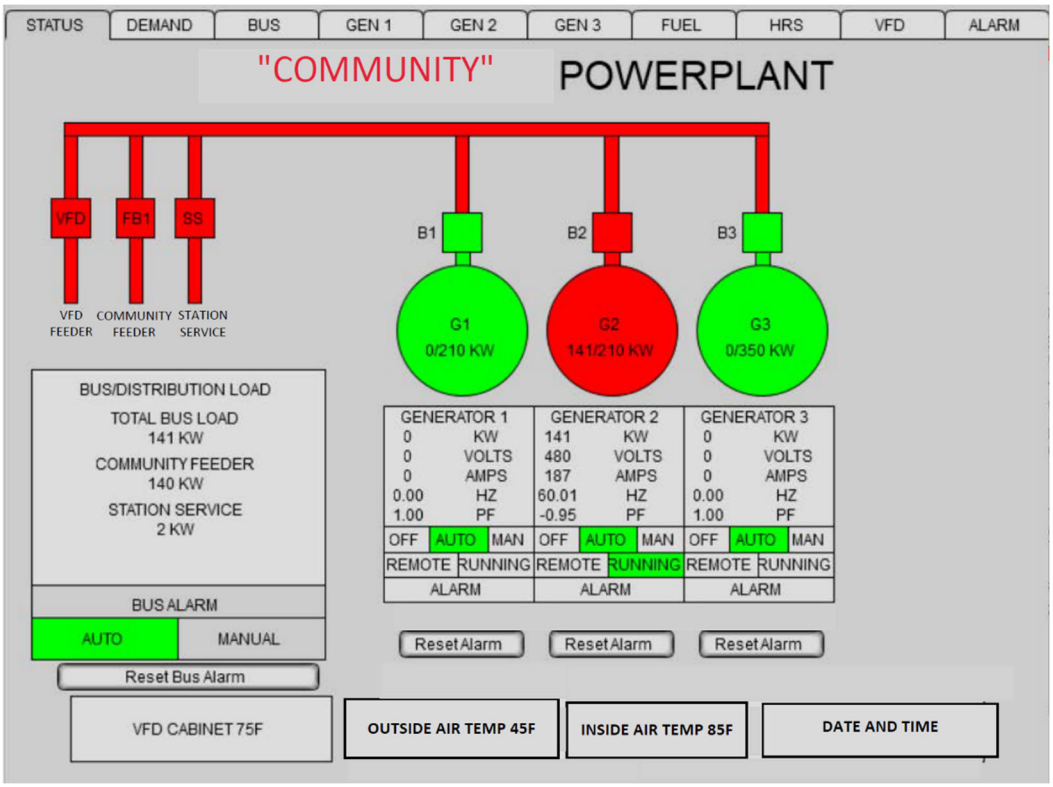
B. Training shall occur after substantial completion of the project using the actual power plant equipment. Coordinate with the Authority and Utility to ensure that the appropriate individuals are available.

C. During training, make modifications to the SCADA system programming as directed by the Authority to incorporate any system control modifications identified during testing, startup, or commissioning.

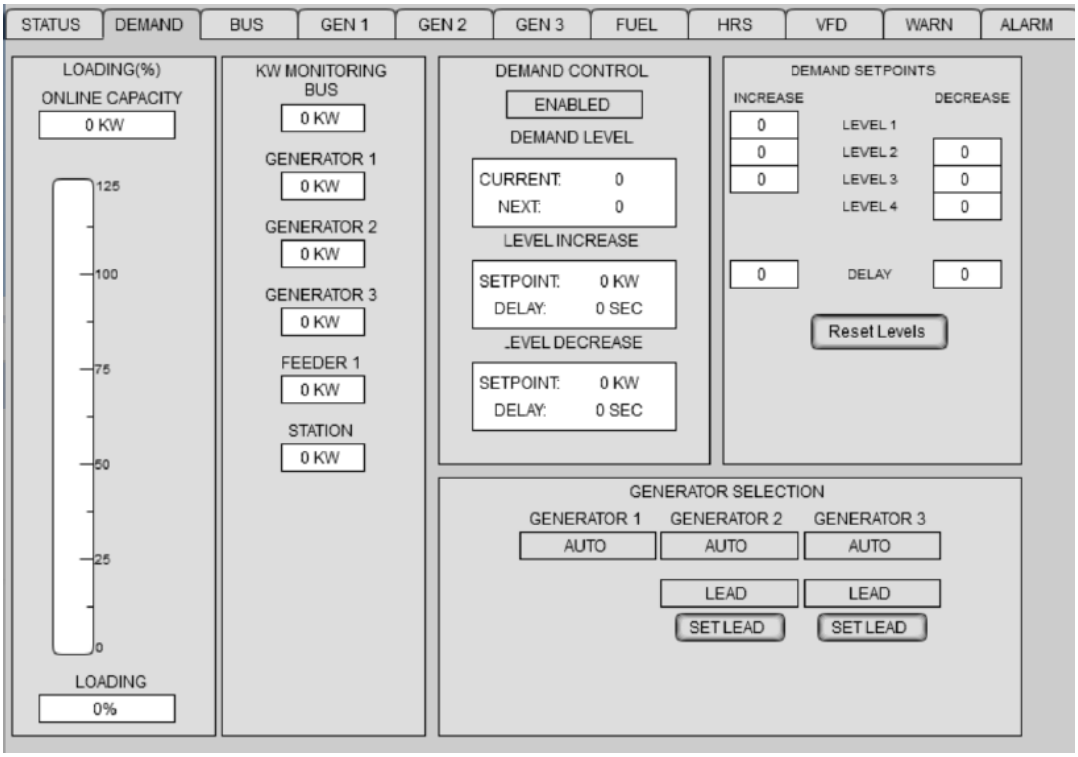
3.3 OIU SCREEN IMAGES

The SCADA system screens shall display all data as specified in Section 26 23 00 - Prime Power Switchgear OR Section 26 23 02 - Upgrade Existing Prime Power Switchgear. At a minimum, the Developer shall provide screens similar to the images shown in following paragraphs. The screen images are representative of the minimum data required and desired format. Each screen image shall be provided for the following devices: Master Section OIU, local PC’s/Devices connected to the LAN, and remote PC’s/Devices connected via the internet.

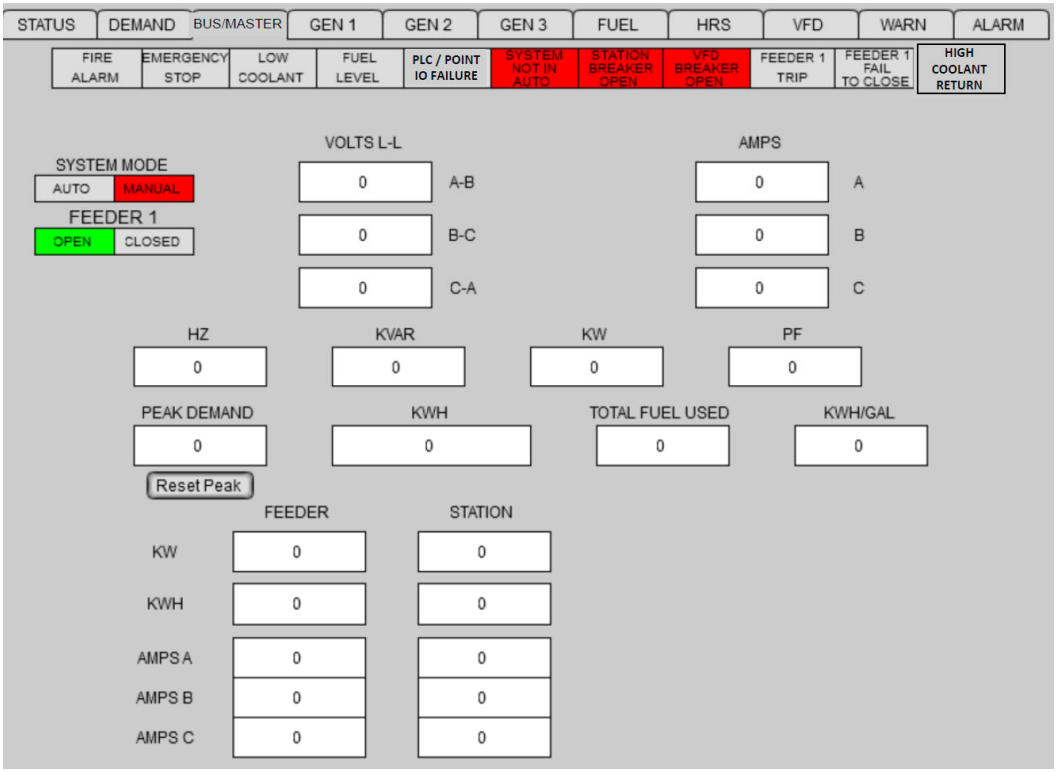
A. Home Screen – Overall Plant Status:



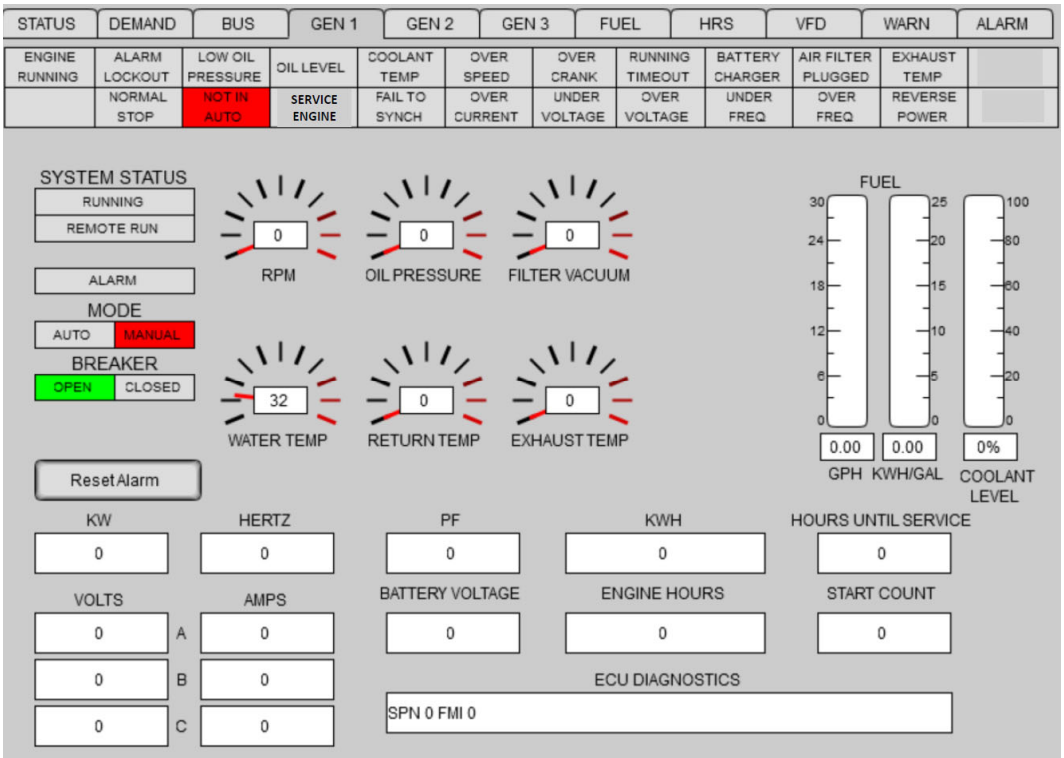
B. Demand Control Screen:



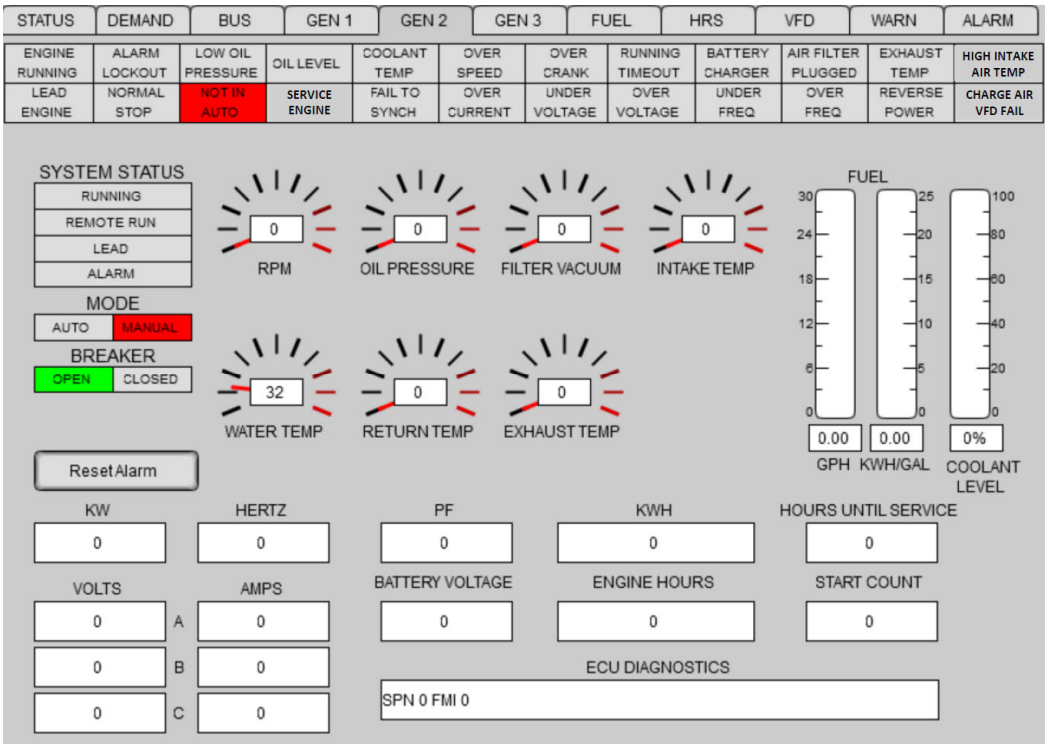
C. Bus Monitoring & Metering Screen:



