

SECTION 26 62 00 - POWER GENERATION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide labor, materials, equipment and services to perform operations required for the complete installation and related Work as required in Contract Documents.
- B. The electrical contractor shall provide a complete and operative power generator set fully enclosed in a weatherproof housing with all components being factory assembled and ready for use as a complete package.
- C. Generator shall be emergency and meet requirements of NFPA 70, Article 700. (NEC 700).
- D. Generator shall meet requirements for NFPA 110, level 1 compliance.
- E. Power generation includes but is not limited to the following work:
 - 1. Engine-Generator(s)
 - 2. Transfer switch(es)
 - 3. Cooling system
 - 4. Exhaust system (fresh air intake, louver)
 - 5. Any general contracting work required for proper installation (e.g., wall cuts, patching, concrete work, roof penetrations, etc.)
 - 6. Fuel piping
 - 7. Weatherproof Enclosure
 - 8. Control/alarm panel at generator and transfer switch
 - 9. Remote control/alarm panel
 - 10. Concrete equipment pads
 - 11. Feeders and overcurrent protection
 - 12. Performance Testing
 - 13. Training

1.2 QUALITY ASSURANCE

- A. Manufacturers of all equipment in the complete system shall be firms regularly engaged in manufacture of engine driven standby generator systems, of types, ratings and characteristics required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. The System Supplier shall meet the following:
 - 1. Be a firm that has been engaged in supervising installation of and servicing engine generator sets for a minimum of 20 years.
 - 2. Maintain a factory authorized service organization with factory trained service technicians.
 - 3. Be domiciled and have a full service branch within a 60 mile radius of the project.

4. Maintain a stock of standard spare parts and offer 24 hour service availability, 7 days a week. The supplier shall have sufficient parts inventory to maintain over the counter availability of at least 90% of any required parts. The generator set supplier shall guarantee 100% parts availability within 48 hours from the time an order is entered with the dealer.
 5. Own a fleet of trailer mounted generator sets with units comparable one being supplied, available for use by the Owner to prevent extended down time.
- C. The System Installer shall be qualified with at least 5 years of successful installation experience on projects with engine generator system installation work similar to that required for project.
- D. All materials and parts comprising the unit shall be new and unused, of current manufacture and free from all defects or imperfections affecting performance.
- E. The following testing shall have been conducted on a separate, representative, preproduction prototype model of the generator set specified.
1. Complete thermal evaluation of all electrical parts must include actual measurement by thermocouples of all internal generator and exciter hot spot temperatures. No position measured any place in the windings must exceed the temperature rise limits of NEMA for the particular type of insulation system used. These tests must be performed on a prototype generator and prime mover combination.
 2. With system operating at rated volts, amps, power factor and speed, the prototype generator terminals must be short circuited ten times on all three phases for a duration to ten seconds. Generator set must build up and perform normally without manual intervention of any kind such as resetting of circuit breakers or other tripping devices, when short circuit is removed.
 3. With prototype generator set operating at no load, rated speed and voltage, the AC sensing circuit to the regulator must be disconnected and remain disconnected for a period of at least one hour. The generator set must be fully operative after the test, and without evidence of any kind of damage.
 4. Torsional fatigue tests must be performed on the complete prototype generator set. Calculations based on engine and generator data separately are not acceptable.
 5. The prototype generator, exciter and voltage regulator characteristic must be matched to the torque curve of the prime mover.
 - a) With generator set operating at rated speed, voltage and load, reduce speed to half rated by manually overriding the governor control. Generator set must recover to full speed with the rated load connected when the governor control is returned to its

normal mode.

- b) Calculations must demonstrate that the exciter and voltage regulator will permit utilization of at least 80% of maximum available prime mover torque at all speeds between 50% and rated speed, and with rated load connected to its terminals, will provide fast and positive recovery from transient disturbances.
- 6. Endurance testing of at least 500 hours at rated load and speed is required without damage or failures of electrical or mechanical components occurring to the prototype generator set.
 - 7. The prototype generator must sustain at least 90% of no load voltage for ten seconds with 250% of rated load at zero power factor connected to its terminals.
 - 8. Temperature rise tests must be performed on all components of the cooling system. All shutdown devices must be tested by actually simulating cooling or oil system malfunctions. Simulating failure conditions by shorting or opening sensing circuits only, is not acceptable.
- F. The system shall conform to the following standards.
- 1. Applicable articles of the 2017 NFPA 70 National Electric Code.
 - 2. UL 2200, "Stationary Generator Assemblies"
 - 3. UL 1008, "Automatic Transfer Switches".
 - 4. NFPA 110.
 - 5. All standby generator system components, including automatic transfer switches, which are UL listed and labeled.
 - 6. The system comply with applicable portions of IEEE Standard 241, "IEEE Recommended Practice for Electric Power Systems in Commercial Buildings" pertaining to standby power.

1.3 SYSTEM DESCRIPTION AND OPERATION

- A. The generator set start-stop sequence shall be initiated manually or automatically from a transfer switch auxiliary contact. The control system shall automatically engage the cranking motor, sense engine starting speed, disengage the motor, and arm the engine protection circuit.
- B. The generator set shall immediately shut down in the event of overspeed, low oil pressure, high water temperature and overcrank. Cause of shutdown shall be indicated by a light annunciator. System logic shall prevent restart until fault is cleared. There shall be a provision for manual and emergency shutdown.

- C. The generator set shall automatically start upon failure of normal source voltage. Provide a field adjustable from 3 to 30 seconds delay time control between normal source failure and engine starting.
- D. The system shall transfer loads from normal source power to emergency source when engine-generator reaches 90% of its rated voltage.
- E. The system shall retransfer emergency loads from emergency generator to normal source ten minutes after normal source has reached 90% or more of normal voltage. Provide a 5 to 25 minute adjustable timer. If emergency generator fails while supplying load, retransfer emergency loads from emergency generator to normal source instantaneously when normal source has 90% or more of normal voltage.
- F. The system shall run the engine for a period of five minutes after retransfer of emergency loads to normal source. The engine-generator will then shut down, automatically resetting and leaving all controls ready for the next emergency start condition.
- G. The system shall use a time clock to automatically exercise engine once four weeks. The time clock contacts shall simulate loss of normal voltage, start engine, and shut engine down after fifteen minutes of operation. The load shall not transfer to the emergency source during the exercise time. Provide a selector switch to permit cycling engine-generator under load or no-load conditions.
- H. Motors shall be started across-the-line unless otherwise called for.

1.4 SUBMITTALS

- A. Submit five copies or electronic files of shop drawings on equipment and accessories. Include the following:
 - 1