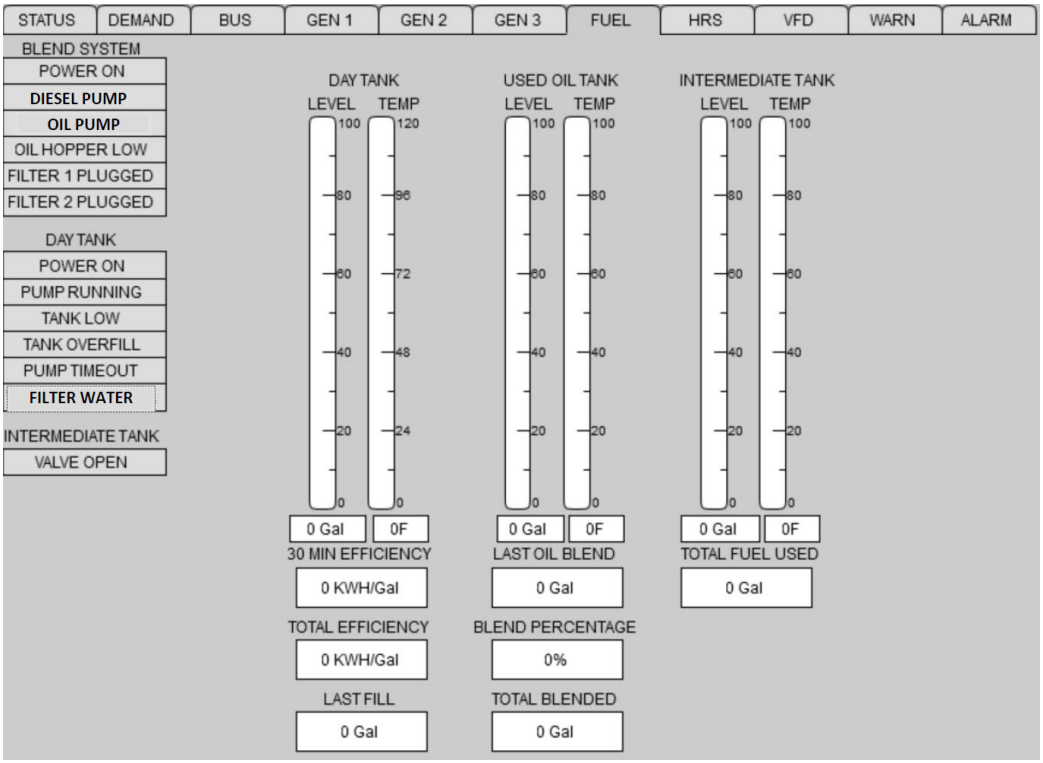
D. Engine-Generator Screen (for engines without charge air cooler):



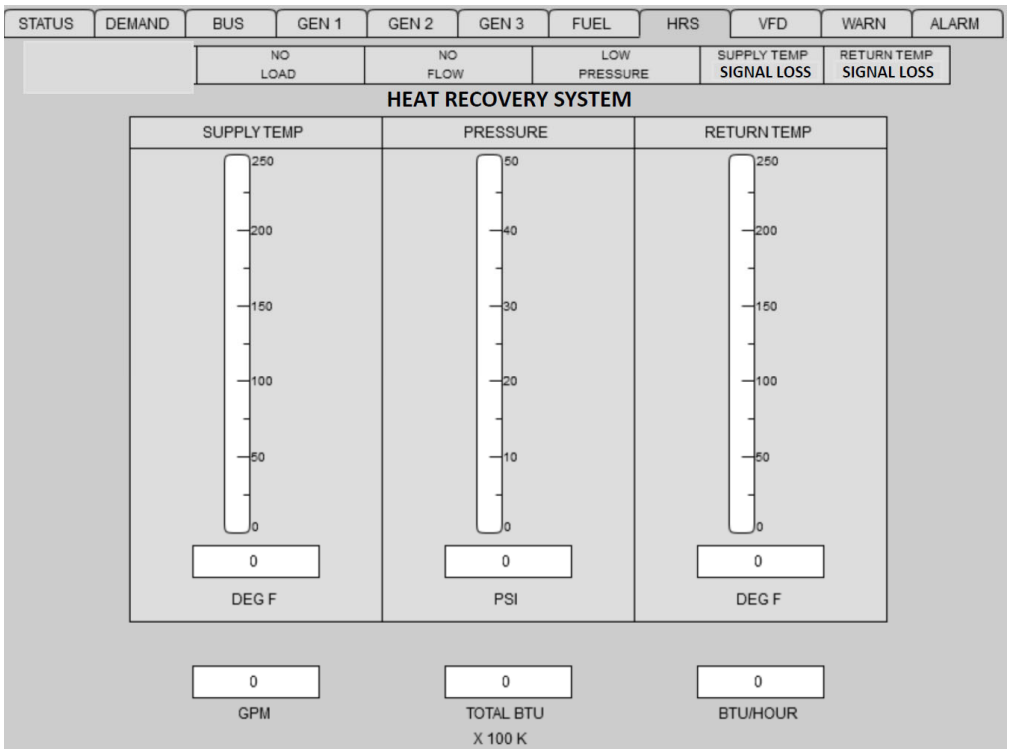
E. Engine-Generator Screen (for engines with charge air cooler):



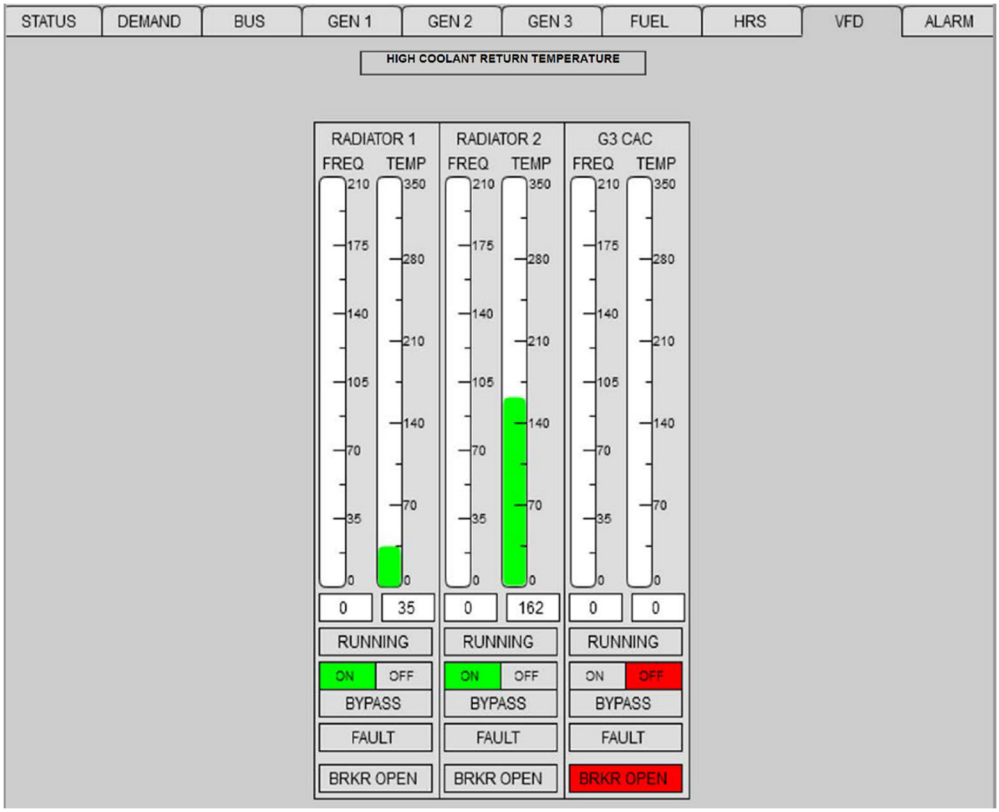
F. Fuel System Monitoring & Alarm Screen:



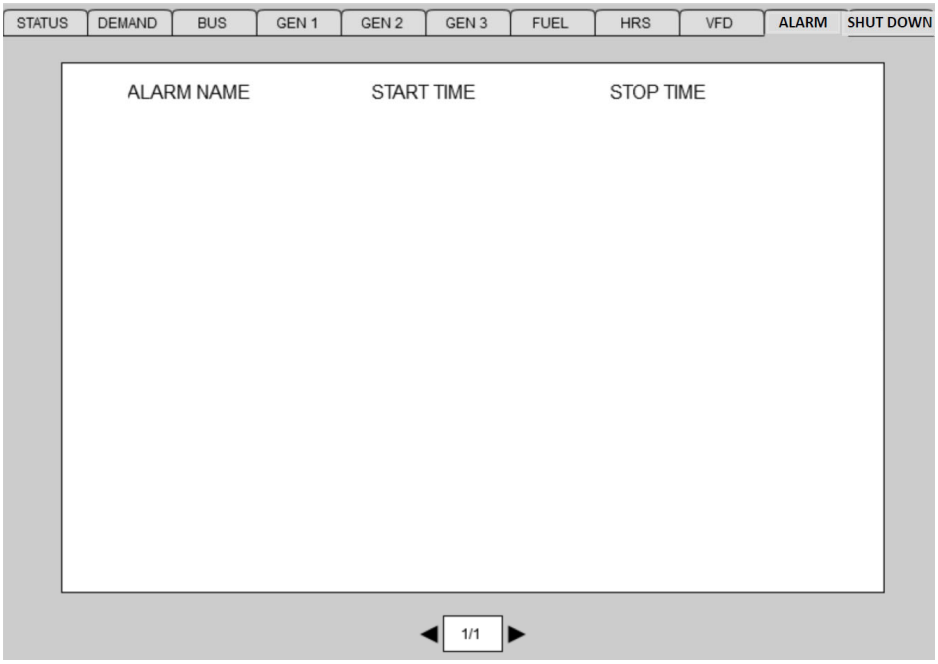
G. Heat Recovery Monitoring & Metering Screen:



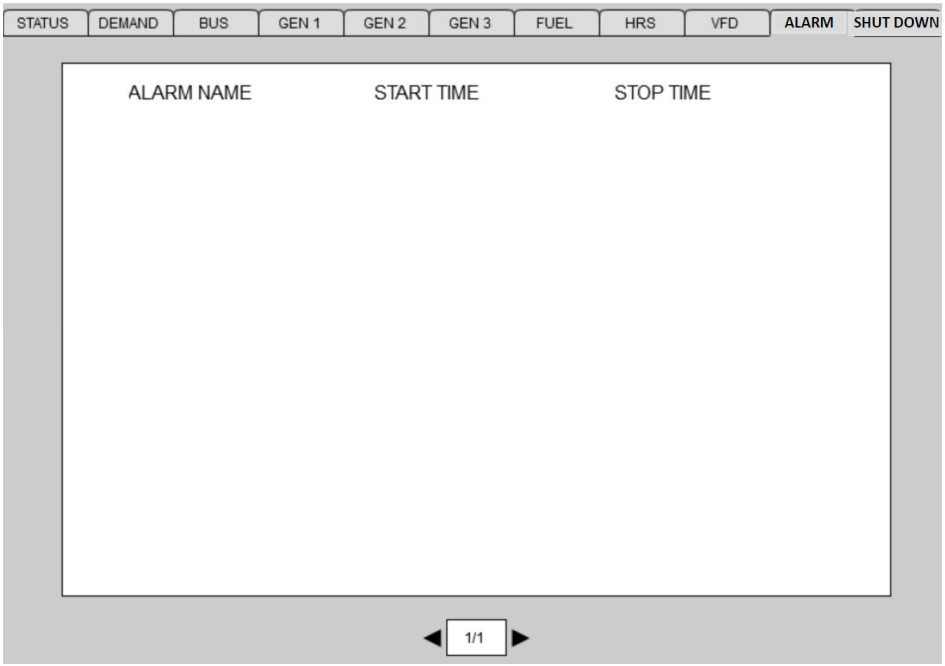
H. Variable Frequency Drive (VFD) Monitoring Screen:



I. Alarm History Screen: Provide an Alarm History Screen for the following conditions: All Type 1 Engine Soft Shutdown alarms and the Master Section Low Fuel Level, PLC/ Point I/O, System Not In Auto, and Feeder Breaker Trip alarms. The Alarm History screen shall use alternating yellow and white lines.

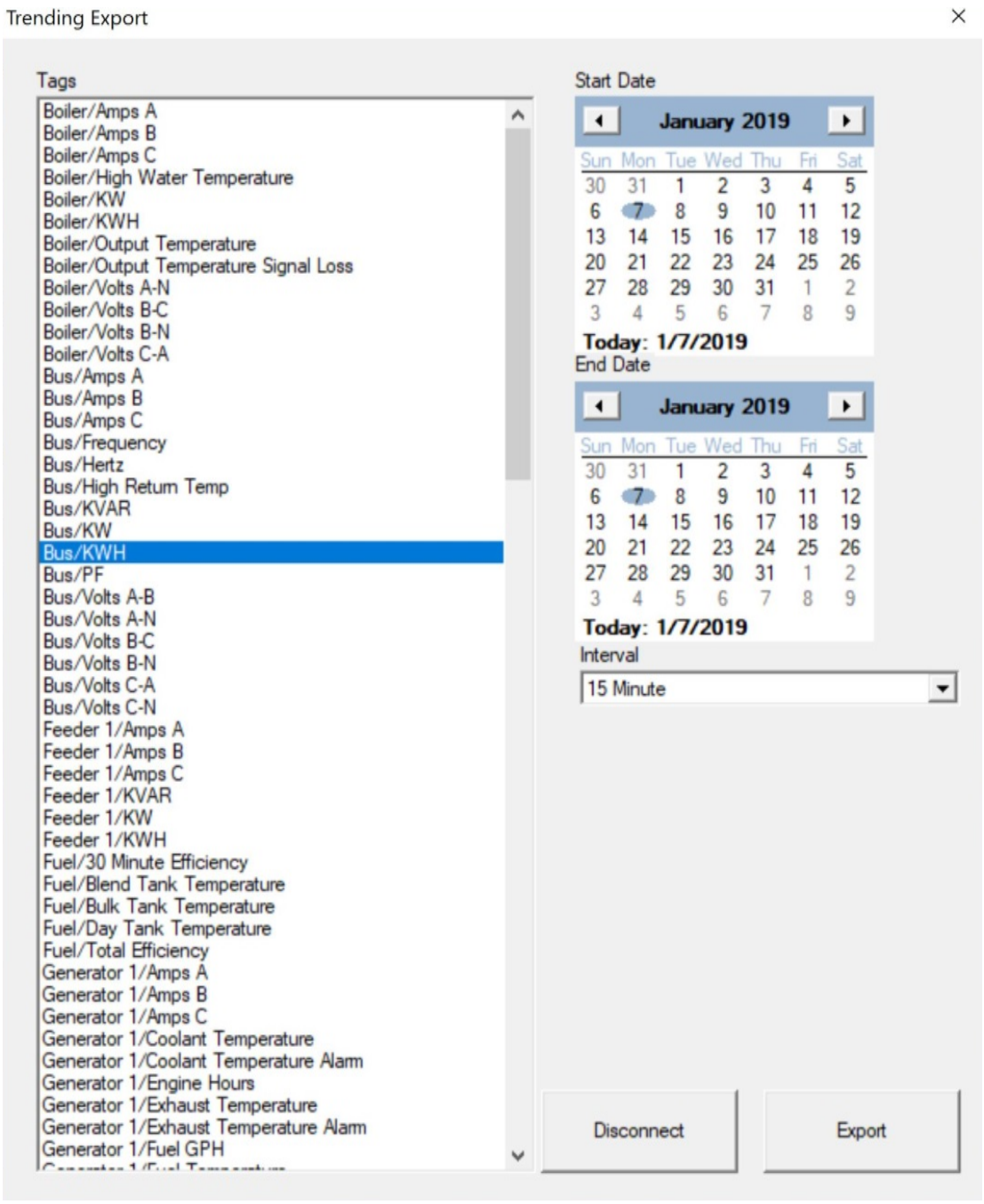


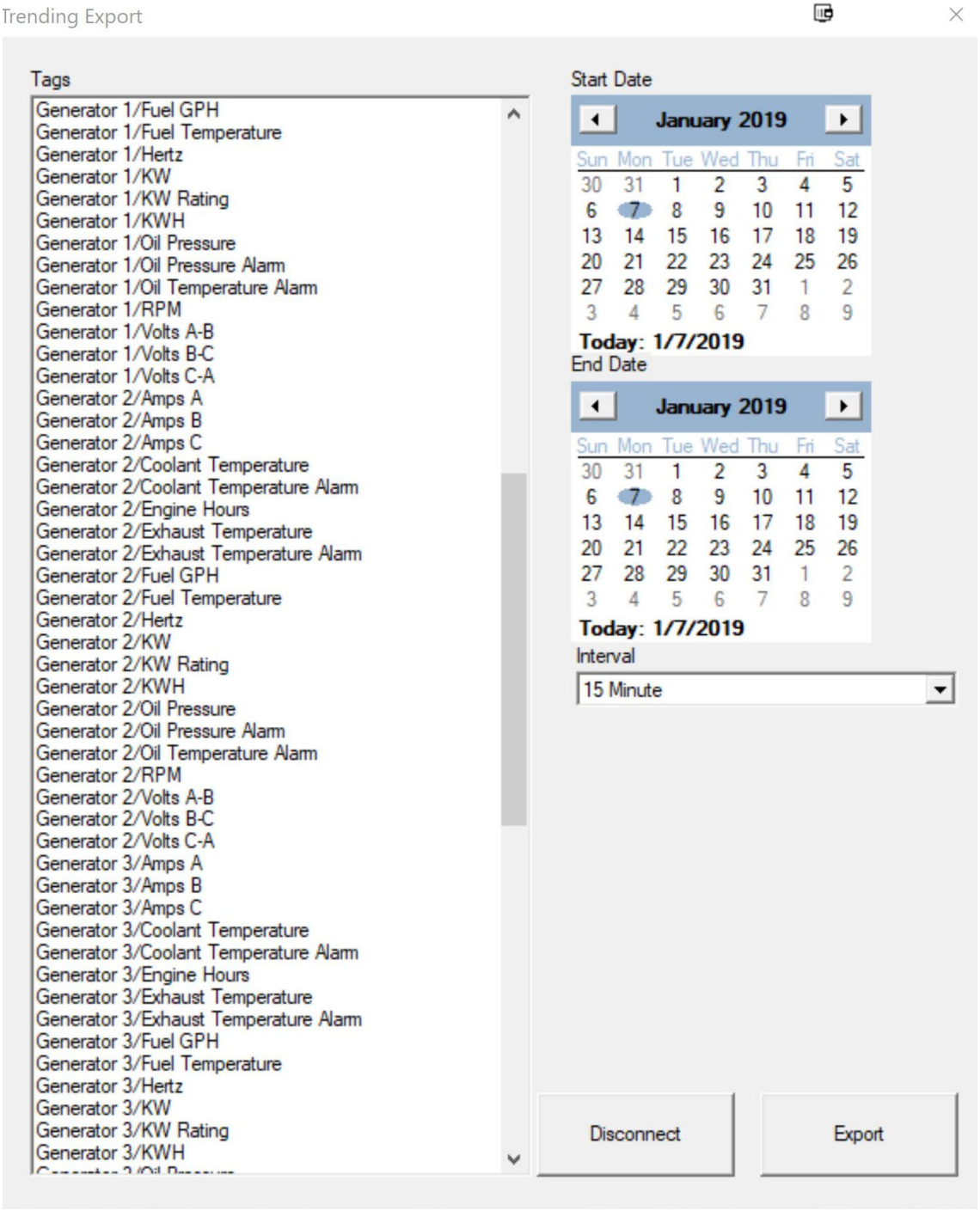
J. Shut Down History Screen: Provide a Shut Down History Screen for the following conditions: All Type 2 Engine Hard Shutdown alarms, All Type 3 Generation alarms, and the Master Section Fire Alarm, Emergency Stop, and Low Coolant Level alarms. The Shut Down History screen shall use alternating red and white lines.

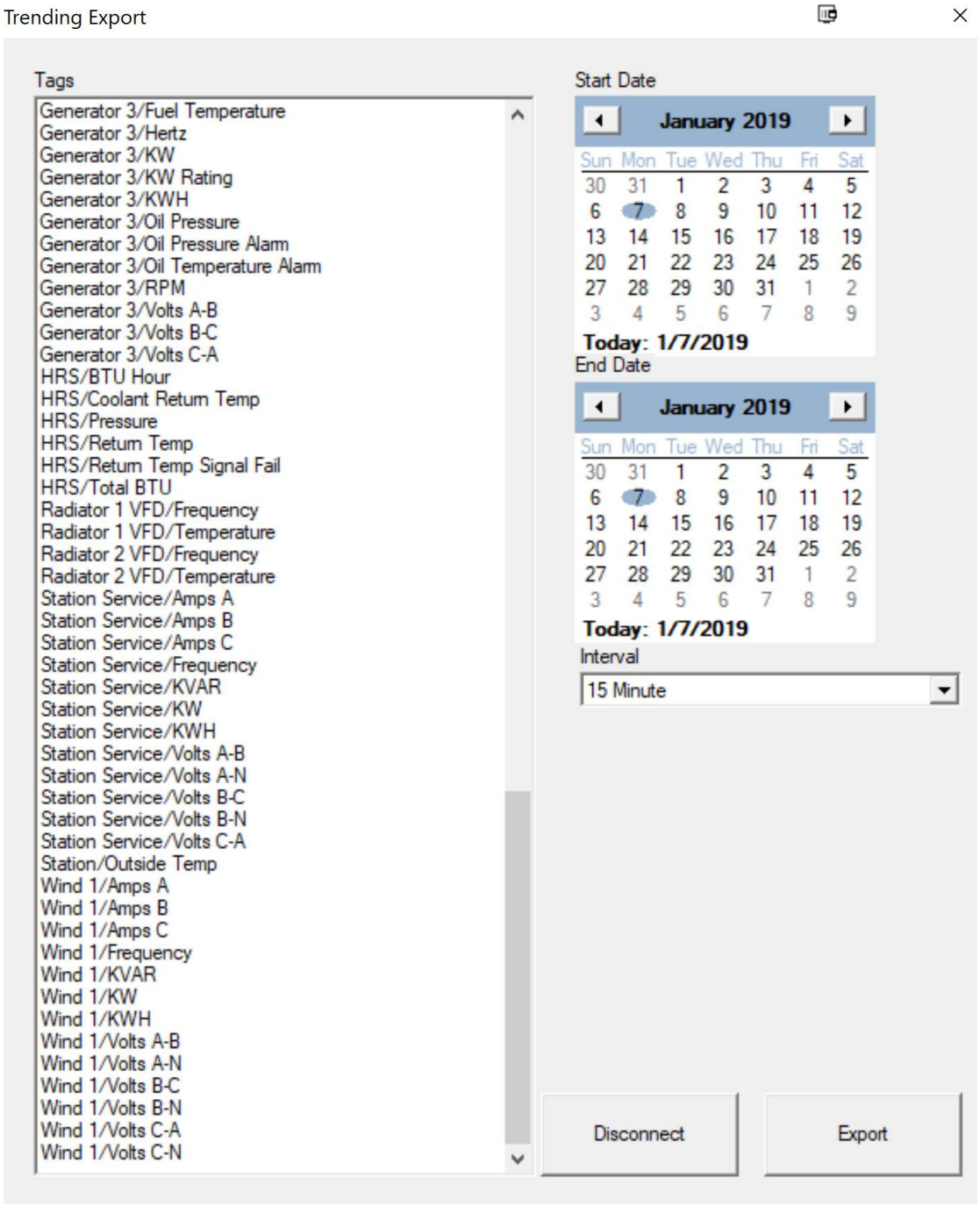


3.4 TRENDING APPLICATION TAGS

The following Trending Export screens show a representative example of historical data to be archived and available for trending. Provide tags and trend all PLC and SCADA data:




Trending Export
Tags
Generator 1/Fuel GPH
Generator 1/Fuel Temperature
Generator 1/Hertz
Generator 1/KW
Generator 1/KW Rating
Generator 1/KWH
Generator 1/Oil Pressure
Generator 1/Oil Pressure Alarm
Generator 1/Oil Temperature Alarm
Generator 1/RPM
Generator 1/Volts A-B
Generator 1/Volts B-C
Generator 1/Volts C-A
Generator 2/Amps A
Generator 2/Amps B
Generator 2/Amps C
Generator 2/Coolant Temperature
Generator 2/Coolant Temperature Alarm
Generator 2/Engine Hours
Generator 2/Exhaust Temperature
Generator 2/Exhaust Temperature Alarm
Generator 2/Fuel GPH
Generator 2/Fuel Temperature
Generator 2/Hertz
Generator 2/KW
Generator 2/KW Rating
Generator 2/KWH
Generator 2/Oil Pressure
Generator 2/Oil Pressure Alarm
Generator 2/Oil Temperature Alarm
Generator 2/RPM
Generator 2/Volts A-B
Generator 2/Volts B-C
Generator 2/Volts C-A
Generator 3/Amps A
Generator 3/Amps B
Generator 3/Amps C
Generator 3/Coolant Temperature
Generator 3/Coolant Temperature Alarm
Generator 3/Engine Hours
Generator 3/Exhaust Temperature
Generator 3/Exhaust Temperature Alarm
Generator 3/Fuel GPH
Generator 3/Fuel Temperature
Generator 3/Hertz
Generator 3/KW
Generator 3/KW Rating
Generator 3/KWH
Start Date
January 2019
Sun Mon Tue Wed Thu Fri Sat
30 31 1 2 3 4 5
6 7 8 9 10 11 12
13 14 15 16 17 18 19
20 21 22 23 24 25 26
27 28 29 30 31 1 2
3 4 5 6 7 8 9
Today: 1/7/2019
End Date
January 2019
Sun Mon Tue Wed Thu Fri Sat
30 31 1 2 3 4 5
6 7 8 9 10 11 12
13 14 15 16 17 18 19
20 21 22 23 24 25 26
27 28 29 30 31 1 2
3 4 5 6 7 8 9
Today: 1/7/2019
Interval
15 Minute
Disconnect
Export



END OF SECTION

SECTION 26 32 13.10
NAPASKIAK ENGINE GENERATORS

Notes:

1) ***All paragraphs below shown in light italic text reference work that was performed as part of the prior engine-generator purchase contract and are included here for reference only.***
2) ***All paragraphs below shown in standard text are to be performed under this contract.***
3) ***Pacific Power is the fabricator that is providing these engine-generators under the purchase contract. Approved submittals for the engine-generators will be made available to the successful bidder upon request.***

PART 1 - GENERAL

1.1 SCOPE

A. The Work included herein shall consist of providing, fabricating, and shop testing complete engine generators as specified herein.

B. The engine generators shall be delivered complete and ready for installation.

C. Provide all accessories as specified for all engine generators plus any additional components listed.

1.2 RELATED REQUIREMENTS

A. Section 26 32 13.20 - Rebuilt Engines

1.3 SUBMITTALS

A. Provide submittal for all specified items in a single electronic file in Adobe Acrobat PDF format.

B. Provide complete and accurate drawings of the equipment, including outline drawings and dimensional data which fully describe the height, width, and depth of the equipment; skid construction; schematics; wiring diagrams; and other relevant details.

C. Provide mechanical and electrical performance data for the engine and generator.

D. Provide manufacturer's catalog literature for all accessories and equipment.

E. A torsional vibration analysis (TVA) has been prepared and accepted for the following engine-generator combinations indicated in paragraph 2.2 specific configuration:

1. Detroit Diesel Series 60, 6063TK35 with Newage/Stamford HCI534D.

For any substitute engine generator combinations not specifically listed above, a TVA shall be provided for the proposed engine generator combination within 14-days of contract award.

1.4 REGULATORY COMPLIANCE

The Environmental Protection Agency (EPA) has issued New Source Performance Standards (NSPS) regulations governing use of stationary diesel engines in remote areas

of Alaska. These regulations were revised effective June 29, 2021. The following provisions of 40 CFR apply to this solicitation:

A. The Environmental Protection Agency (EPA) has issued regulations governing the rebuilding of diesel engines for controlling and maintaining emissions and performance standards. In order to comply with EPA emissions requirements and also be compatible with the intended service applications, the used diesel engine(s) furnished under this solicitation ***must have a block manufacture date on or before April 1st, 2006****. In addition to the block, the rebuilt engine must also contain at least one other documented major component that is remanufactured.*

B. 40 CFR 60.4211(a)(3) of EPAs New Source Performance Standards (NSPS) stipulates that an Owner or operator of a stationary diesel engine must meet the requirements of 40 CFR part 1068, as they apply. ***A pre-2007 model year engine must be certified to at least a nonroad Tier 1 emissions standard.***

C. 40 CFR 1068.120 describes requirements for rebuilding engines. ***The rebuild requirements of 40 CFR 1068 apply to engines furnished under this solicitation****.*

In order to comply with EPA emissions requirements and also be compatible with the intended service applications, the diesel engines furnished under this solicitation shall utilize a block manufactured on or before April 1, 2006, shall be certified nonroad minimum Tier 1, and shall meet the other requirements of these specifications.

1.5 QUALITY ASSURANCE

A. Equipment shall not have been in service at any time prior to delivery, except as required by tests.

B. All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practices. Individual parts shall be manufactured to standard sizes and gauges so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable.

C. Equipment and components furnished under these specifications shall be in accordance with the requirements of applicable UL, NEC, IEEE, NEMA, and ANSI standards.

1.6 FABRICATOR QUALIFICATIONS

The engine generators shall be furnished, assembled, and tested by a qualified fabricator (Fabricator) who is regularly engaged in the business of providing diesel engine driven generator equipment.

A. The Fabricator must have staff with extensive experience in packaging diesel engine driven electrical generators. A list of five successful installations that key staff have worked on may be requested by the Authority after the bid opening and prior to award in order to verify Fabricator qualifications. The list must include installation date, description of installation, and a reference contact for each installation.

B. The Fabricator must maintain a competent service organization that is available for field service calls. A description of the organization including resumes of key personnel may be requested by the Authority after the bid opening and prior to award in order to verify Fabricator qualifications.

C. The Fabricator must have a fabrication facility with adequate space and appropriate equipment as required to perform the work. The Authority may inspect the Fabricator's shop after the bid opening and prior to award in order to verify Fabricator qualifications.

1.7 FABRICATOR WARRANTIES

A. The Fabricator shall warrant the work for a period of not less than one-year after energization of the equipment or 18 months after delivery to the F.O.B. point, whichever comes first.

B. In the event of equipment or component failure during the warranty period, the Fabricator shall repair or replace such defective equipment or components and bear all associated costs. Costs shall include material, parts, and labor. The Fabricator will be allowed to charge for travel and per diem expenses within Alaska related to warranty service at actual cost plus 10%. The Fabricator shall assist the Authority as directed to determine the cause of failure and pursue manufacturer's warranties to the extent necessary to obtain replacement equipment and provide proof of action taken upon request.

C. Provide a nametag on each piece of equipment that clearly identifies the party responsible for the warranty. Nametag shall include the name, address, and phone number, and shop order or Fabricator's serial number.

1.8 OPERATION AND MAINTENANCE MANUALS.

A. Provide one (1) complete bound set of operation and maintenance (O&M) manuals for each unique engine generator unit. Identification symbols for all replaceable parts and assemblies shall be included. Provide manuals for the following equipment:

1. *Engine.*
2. *Generator.*
3. *Voltage Regulator.*
4. *All accessories.*

B. For each engine provide all available factory service publications including parts manuals, service manuals, component technical manuals, etc.

C. For all other components of each engine generator unit provide:

1. *Equipment function, normal operating characteristics, and limiting conditions.*
2. *Assembly, installation, alignment, adjustment, and checking instructions.*
3. *Operating instructions for start-up, routine and normal operation, regulation and control, shutdown, and emergency conditions.*
4. *Lubrication and maintenance instructions.*
5. *Guide to "troubleshooting."*
6. *Parts list.*

7. *Outline, cross section, elevation, and assembly drawings*
8. *Engineering data including all mechanical and electrical performance characteristics.*
9. *Complete AC connection and three-line diagrams.*
10. *Complete DC schematics including voltage regulator, fuel injector pump, sensors, switches, fuses, and all other devices.*

D. *The operation and maintenance manuals shall be in addition to any instructions or parts list packed with or attached to the equipment when delivered, or any information submitted for review.*

E. *Bind materials in locking three ring "D" style binders. Binder capacities shall not exceed 3 inches, nor shall material included exceed the designed binder capacity. If material to be bound exceeds capacity rating, multiple volumes shall be furnished. Binder capacity shall not be less than approximately 1/2 inch greater than the thickness of the material within the binder. Permanently label with project information on the front cover and edge.*

F. *Where reduction is not practical, larger drawings shall be folded separately and placed in envelopes, which are bound into the manuals. Each envelope shall bear suitable identification on the outside.*

G. *All information in the O&M manuals shall be new and original publications.*

PART 2 - PRODUCTS

2.1 GENERAL CONFIGURATION AND MANUFACTURERS

A. *All units shall be complete skid mounted engine generators utilizing all new components except where allowance is made for rebuilt engines.*

B. *All units shall be configured as specified herein and shall include all accessories as indicated.*

C. *Engines shall be rated for prime power duty at the horsepower (shaft) and electrical kilowatt (generator) ratings indicated for each unit. All engines shall be 1800 RPM unless specifically indicated otherwise. All starting and control systems shall be 24 VDC.*

D. *Provide engines of the manufacturer and model as indicated in Paragraph 2.2 - Specific Configuration, no other substitutes except as specifically noted below.*

E. *Approved equal substitutions of engines will be allowed only by Engineer's approval. To obtain approval, submittals must clearly demonstrate the following:*

1. *The substitute engine must meet all of the requirements of Paragraph 2.3*
2. *The substitute engine manufacturer must have at least one factory authorized service representative with a permanent shop in Southcentral Alaska.*
3. *The size and weight of the substitute engine must not exceed that of the specified engine by more than 10%.*

4. *The physical layout, piping connections, and service access areas of the substitute engine must be sufficiently similar to that of the specified engine so that no major changes will be required to the power plant design.*
5. *The substitute engine must meet or exceed the fuel efficiency rate of the specified engine. Provide fuel curve showing fuel consumption (kWh/gallon) at 25%, 50%, 75% and 100% of prime rated capacity.*
6. *The substitute engine must be provided with a single jacket water cooling circuit with a separate air-to-air aftercooler. Low temperature liquid aftercoolers will not be accepted.*
7. *The substitute engine must meet or exceed the heat rejection to the jacket water circuit of the specified engine.*
8. *The engine must not be equipped, or require to be equipped, with any exhaust emissions equipment including Exhaust Gas Recirculation, Diesel Oxidation Catalyst, Diesel Particulate Filter, or Selective Catalytic Reduction.*

F. *Provide Newage/Stamford generators as indicated in the Specific Configuration requirements that follow or Kato equal, no other substitutes except as specifically noted below. The generator shall be rated for continuous output at the value and temperature rise indicated at 0.8 power factor. The generator shall be 2/3 pitch winding, 3 phase, 277/480 volt, 12 lead reconnectable, with PMG excitation.*

G. *If a Marathon or other generator of equivalent or greater capacity is provided it shall be modified and upgraded prior to installation. Upon receipt of the generator from the factory it shall be taken to a manufacturer's authorized warranty service shop and the following tasks shall be performed:*

1. *Remove rotor assembly, bearing, exciter, diode plate and inspect for defects.*
2. *If any defects are encountered immediately file a warranty claim with the manufacturer.*
3. *Electrically test all windings.*
4. *Encapsulate exciter rotor winding with epoxy.*
5. *Replace bearing prior to reinstalling exciter. Bearing shall meet the minimum requirements of these specifications.*
6. *Replace diode plate mounting bolts with grade 8 bolts and use Loctite.*
7. *Insulate main rotor leads with phase paper. Secure leads with heat shrinkable polyester tape using epoxy on all knots.*
8. *Spray coat all windings with epoxy.*
9. *Dynamically balance and re-assemble.*
10. *Test at rated RPM.*

2.2 SPECIFIC CONFIGURATION

Furnish Engine Generators of the capacity and configuration listed below:

No. 1: ***Engine*** *- Detroit Diesel, Series 60, 12.7 liter, 550 HP at 1800 rpm, Model 6063TK35, DDEC IV, no substitutes, rebuilt in accordance with Specification 26 32 13.20. All starting and control systems shall be 24 VDC.* ***Generator*** *- Minimum 470kW continuous at 105°C rise, Newage/Stamford HCI-534D or Kato equal.*

2.3 ENGINE

A. Provide a skid mounted, 1800 RPM, diesel engine complete with generator/alternator and ready for service.

B. In final assembly, engines shall be configured without a charging alternator, fan, radiator, accessory reduction gear drive, or any other accessories not specifically required by these specifications.

C. Engine Control: All engine control functions will be performed by remote switchgear which will perform all start/stop, speed, paralleling, and load sharing control functions in addition to all engine function monitoring and safety shut downs. Engine manufacturer's electronic control panels shall not be provided.

D. ECM and Isochronous Governor: Provide an Engine Control Unit (ECM) for interface with the switchgear. Mount in a readily accessible location on the engine or on the generator enclosure. Provide service loops in wiring harnesses as required.

E. Program the ECM for nominal 1800 RPM operation at 2.5 VDC input, variable RPM above and below 2.5 VDC input, and idle operation at input less than or equal to 0.5 VDC.

F. Fuel: The engine shall be capable of satisfactory performance on No. 1 or No. 2 Ultra Low Sulphur Diesel (ULSD) Fuel.

G. Fuel System: The engine shall have manufacturer's engine mounted fuel filters with replaceable elements. Fuel supply and return lines shall be routed to the front of generator skid for field connection to the plant piping. See Drawings for detailed configuration.

H. Lubrication: The engine shall have a gear type lubricating oil pump for supplying oil under pressure to the main bearings, crankshaft bearings, pistons, piston pins, timing gears, camshaft bearings and valve rocker mechanism. Threaded spin-on type, full flow lubricating oil filters shall be provided. The oil drain line shall be terminated with a ball valve and bulkhead fitting through the skid on the side of the unit. See Drawings for detailed configuration.

I. Oil Level: The engine shall have a combination visual oil level site gauge with adjustable high and low level switches, Murphy L129CK1 or approved equal. Mount on rubber isolators and connect to engine with minimum #8 hoses. Carefully route upper vent hose to avoid any low point traps and connect directly into crankcase. Route lower hose to a connection directly on the oil pan. Do not tee lower hose into oil drain line. See Drawings for installation detail.

J. Fuel and Oil Hoses: All hoses for fuel, lube oil, vents, mechanical gauges, etc., shall be Aeroquip type FC300, Eaton Weatherhead H569 or approved equal. Minimum hose size shall be 5/16" (#6). Provide with re-useable JIC swivel type

fittings. Push-on or barb type hose connections will not be allowed. Route hoses to avoid wear points and to ensure access to normal service points on the engine. Securely support hoses from engine and skid.

K. *Glycol Hoses: All hoses for glycol shall be Teflon hose with stainless steel outer braid, Eaton Weatherhead H243 or approved equal. Provide with re-useable plated steel straight JIC swivel ends with NPT adapters. Route hoses to avoid wear points and to ensure access to normal service points on the engine. Securely support hoses from engine and skid.*

L. *Wire Loom: All wiring for control and instrumentation shall be routed in plastic loom. Provide tee fittings for all branch connections. Route loom to avoid wear points and to ensure access to normal service points on the engine. Securely support loom from engine and skid.*

M. *Protective Guards: All moving parts and hot surfaces shall be provided with protective guards in accordance with U.L Standard 2200.*

N. *Air Cleaners: The engine shall be provided with a metal canister air cleaner with a reusable oiled cotton stock element. John Deere, K&N, Parker, or approved equal. Open disposable type air filters or plastic canisters will not be accepted. Provide visual air restriction indicator, 1/8" MPT, 20" water column limit, manual reset, Donaldson X002251 or approved equal.*

O. *Starting: The engine shall be equipped with a 24 VDC electric starting system. The starting system shall be of sufficient capacity to crank the engine at a speed which will allow full diesel starting. A 24 VDC starter auxiliary relay shall be remote mounted in control wiring junction box. John Deere AT145341, Caterpillar 9X-8124, or Denso equal.*

P. *Control Power: To provide 24VDC power to the control wiring junction box, a 30A circuit breaker with switch shall be mounted on the engine in the vicinity of the starter, Cooper 187-030-F-00 or approved equal. A second identical circuit breaker shall be installed to provide dedicated power to the engine ECU.*

Q. *Sensors and Safety Controls: The engine shall be equipped with the following:*

1. *Air Filter Vacuum Sensor. 4-20mA, -30"Hg to 0 PSIG, 1/8" MPT. Noshok 100-30V-1-1-1-7 or approved equal.*

2. *Exhaust Gas Temperature. High temperature (650°C) 2 wire 100 ohm RTD with 2' high temperature lead wire, spring strain relief, Deutz DT06-2S-E008 male connector, Deutz DT04-2P-E008 female connector, and compression fitting with 1/4" MPT adapter. Eustis RGB7B203B02X0 with NS44 adapter or approved equal. See note 2 below for installation.*

3. *Intake Air Temperature Sensor. 4-20mA, 20-240°F, 1/2" MPT. Noshok 800-20/240-1-1-8-8-025-6 or approved equal. Note that this is only installed on units with charge air coolers as indicated in the prior Specific Configuration requirements. See note 3 below for installation.*

Note 1. The above listed sensors shall be independent from engine gauges and all other devices and sensors. Where standard factory furnished sensors for the above listed functions are required for operation of the ECU, provide

additional duplicate sensors as specified. All sensors shall be installed on the engine and wired to terminal blocks as indicated in the Drawings.

Note 2. Upon completion of shop testing, if exhaust gas temperature sensor is installed in flex remove sensor and tywrap to engine in a secure location for shipping.

Note 3. Intake air temperature sensor will be field installed in charge air tubing off the engine. Provide min 6' service loop of wire in loom for field routing and termination. Tywrap sensor to engine in a secure location for shipping.

R. Safety Controls: The automatic switchgear provided by others shall be equipped with automatic safety controls which will shut down the engine in the event of high jacket water temperature (primary), high lubricating oil temperature, low lubricating oil pressure, high or low lubricating oil level, high air filter vacuum, and engine overspeed based on J1939 CANbus and engine mounted sensors. Note that a single low water shut down switch will be installed on the external cooling system.

2.4 EXHAUST FLEX

A. A flexible, continuous, 18 inch long stainless steel exhaust flex connector with welded connections shall be furnished for each engine, Alaska Rubber, DME, Harco, or approved equal. Provide an appropriate engine mating connection at one end and an ASA 125 lb. flange at the opposite end sized as indicated below. Slotted cuff connections are not acceptable. Provide gasket, bolts, v-clamp, or any other components required for connection to the engine. Provide a 90° elbow where required for the flex to be installed vertically. Note that if the exhaust temperature sensor cannot be installed directly in the outlet connection, a 1/4" FPT stainless steel thread-o-let shall be welded into the flex between the engine connection and the corrugated hose.

1. Provide 6" flanged end for all engines.

2.5 ACCESSORIES

Provide the following accessories for each engine generator (unless otherwise indicated):

A. Spring vibration isolators complete with mounting hardware, four (4) per each unit, sized for the complete engine generator unit weight. Caldyn Type RJ or approved equal.

B. Drip pan, 16-gauge galvanized sheet metal, liquid tight joints, 20" wide by 50" long by 1" high.

C. Minimum 800 cold crank amp 12-volt starting batteries, two for each engine. Batteries shall be sealed maintenance free, Optima Red Top NAPA Part Number BAT N993478RED or approved equal. Furnish and install battery racks sized to hold the batteries with hardware to secure the battery for shipping.

D. Each engine shall be provided with two each #2/0 AWG arctic flex battery cables, 15 ft. long, plus one each #2/0 AWG by 12-inch long jumper. All cables shall include compression type terminal ends shipped loose. One battery cable shall be

red for the positive lead and the other shall be black for the negative lead. The jumper shall be black with red heat shrink one end. Provide plastic terminal covers.

2.6 COOLING SYSTEM

A. Engine cooling shall be by remote radiators (provided by others) with coolant circulation driven by the engine coolant pump.

B. Glycol Filter: Provide screw-on canister style filter element with 3/8" NPT connections on head, Wix #24019 head with #24069 element or approved equal. Mount head on steel bracket fixed to front or side of engine. Connect to engine with glycol hoses with 3/8" NPT quarter turn gauge cock isolation valves. Connect inlet to thermostat housing and connect outlet to water pump inlet. On thermostat housing connection provide 3/8" NPT tee fitting with plug for field connection of pre-heat line by others. When filters are provided as part of engine manufacturer's assembly the standard factory filters may be substituted for the above specified parts; however, equivalent mounting, connections, and isolation valves shall be included.

C. Perform a marine conversion on the engine in accordance with Specification 26 32 13.20.

2.7 DIAGNOSTIC GAUGE

A. Provide a J1939 multi-function monitoring panel, Murphy PV101-C or approved equal. The panel must not be configured for Tier 4 engines and must be programmed specifically to read data from the specified engine. The panel shall be mounted on the side of the control wiring junction box. Provide with wiring harness as required for connection to ECU and battery power.

2.8 GENERATOR/ALTERNATOR

A. Generator shall be a single bearing, four pole, synchronous type. Generator shall be directly connected to the engine flywheel housing and driven through a flexible coupling to ensure permanent alignment. Windings shall 2/3 pitch, random wound, and lashed at the end turns to provide superior mechanical strength. The generator shall be brushless, 12 lead reconnectable, three phase, 60 Hz, 1800 RPM, and connected for 277/480V service.

B. The rotating assembly shall be dynamically balanced to less than 2 mils peak to peak displacement and shall be designed to have an over speed withstand of 125% of rated speed for 2 minutes in accordance with NEMA MG1-32.

C. Cast iron end brackets with bearing bores machined for an O-Ring to retard bearing outer race rotation and fabricated steel frames shall be used. Bearings shall be pre-lubricated, double shielded, ball type, single row Conrad, C3 fit. Minimum B-10 bearing life shall be 30,000 hours for single bearing units.

D. Generator wiring diagram shall be permanently installed on the inside of the terminal enclosure cover.

E. The insulation system of both the rotor and stator shall be of NEMA Class H materials or better and shall be synthetic and non-hygroscopic. The stator winding

and rotor shall be coated with resin plus an epoxy sealant for extra moisture and abrasion resistance.

F. *The generator shall be equipped with a permanent magnet generator (PMG) excitation system. The system shall supply a minimum short circuit support current of 300% of the rating for 10 seconds. The rotating exciter shall use a three-phase full wave rectifier assembly with hermetically sealed silicon diodes protected against abnormal transient conditions by a multi-plate selenium surge protector. The diodes shall be designed for safety factors of 5 times voltage and 1.5 times current.*

G. *Voltage Regulator: The voltage regulator shall be compatible with the PMG excitation and shall control the output of the brushless AC generator by regulating the current into the exciter field. The regulator shall include an autotuning feature with two PID stability groups. The voltage regulation shall be minimum 0.25% accuracy. Basler DECS-150 5NS1V1N1S or approved equal.*

1. *The voltage regulator shall be configured for rear mounting and shall be mounted inside of the control wiring junction box as indicated in the Drawings.*
2. *The voltage regulator shall be connected to the 3 phase voltage sensing, field, and PMG on terminal blocks in the control wiring junction box as indicated in the Drawings.*

H. *Nameplate: On the side of the generator housing, provide a nameplate that provides the following information. The nameplate shall be located in a clearly visible location and shall not be obscured by the terminal enclosure or located such that the nameplate is behind any part of the generator or housing.*

1. *Rated kW as specified.*
2. *Full load amps.*
3. *Rated voltage, phase, and power factor.*
4. *Rated voltage and current of the field exciter.*

I. *Each generator shall be provided with a standard sized terminal compartment. The terminal compartment shall be provided with a load connection block to allow easy field termination of the load, neutral, and ground conductors. The generator neutral connection shall not be connected to the mounting skid or the generator frame. The neutral shall be isolated for field grounding by others at the switchgear or transformer.*

J. *The generator shall be self-ventilated with a direct drive one-piece, cast aluminum alloy, unidirectional internal fan for high volume, low noise air delivery. Airflow shall be from opposite drive end through generator to drive end. The exciter shall be in the airflow.*

K. *Replace the standard factory hardware used for attachment of the generator coupling disc to the engine flywheel with Grade 8 hex head bolts. Install heavy gauge washers, tighten and torque bolts in accordance with manufacturer's specifications, and paint pen mark after final torquing.*

2.9 MOUNTING SKID

A. The engine generator shall be equipped with a suitable full length base frame (skid) for mounting the engine and generator. The skid shall be constructed from structural steel channel with ends beveled and plated for short term skidding and rolling of unit. ***No formed or stamped steel base frame designs will be accepted.*** *Provisions shall be made so that the generator can slide back a minimum of 12" to access the rear main seal on the engine without removing the generator end off of the skid or requiring the use of blocking to support it. See the Drawings for skid design and layout.*

B. Provisions shall be made in the skid for the mounting of vibration isolators at locations as indicated on the Drawings. Wedge washers shall be welded in place on the skid to provide a flat surface for the vibration isolator lock nuts.

C. Each engine generator shall be placed on the skid at the location indicated on the Drawings.

2.10 WIRING INTERFACE WITH REMOTE SWITCHGEAR

A. A control wiring junction box shall be furnished for each generator as follows:

1. The junction box shall be steel, NEMA 12, with hinged door and screw down latches. B-Line, Hoffman or approved equal. See Drawings for size.

2. The junction box orientation, device layout, terminal block layout, and labeling shall be as indicated on the Drawings.

3. Install the voltage regulator and the instrument panel as previously specified in the junction box as shown on the Drawings.

4. All wiring for control, monitoring, and safety shall be terminated on terminal blocks within the control wiring junction. The terminals shall be IDEC or approved equal, BNH15LW except where indicated 50A provide BNH50W. Terminals shall be mounted on DIN rail with heavy duty end anchors. Each terminal block and all wire terminations shall be individually numbered as indicated.

5. The generator control wiring shall be provided with a maintenance loop of sufficient length to allow the generator to be slid back 12" minimum for maintenance of the engine without being disconnected.

6. The engine control wiring shall be connected to the ECU mounting panel using manufacturer's standard connectors.

B. The DC power supply for the switchgear shall be provided from the engine starting batteries through the engine-mounted circuit breaker. Terminals shall be provided as indicated on the Drawings for supplying 24 VDC to the switchgear. All remote indication will be 24VDC, 4-20mA, or as otherwise indicated. All switches used for remote indication shall be rated for operation at 24 VDC.

C. Label each control wiring junction box with the serial number of the associated engine. Connect to the engine and generator prior to performing the load test.

2.11 PAINTING

Each unit shall be painted Detroit Diesel Blue, #TTF SD15237SP including engine, skid, and generator.

2.12 SPARE FILTERS

In addition to the filters installed on the engines, provide the following quantities of replacement filters for each engine plus break in oil. Package spare filters and oil in boxes and label each box with the engine model and the community name.

A. Twelve (12) oil filters.

B. Four (4) fuel filters.

C. Two (2) air filters plus one air filter service kit.

D. Four (4) glycol filters.

E. Break in oil identical to oil installed in engine. One (1) gallon for each engine.

PART 3 - EXECUTION

3.1 FACTORY TESTS

A. Prior to shipment, the engine generator Fabricator shall perform factory tests on each unit at the shop where the engine generator is assembled. Supply sufficient notice to the Authority prior to performing tests. The Authority reserves the right to witness all tests. Test procedures shall conform to ASME, IEEE, and ANSI

standards, and NEMA standard practices section on testing, as appropriate and applicable.

B. The Fabricator shall provide all required mechanical and electrical equipment including but not limited to fuel supply, radiator, charge air cooler, exhaust, load bank, voltage regulator, etc.

C. The Fabricator shall provide all required measuring and indicating devices. All devices shall be certified correct or correction data furnished for the device.

D. Prior to performing the load test, the engine generator Fabricator shall perform the following:

1. Verify that engine is filled with break in oil. The break in oil shall be approved by the engine manufacturer for 100 to 500 hour run time. Pull a sample of the clean lube oil installed in the engine.

2. Perform hydrostatic test on water jackets to ensure that water seals and water jackets are watertight. Test report shall indicate pressure at which test was made and the results.

3. Connect engine coolant piping to radiator or heat exchanger. Note that all engine coolant circulation must be performed by the engine water pump without the benefit of any external pump or pressurized system.

4. Install thermometer to monitor coolant return temperature entering the engine for comparison against the coolant discharge temperature.

5. Connect engine air piping to charge air cooler.

6. Connect engine and generator to the associated control wiring junction box.

E. Engine Tests: Perform customary commercial factory 8 hour load test on each engine generator including, but not limited to, the following:

1. Prior to the 8 hour run, connect the ECU to an analog throttle input and verify that it is correctly responding including idle operation at input less than or equal to 0.5 VDC, 1800 RPM at 2.5 VDC, and variable RPM above and below 2.5 VDC. Note confirmation on the load test.

2. Take a screen shot to document the ECU throttle programming and include with the load test reports for each engine.

3. Place engine in continuous operation without stoppage for a period of not less than eight hours. Operate not less than one hour at each load point (1/2, 3/4, and full load) and 1 hour at 110 percent of rated load. If stoppage becomes necessary during this period, repeat the 8-hour run.

4. Record the following data at the start, at 15-minute intervals, and at the end of each load run: Hz, kW load, fuel consumption, exhaust temperature, intake air temperature, jacket water temperature, coolant return temperature, lube oil temperature, lube oil pressure, manifold (boost) pressure, and crankcase vacuum.

5. Tests shall indicate satisfactory operation and attainment of guarantees and specified performance.

F. Provide completed test reports to the Authority. Reports shall include but not limited to the following:

1. Complete 8-hour load test data.

2. Screen shots of throttle programming and confirmation of response.

3. Photos of split oil filters as described below.

4. Laboratory analysis of the clean lube oil sample and the sample pulled after the test as described below.

3.2 PREPARATION AND SHIPPING

A. Upon completion of testing perform the following steps to prepare for shipping:

1. Flush the cooling system with extended life 50/50 ethylene glycol mix, Shell Rotella ELC or approved equal. Install covers over the connections. Note that if testing was performed with extended life ethylene glycol solution the engine does not need to be flushed.

2. Pull a sample of the lube oil. Send to a laboratory for analysis. Include the sample of clean lube oil pulled prior to the load test for reference comparison.

3. Remove oil filter, split case, inspect contents and take photo to document. Note that if metal fragments are found contact the Authority immediately. Install new oil filter.

4. Remove any dirt from the air cleaner; check all seals and gaskets. Put lubricant on all points given in the lubrication chart of the engine operation guide.

5. Turn the engine at cranking speed with throttle control in full off position and use a sprayer to add a mixture of 50% VCI (volatile corrosion inhibitor) oil and 50% 30-weight engine oil into the air intake or turbocharger inlet.

6. Continue spraying the VCI-oil mixture into the air intake or turbocharger inlet long enough to ensure the cylinders and exhaust ports are coated.

7. Clean the outside of the engine and inspect and ensure that the engine and generator are covered by good quality paint. Correct any deficiencies.

8. Spray a thin amount of VCI-oil mixture on the flywheel, ring gear teeth, and starter pinion. Install the covers to keep the vapors in.

9. Install a positive mechanical seal consisting of a fitting plate and gasket on exhaust opening. Then install all covers and/or tape on any other openings. Ensure all covers are air tight and weatherproof. Use waterproof, weather resistant type tape. Do not install tape in such a manner as will damage paint when the tape is removed. Install a mechanical protective device over any protruding items, which may be vulnerable to damage during transportation.

B. After preparing the equipment for shipping, package each engine generator separately as follows:

1. *Coil wiring harnesses and secure control wiring junction box and ECU mounting panel to generator.*
2. *Put a waterproof cover over the entire engine generator unit. Make the cover tight, but loose enough to let air circulate around the unit to prevent damage to exposed metal parts from condensation.*
3. *All other included components (spare parts, loose items, etc.) shall be packaged individually in waterproof wrapping. Each individual component package shall then be packed in a box or crate, and each box/crate wrapped in waterproof wrapping to prevent corrosion to the components during extended periods of outside storage. All boxes or crates shall be palletized onto the minimum number of pallets, as required for the quantity and size of the boxes/crates.*
4. *Each component package shall be sequentially numbered and marked for ease of identification. Each box/crate shall also be marked with a unique identifying number. Each pallet shall be provided with a packing slip identifying the number of each box/crate on the pallet, in addition to a listing of each component package within each box/crate. Each pallet shall be marked (with two inch high letters/numbers), on all four sides and the top, with the project or community name.*
5. *Two copies of the packing slip identifying the quantity of pallets, the crates/boxes on each pallet, and the listing of component packages within each box/crate shall be provided to the Authority.*

C. *Final payment will not be made until completion of the following:*

1. *All engine-generators and all loose ship parts have been accepted by the Authority at the F.O.B. Point.*
2. *All required manuals have been accepted by the Authority at the F.O.B. Point.*
3. *All test reports have been received and approved by the Authority.*

3.3 INSTALLATION AND COMMISSIONING

A. Install the engine generators as indicated on the Drawings.

B. Adjust spring vibration isolators as indicated on the Drawings.

C. Ensure correct fit and alignment of all connections to not cause stress on engine connections or wear on piping, hoses, conduit, wiring, etc.

D. Have the Fabricator that provided the engine-generators or their authorized representative perform initial startup, test run, and final inspection as required to ensure full authorization of factory warranty by the Fabricator.

E. Assist the Authority with functional testing and commissioning as required by the Contract Documents.

END OF SECTION

SECTION 26 32 13.30
RAMPART ENGINE GENERATORS

Notes:

1) ***All paragraphs below shown in light italic text reference work that was performed as part of the prior engine-generator purchase contract and are included here for reference only.***
2) ***All paragraphs below shown in standard text are to be performed under this contract.***
3) ***49th State Power is the fabricator that is providing these engine-generators under the purchase contract. Approved submittals for the engine-generators will be made available to the successful bidder upon request.***

PART 1 - GENERAL

1.1 SCOPE

A. The Work included herein shall consist of providing, fabricating, and shop testing complete engine generators as specified herein.

B. The engine generators shall be delivered complete and ready for installation.

C. Provide all accessories as specified for all engine generators plus any additional components listed.

1.2 RELATED REQUIREMENTS – not used

1.3 SUBMITTALS

A. Provide submittal for all specified items in a single electronic file in Adobe Acrobat PDF format.

B. Provide complete and accurate drawings of the equipment, including outline drawings and dimensional data which fully describe the height, width, and depth of the equipment; skid construction; schematics; wiring diagrams; and other relevant details.

C. Provide mechanical and electrical performance data for the engine and generator.

D. Provide manufacturer's catalog literature for all accessories and equipment.

E. A torsional vibration analysis (TVA) has been prepared and accepted for the following engine-generator combinations indicated in paragraph 2.2 Specific Configuration:

1. John Deere 4045AFM85 with Newage/Stamford UCI274E.

2. John Deere 4045TFM85 with Newage/Stamford UCI274C.

For any substitute engine generator combinations not specifically listed above, a TVA shall be provided for the proposed engine generator combination within 14-days of contract award.

1.4 REGULATORY COMPLIANCE

The Environmental Protection Agency (EPA) has issued New Source Performance Standards (NSPS) regulations governing use of stationary diesel engines in remote areas of Alaska. The following provision of 40 CFR Subpart IIII applies to this solicitation:

A. On November 13, 2019, 40 CFR 60.4216 (c) was revised as follows: Manufacturers, owners, and operators of stationary CI ICE that are located in remote areas of Alaska may choose to meet the applicable emission standards for emergency engines in §§ 60.4202 and 60.4205, and not those for non-emergency engines in §§ 60.4201 and 60.4204, except that for 2014 model year and later nonemergency CI ICE, the owner or operator of any such engine must have that engine certified as meeting at least the Tier 3 PM standards in 40 CFR 89.112 or 40 CFR 1042.101.

In order to comply with EPA emissions requirements and also be compatible with the intended service applications, the diesel engine furnished under this solicitation shall be a new Tier 3 Marine certified engine.

1.5 QUALITY ASSURANCE

A. Equipment shall not have been in service at any time prior to delivery, except as required by tests.

B. All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practices. Individual parts shall be manufactured to standard sizes and gauges so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable.

C. Equipment and components furnished under these specifications shall be in accordance with the requirements of applicable UL, NEC, IEEE, NEMA, and ANSI standards.

1.6 FABRICATOR QUALIFICATIONS

The engine generators shall be furnished, assembled, and tested by a qualified fabricator (Fabricator) who is regularly engaged in the business of providing diesel engine driven generator equipment.

A. The Fabricator must have staff with extensive experience in packaging diesel engine driven electrical generators. A list of five successful installations that key staff have worked on may be requested by the Authority after the bid opening and prior to award in order to verify Fabricator qualifications. The list must include installation date, description of installation, and a reference contact for each installation.

B. The Fabricator must maintain a competent service organization that is available for field service calls. A description of the organization including resumes of key personnel may be requested by the Authority after the bid opening and prior to award in order to verify Fabricator qualifications.

C. The Fabricator must have a fabrication facility with adequate space and appropriate equipment as required to perform the work. The Authority may inspect

the Fabricator's shop after the bid opening and prior to award in order to verify Fabricator qualifications.

1.7 FABRICATOR WARRANTIES

A. The Fabricator shall warrant the work for a period of not less than one-year after energization of the equipment or 18 months after delivery to the F.O.B. point, whichever comes first.

B. In the event of equipment or component failure during the warranty period, the Fabricator shall repair or replace such defective equipment or components and bear all associated costs. Costs shall include material, parts, and labor. The Fabricator will be allowed to charge for travel and per diem expenses within Alaska related to warranty service at actual cost plus 10%. The Fabricator shall assist the Authority as directed to determine the cause of failure and pursue manufacturer's warranties to the extent necessary to obtain replacement equipment and provide proof of action taken upon request.

C. Provide a nametag on each piece of equipment that clearly identifies the party responsible for the warranty. Nametag shall include the name, address, and phone number, and shop order or Fabricator's serial number.

1.8 OPERATION AND MAINTENANCE MANUALS.

A. Provide one (1) complete bound set of operation and maintenance (O&M) manuals for each unique engine generator unit. Identification symbols for all replaceable parts and assemblies shall be included. Provide manuals for the following equipment:

1. *Engine.*
2. *Generator.*
3. *Voltage Regulator.*
4. *All accessories.*

B. For each engine provide all available factory service publications including parts manuals, service manuals, component technical manuals, etc.

C. For all other components of each engine generator unit provide:

1. *Equipment function, normal operating characteristics, and limiting conditions.*
2. *Assembly, installation, alignment, adjustment, and checking instructions.*
3. *Operating instructions for start-up, routine and normal operation, regulation and control, shutdown, and emergency conditions.*
4. *Lubrication and maintenance instructions.*
5. *Guide to "troubleshooting."*
6. *Parts list.*
7. *Outline, cross section, elevation, and assembly drawings*
8. *Engineering data including all mechanical and electrical performance characteristics.*
9. *Complete AC connection and three-line diagrams.*
10. *Complete DC schematics including voltage regulator, fuel injector pump, sensors, switches, fuses, and all other devices.*

D. The operation and maintenance manuals shall be in addition to any instructions or parts list packed with or attached to the equipment when delivered, or any information submitted for review.

E. Bind materials in locking three ring "D" style binders. Binder capacities shall not exceed 3 inches, nor shall material included exceed the designed binder capacity. If material to be bound exceeds capacity rating, multiple volumes shall be furnished. Binder capacity shall not be less than approximately 1/2 inch greater than the thickness of the material within the binder. Permanently label with project information on the front cover and edge.

F. Where reduction is not practical, larger drawings shall be folded separately and placed in envelopes, which are bound into the manuals. Each envelope shall bear suitable identification on the outside.

G. All information in the O&M manuals shall be new and original publications.

PART 2 - PRODUCTS

2.1 GENERAL CONFIGURATION AND MANUFACTURERS

A. All units shall be complete skid mounted engine generators utilizing all new components.

B. All units shall be configured as specified herein and shall include all accessories as indicated.

C. Engines shall be rated for prime power duty at the horsepower (shaft) and electrical kilowatt (generator) ratings indicated for each unit. All engines shall be 1800 RPM unless specifically indicated otherwise. All starting and control systems shall be 24 VDC.

D. Provide engines of the manufacturer and model as indicated in Paragraph 2.2 - Specific Configuration, no other substitutes except as specifically noted below.

E. Approved equal substitutions of engines will be allowed only by Engineer's approval. To obtain approval, submittals must clearly demonstrate the following:

1. *The substitute engine must meet all of the requirements of Paragraph 2.3*
2. *The substitute engine manufacturer must have at least one factory authorized service representative with a permanent shop in Southcentral Alaska.*
3. *The size and weight of the substitute engine must not exceed that of the specified engine by more than 10%.*
4. *The physical layout, piping connections, and service access areas of the substitute engine must be sufficiently similar to that of the specified engine so that no major changes will be required to the power plant design.*
5. *The substitute engine must meet or exceed the fuel efficiency rate of the specified engine. Provide fuel curve showing fuel consumption (kWh/gallon) at 25%, 50%, 75% and 100% of prime rated capacity.*
6. *The substitute engine must be provided with a single jacket water cooling circuit without a separate aftercooler circuit except where specifically*

indicated to have an air-to-air aftercooler. Low temperature liquid aftercoolers will not be accepted.

7. *The substitute engine must meet or exceed the heat rejection to the jacket water circuit of the specified engine.*
8. *The engine must not be equipped, or require to be equipped, with any exhaust emissions equipment including Exhaust Gas Recirculation, Diesel Oxidation Catalyst, Diesel Particulate Filter, or Selective Catalytic Reduction.*

F. *Provide Newage/Stamford generators as indicated in the Specific Configuration requirements that follow or Kato equal, no other substitutes except as specifically noted below. The generator shall be rated for continuous output at the value and temperature rise indicated at 0.8 power factor. The generator shall be 2/3 pitch winding, 3 phase, 277/480 volt, 12 lead reconnectable, with PMG excitation.*

G. *If a Marathon or other generator of equivalent or greater capacity is provided it shall be modified and upgraded prior to installation. Upon receipt of the generator from the factory it shall be taken to a manufacturer's authorized warranty service shop and the following tasks shall be performed:*

1. *Remove rotor assembly, bearing, exciter, diode plate and inspect for defects.*
2. *If any defects are encountered immediately file a warranty claim with the manufacturer.*
3. *Electrically test all windings.*
4. *Encapsulate exciter rotor winding with epoxy.*
5. *Replace bearing prior to reinstalling exciter. Bearing shall meet the minimum requirements of these specifications.*
6. *Replace diode plate mounting bolts with grade 8 bolts and use Loctite.*
7. *Insulate main rotor leads with phase paper. Secure leads with heat shrinkable polyester tape using epoxy on all knots.*
8. *Spray coat all windings with epoxy.*
9. *Dynamically balance and re-assemble.*
10. *Test at rated RPM.*

2.2 SPECIFIC CONFIGURATION

Furnish Engine Generators of the capacity and configuration listed below:

No. 1: ***Engine*** *- 148 hp, 100 ekW prime, John Deere 4045AFM85, Tier 3 Marine. Starting and Control Voltage = 24 VDC (convert as required).*
Generator *- Minimum 125kW continuous at 105°C rise, Newage/Stamford UCI274E or Kato equal.*

No. 2: ***Engine*** *- 99 hp, 65 ekW prime, John Deere 4045TFM85, Tier 3 Marine. Starting and Control Voltage = 24 VDC (convert as required).*
Generator *- Minimum 90kW continuous at 105°C rise, Newage/Stamford UCI274C or Kato equal.*

2.3 ENGINE

A. Provide a skid mounted, 1800 RPM, diesel engine complete with generator/alternator and ready for service. The unit shall be of newest design and of recent manufacture.

B. Marine engines shall be furnished without a heat exchanger, coolant expansion tank, or accessory reduction gear drive. Factory installed components shall be removed as required.

C. All engines shall be furnished without a charging alternator. Factory installed components shall be removed as required. Idler pulleys shall be added and belt guards shall be modified as required.

D. The engine shall be a four-cycle, water-cooled, direct injection diesel engine of 4 or 6 cylinder in-line configuration as indicated by model number and shall be provided with a gear driven coolant pump where offered by manufacturer.

E. Cylinder Liners: The engines shall be provided with removable cylinder liners to facilitate field rebuilding.

F. Horsepower: Certified engine power curves and fuel consumption at 25%, 50%, 75%, and 100% loading, shall be submitted showing the manufacturer's approval of the engine rating for engine generator prime power application. Special ratings or "continuous standby" ratings will not be acceptable.

G. Engine Control: All engine control functions will be performed by remote switchgear which will perform all start/stop, speed, paralleling, and load sharing control functions in addition to all engine function monitoring and safety shut downs. Engine manufacturer's electronic control panels shall not be provided.

H. ECU and Isochronous Governor: Provide an Engine Control Unit (ECU) for interface with the switchgear. Program the ECU for nominal 1800 RPM operation at 2.5 VDC input, variable RPM above and below 2.5 VDC input, and idle operation at input less than or equal to 0.5 VDC.

I. ECU Mounting: When available from the engine manufacturer, provide an ECU mounting panel for installation of the ECU and accessories. Configure wiring harness so that ECU panel can be installed approximately 2' above the top of the generator enclosure. Provide wiring pigtails to connect the terminals in the engine control wiring junction box to the ECU mounting panel using manufacturer's standard connectors.

J. Fuel: The engine shall be capable of satisfactory performance on No. 1 or No. 2 Ultra Low Sulphur Diesel (ULSD) Fuel.

K. Fuel System: The engine shall have manufacturer's engine mounted fuel filters with replaceable elements. Fuel supply and return lines shall be routed to the front of generator skid for field connection to the plant piping. See Drawings for detailed configuration.

L. Lubrication: The engine shall have a gear type lubricating oil pump for supplying oil under pressure to the main bearings, crankshaft bearings, pistons, piston pins, timing gears, camshaft bearings and valve rocker mechanism. Threaded spin-on

type, full flow lubricating oil filters shall be provided. The oil drain line shall be routed to the front of generator skid for field connection to the plant piping. See Drawings for detailed configuration.

M. Oil Level: The engine shall have a combination visual oil level site gauge with adjustable high and low level switches, Murphy L129CK1 or approved equal. Mount on rubber isolators and connect to engine with minimum #8 hoses. Carefully route upper vent hose to create a high point and connect directly into crankcase. Route lower hose to a connection directly on the oil pan. Do not tee lower hose into oil drain line. See Drawings for installation detail.

N. Fuel and Oil Hoses: All hoses for fuel, lube oil, vents, mechanical gauges, etc., shall be Aeroquip type FC300, Eaton Weatherhead H569 or approved equal. Minimum hose size shall be 5/16" (#6). Provide with re-useable JIC swivel type fittings. Push-on or barb type hose connections will not be allowed. Route hoses to avoid wear points and to ensure access to normal service points on the engine. Securely support hoses from engine and skid.

O. Glycol Hoses: All hoses for glycol shall be Teflon hose with stainless steel outer braid, Eaton Weatherhead H243 or approved equal. Provide with re-useable plated steel straight JIC swivel ends with NPT adapters. Route hoses to avoid wear points and to ensure access to normal service points on the engine. Securely support hoses from engine and skid.

P. Wire Loom: All wiring for control and instrumentation shall be routed in plastic loom. Provide tee fittings for all branch connections. Route loom to avoid wear points and to ensure access to normal service points on the engine. Securely support loom from engine and skid.

Q. Protective Guards: All moving parts and hot surfaces shall be provided with protective guards in accordance with U.L Standard 2200.

R. Air Cleaners: The engine shall be provided with a metal canister air cleaner with a reusable oiled cotton stock element. John Deere, K&N, Parker, or approved equal. Open disposable type air filters or plastic canisters will not be accepted. Provide visual air restriction indicator, 1/8" MPT, 20" water column limit, manual reset, Donaldson X002251 or approved equal.

S. Starting: The engine shall be equipped with a 24 VDC electric starting system. The starting system shall be of sufficient capacity to crank the engine at a speed which will allow full diesel starting. A 24 VDC starter auxiliary relay shall be remote mounted in control wiring junction box. John Deere AT145341, Caterpillar 9X-8124, or Denso equal.

T. Control Power: To provide 24VDC power to the control wiring junction box, a 30A circuit breaker with switch shall be mounted on the engine in the vicinity of the starter, Cooper 187-030-F-00 or approved equal.

U. Sensors and Safety Controls: The engine shall be equipped with the following:

1. Air Filter Vacuum Sensor. 4-20mA, -30"Hg to 0 PSIG, 1/8" MPT. Noshok 100-30V-1-1-1-7 or approved equal.

2. *Exhaust Gas Temperature. High temperature (650°C) 2 wire 100 ohm RTD with 2' high temperature lead wire, spring strain relief, Deutz DT06-2S-E008 male connector, Deutz DT04-2P-E008 female connector, and compression fitting with 1/4" MPT adapter. Eustis RGB7B203B02X0 with NS44 adapter or approved equal. See note 2 below for installation.*

Note 1. The above listed sensors shall be independent from engine gauges and all other devices and sensors. Where standard factory furnished sensors for the above listed functions are required for operation of the ECU, provide additional duplicate sensors as specified. All sensors shall be installed on the engine and wired to terminal blocks as indicated in the Drawings.

Note 2. Upon completion of shop testing, if exhaust gas temperature sensor is installed in flex remove sensor and tywrap to engine in a secure location for shipping.

V. *Safety Controls: The automatic switchgear provided by others shall be equipped with automatic safety controls which will shut down the engine in the event of high jacket water temperature (primary), high lubricating oil temperature, low lubricating oil pressure, high or low lubricating oil level, high air filter vacuum, and engine overspeed based on J1939 CANbus and engine mounted sensors. Note that a single low water shut down switch will be installed on the external cooling system.*

2.4 EXHAUST FLEX

A. *A flexible, continuous, 18 inch long stainless steel exhaust flex connector with welded connections shall be furnished for each engine, Alaska Rubber, DME, Harco, or approved equal. Provide an appropriate engine mating connection at one end and an ASA 125 lb. flange at the opposite end sized as indicated below. Slotted cuff connections are not acceptable. Provide gasket, bolts, v-clamp, or any other components required for connection to the engine. Provide a 90° elbow where required for the flex to be installed vertically. Note that if the exhaust temperature sensor cannot be installed directly in the outlet connection, a 1/4" FPT stainless steel thread-o-let shall be welded into the flex between the engine connection and the corrugated hose.*

1. *Provide 4" flanged end for all 4045 engines.*

2.5 ACCESSORIES

Provide the following accessories for each engine generator (unless otherwise indicated):

A. *Spring vibration isolators complete with mounting hardware, four (4) per each unit, sized for the complete engine generator unit weight. Caldyn Type RJ or approved equal.*

B. *Drip pan, 16-gauge galvanized sheet metal, liquid tight joints, 20" wide by 50" long by 1" high.*

C. *Minimum 800 cold crank amp 12-volt starting batteries, two for each engine. Batteries shall be sealed maintenance free, Optima Red Top NAPA Part Number BAT N993478RED or approved equal. Furnish and install battery racks sized to hold the batteries with hardware to secure the battery for shipping.*

D. Each engine shall be provided with two each #2/0 AWG arctic flex battery cables, 15 ft. long, plus one each #2/0 AWG by 12-inch long jumper. All cables shall include compression type terminal ends shipped loose. One battery cable shall be red for the positive lead and the other shall be black for the negative lead. The jumper shall be black with red heat shrink one end. Provide plastic terminal covers.

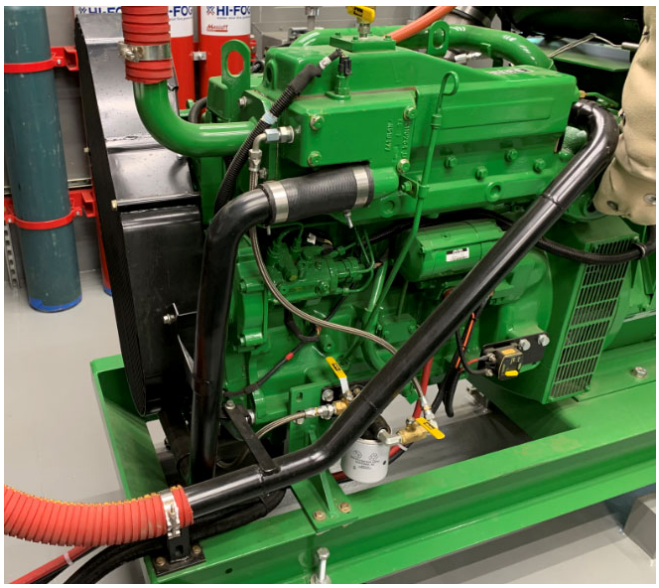
2.6 COOLING SYSTEM

A. Engine cooling shall be by remote radiators (provided by others) with coolant circulation driven by the engine coolant pump.

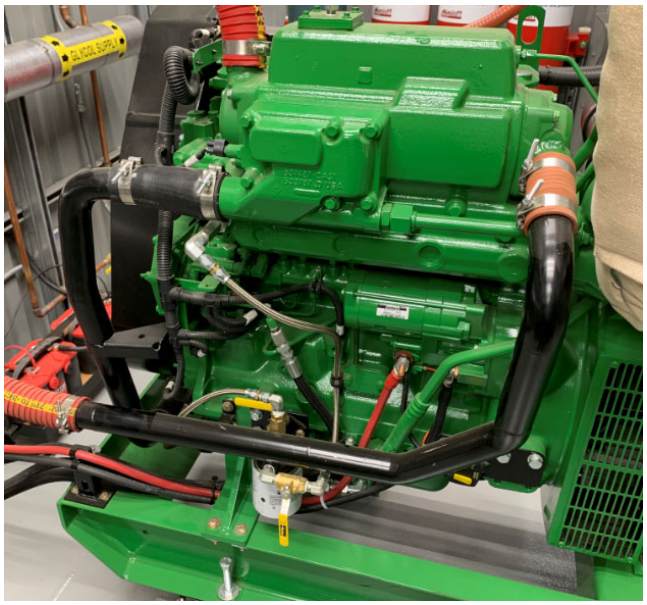
B. Glycol Filter: Provide screw-on canister style filter element with 3/8" NPT connections on head, Wix #24019 head with #24069 element or approved equal. Mount head on steel bracket fixed to front or side of engine. Connect to engine with glycol hoses with 3/8" NPT quarter turn gauge cock isolation valves. Connect inlet to thermostat housing and connect outlet to water pump inlet. On thermostat housing connection provide 3/8" NPT tee fitting with plug for field connection of pre-heat line by others. When filters are provided as part of engine manufacturer's assembly the standard factory filters may be substituted for the above specified parts; however, equivalent mounting, connections, and isolation valves shall be included.

C. Modify marine engines as follows:

1. John Deere 4045TFM - Remove coolant tank and other accessories that are not required. Install a bent or welded section of 2 inch steel tube routed to the front of the left skid and supported from the skid. See photograph for representative installation.



2. *John Deere 4045AFM - Remove coolant tank and other accessories that are not required. Note that the 4045AFM85 engines have small ports in the coolant hose connection fittings that are overly restrictive. To provide adequate flow for prime power application remove the coolant discharge and suction connection fittings. Cut off hose ends and drill or bore out a 2.5 inch diameter hole. Furnish new 2 inch aluminum king nipples, cut off threads, and weld to housings. Reinstall connection fittings with discharge oriented vertically and suction oriented horizontally. Install a bent or welded section of 2 inch steel tube routed to the front of the left skid and supported from the skid. Provide hose barbs on each end and connect to engine suction fitting with short section of silicone hose as required. See photographs below for representative installation.*



2.7 DIAGNOSTIC GAUGE

A. Provide a J1939 multi-function monitoring panel programmed to receive unique John Deere fault codes, John Deere DG14 or approved equal. Note that the panel must be programmed for operation with a Marine Tier 3 engine, no exceptions. The panel shall be mounted on the side of the control wiring junction box. Provide with wiring harness as required for connection to ECU and battery power.

2.8 GENERATOR/ALTERNATOR

A. Generator shall be a single bearing, four pole, synchronous type. Generator shall be directly connected to the engine flywheel housing and driven through a flexible coupling to ensure permanent alignment. Windings shall 2/3 pitch, random wound, and lashed at the end turns to provide superior mechanical strength. The generator shall be brushless, 12 lead reconnectable, three phase, 60 Hz, 1800 RPM, and connected for 277/480V service.

B. The rotating assembly shall be dynamically balanced to less than 2 mils peak to peak displacement and shall be designed to have an over speed withstand of 125% of rated speed for 2 minutes in accordance with NEMA MG1-32.

C. Cast iron end brackets with bearing bores machined for an O-Ring to retard bearing outer race rotation and fabricated steel frames shall be used. Bearings shall be pre-lubricated, double shielded, ball type, single row Conrad, C3 fit. Minimum B-10 bearing life shall be 30,000 hours for single bearing units.

D. Generator wiring diagram shall be permanently installed on the inside of the terminal enclosure cover.

E. The insulation system of both the rotor and stator shall be of NEMA Class H materials or better and shall be synthetic and non-hygroscopic. The stator winding and rotor shall be coated with resin plus an epoxy sealant for extra moisture and abrasion resistance.

F. The generator shall be equipped with a permanent magnet generator (PMG) excitation system. The system shall supply a minimum short circuit support current of 300% of the rating for 10 seconds. The rotating exciter shall use a three-phase full wave rectifier assembly with hermetically sealed silicon diodes protected against abnormal transient conditions by a multi-plate selenium surge protector. The diodes shall be designed for safety factors of 5 times voltage and 1.5 times current.

G. Voltage Regulator: The voltage regulator shall be compatible with the PMG excitation and shall control the output of the brushless AC generator by regulating the current into the exciter field. The regulator shall include an autotuning feature with two PID stability groups. The voltage regulation shall be minimum 0.25% accuracy. Basler DECS-150 5NS1V1N1S or approved equal.

1. *The voltage regulator shall be configured for rear mounting and shall be mounted inside of the control wiring junction box as indicated in the Drawings.*
2. *The voltage regulator shall be connected to the 3 phase voltage sensing, field, and PMG on terminal blocks in the control wiring junction box as indicated in the Drawings.*

H. Nameplate: On the side of the generator housing, provide a nameplate that provides the following information. The nameplate shall be located in a clearly visible location and shall not be obscured by the terminal enclosure or located such that the nameplate is behind any part of the generator or housing.

1. Rated kW as specified.
2. Full load amps.
3. Rated voltage, phase, and power factor.
4. Rated voltage and current of the field exciter.

I. Each generator shall be provided with a standard sized terminal compartment. The terminal compartment shall be provided with a load connection block to allow easy field termination of the load, neutral, and ground conductors. The generator neutral connection shall not be connected to the mounting skid or the generator frame. The neutral shall be isolated for field grounding by others at the switchgear or transformer.

J. The generator shall be self-ventilated with a direct drive one-piece, cast aluminum alloy, unidirectional internal fan for high volume, low noise air delivery. Airflow shall be from opposite drive end through generator to drive end. The exciter shall be in the airflow.

K. Replace the standard factory hardware used for attachment of the generator coupling disc to the engine flywheel with Grade 8 hex head bolts. Install heavy gauge washers, tighten and torque bolts in accordance with manufacturer's specifications, and paint pen mark after final torquing.

2.9 MOUNTING SKID

A. The engine generator shall be equipped with a suitable full length base frame (skid) for mounting the engine and generator. The skid shall be constructed from structural steel channel with ends beveled and plated for short term skidding and rolling of unit. ***No formed or stamped steel base frame designs will be accepted.*** *Provisions shall be made so that the generator can slide back a minimum of 12" to access the rear main seal on the engine without removing the generator end off of the skid or requiring the use of blocking to support it. See the Drawings for skid design and layout.*

B. Provisions shall be made in the skid for the mounting of vibration isolators at locations as indicated on the Drawings. Wedge washers shall be welded in place on the skid to provide a flat surface for the vibration isolator lock nuts.

C. Each engine generator shall be placed on the skid at the location indicated on the Drawings.

2.10 WIRING INTERFACE WITH REMOTE SWITCHGEAR

A. A control wiring junction box shall be furnished for each generator as follows:

1. The junction box shall be steel, NEMA 12, with hinged door and screw down latches. B-Line, Hoffman or approved equal. See Drawings for size.

2. The junction box orientation, device layout, terminal block layout, and labeling shall be as indicated on the Drawings.

3. *Install the voltage regulator and the instrument panel as previously specified in the junction box as shown on the Drawings.*

4. *All wiring for control, monitoring, and safety shall be terminated on terminal blocks within the control wiring junction. The terminals shall be IDEC or approved equal, BNH15LW except where indicated 50A provide BNH50W. Terminals shall be mounted on DIN rail with heavy duty end anchors. Each terminal block and all wire terminations shall be individually numbered as indicated.*

5. *The generator control wiring shall be provided with a maintenance loop of sufficient length to allow the generator to be slid back 12" minimum for maintenance of the engine without being disconnected.*

6. *The engine control wiring shall be connected to the ECU mounting panel using manufacturer's standard connectors.*

B. *The DC power supply for the switchgear shall be provided from the engine starting batteries through the engine-mounted circuit breaker. Terminals shall be provided as indicated on the Drawings for supplying 24 VDC to the switchgear. All remote indication will be 24VDC, 4-20mA, or as otherwise indicated. All switches used for remote indication shall be rated for operation at 24 VDC.*

C. *Label each control wiring junction box with the serial number of the associated engine. Connect to the engine and generator prior to performing the load test.*

2.11 PAINTING

Each unit shall be painted John Deere green including engine, skid, and generator.

2.12 SPARE FILTERS

In addition to the filters installed on the engines, provide the following quantities of replacement filters for each engine plus break in oil. Package spare filters and oil in boxes and label each box with the engine model and the community name.

A. *Twelve (12) oil filters.*

B. *Four (4) fuel filters.*

C. *Two (2) air filters plus one air filter service kit.*

D. *Four (4) glycol filters.*

E. *Break in oil identical to oil installed in engine. One (1) gallon for each engine.*

PART 3 - EXECUTION

3.1 FACTORY TESTS

A. *Prior to shipment, the engine generator Fabricator shall perform factory tests on each unit at the shop where the engine generator is assembled. Supply sufficient notice to the Authority prior to performing tests. The Authority reserves the right to witness all tests. Test procedures shall conform to ASME, IEEE, and ANSI*

standards, and NEMA standard practices section on testing, as appropriate and applicable.

B. The Fabricator shall provide all required mechanical and electrical equipment including but not limited to fuel supply, radiator, exhaust, load bank, voltage regulator, etc.

C. The Fabricator shall provide all required measuring and indicating devices. All devices shall be certified correct or correction data furnished for the device.

D. Prior to performing the load test, the engine generator Fabricator shall perform the following:

1. Verify that engine is filled with break in oil. The break in oil shall be approved by the engine manufacturer for 100 to 500 hour run time, John Deere Break-In Plus or approved equal. Pull a sample of the clean lube oil prior to the load test to be used for reference.

2. Perform hydrostatic test on water jackets to ensure that water seals and water jackets are watertight. Test report shall indicate pressure at which test was made and the results.

3. Connect engine coolant piping to radiator or heat exchanger. Note that all engine coolant circulation must be performed by the engine water pump without the benefit of any external pump or pressurized system.

4. Install thermometer to monitor coolant return temperature entering the engine for comparison against the coolant discharge temperature.

5. Connect engine air piping to charge air cooler.

6. Connect engine and generator to the associated control wiring junction box.

E. Engine Tests: Perform customary commercial factory 8 hour load test on each engine generator including, but not limited to, the following:

1. Prior to the 8 hour run, connect the ECU to an analog throttle input and verify that it is correctly responding including idle operation at input less than or equal to 0.5 VDC, 1800 RPM at 2.5 VDC, and variable RPM above and below 2.5 VDC. Note confirmation on the load test.

2. Take a screen shot to document the ECU throttle programming and include with the load test reports for each engine.

3. Place engine in continuous operation without stoppage for a period of not less than eight hours. Operate not less than one hour at each load point (1/2, 3/4, and full load) and 1 hour at 110 percent of rated load. If stoppage becomes necessary during this period, repeat the 8-hour run.

4. Record the following data at the start, at 15-minute intervals, and at the end of each load run: Hz, kW load, fuel consumption, exhaust temperature, intake air temperature, jacket water temperature, coolant return temperature, lube oil temperature, lube oil pressure, manifold (boost) pressure, and crankcase vacuum.

5. Tests shall indicate satisfactory operation and attainment of guarantees and specified performance.

F. Provide completed test reports to the Authority. Reports shall include but not limited to the following:

1. Complete 8-hour load test data.

2. Screen shots of throttle programming and confirmation of response.

3. Photos of split oil filters as described below.

4. Laboratory analysis of the clean lube oil sample and the sample pulled after the test as described below.

3.2 PREPARATION AND SHIPPING

A. Upon completion of testing perform the following steps to prepare for shipping:

1. Flush the cooling system with extended life 50/50 ethylene glycol mix, Shell Rotella ELC or approved equal. Install covers over the connections. Note that if testing was performed with extended life ethylene glycol solution the engine does not need to be flushed.

2. Pull a sample of the lube oil. Send to a laboratory for analysis. Include the sample of clean lube oil pulled prior to the load test for reference comparison.

3. Remove oil filter, split case, inspect contents and take photo to document. Note that if metal fragments are found contact the Authority immediately. Install new oil filter.

4. Remove any dirt from the air cleaner; check all seals and gaskets. Put lubricant on all points given in the lubrication chart of the engine operation guide.

5. Turn the engine at cranking speed with throttle control in full off position and use a sprayer to add a mixture of 50% VCI (volatile corrosion inhibitor) oil and 50% 30-weight engine oil into the air intake or turbocharger inlet.

6. Continue spraying the VCI-oil mixture into the air intake or turbocharger inlet long enough to ensure the cylinders and exhaust ports are coated.

7. Clean the outside of the engine and inspect and ensure that the engine and generator are covered by good quality paint. Correct any deficiencies.

8. Spray a thin amount of VCI-oil mixture on the flywheel, ring gear teeth, and starter pinion. Install the covers to keep the vapors in.

9. Install a positive mechanical seal consisting of a fitting plate and gasket on exhaust opening. Then install all covers and/or tape on any other openings. Ensure all covers are air tight and weatherproof. Use waterproof, weather resistant type tape. Do not install tape in such a manner as will damage paint when the tape is removed. Install a mechanical protective device over any protruding items, which may be vulnerable to damage during transportation.

B. After preparing the equipment for shipping, package each engine generator separately as follows:

1. *Coil wiring harnesses and secure control wiring junction box and ECU mounting panel to generator.*
2. *Put a waterproof cover over the entire engine generator unit. Make the cover tight, but loose enough to let air circulate around the unit to prevent damage to exposed metal parts from condensation.*
3. *All other included components (spare parts, loose items, etc.) shall be packaged individually in waterproof wrapping. Each individual component package shall then be packed in a box or crate, and each box/crate wrapped in waterproof wrapping to prevent corrosion to the components during extended periods of outside storage. All boxes or crates shall be palletized onto the minimum number of pallets, as required for the quantity and size of the boxes/crates.*
4. *Each component package shall be sequentially numbered and marked for ease of identification. Each box/crate shall also be marked with a unique identifying number. Each pallet shall be provided with a packing slip identifying the number of each box/crate on the pallet, in addition to a listing of each component package within each box/crate. Each pallet shall be marked (with two inch high letters/numbers), on all four sides and the top, with the project or community name.*
5. *Two copies of the packing slip identifying the quantity of pallets, the crates/boxes on each pallet, and the listing of component packages within each box/crate shall be provided to the Authority.*

C. *Final payment will not be made until completion of the following:*

1. *All engine-generators and all loose ship parts have been accepted by the Authority at the F.O.B. Point.*
2. *All required manuals have been accepted by the Authority at the F.O.B. Point.*
3. *All test reports have been received and approved by the Authority.*

3.3 INSTALLATION AND COMMISSIONING

A. Install the engine generators as indicated on the Drawings.

B. Adjust spring vibration isolators as indicated on the Drawings.

C. Ensure correct fit and alignment of all connections to not cause stress on engine connections or wear on piping, hoses, conduit, wiring, etc.

D. Have the Fabricator that provided the engine-generators or their authorized representative perform initial startup, test run, and final inspection as required to ensure full authorization of factory warranty by the Fabricator.

E. Assist the Authority with functional testing and commissioning as required by the Contract Documents.

END OF SECTION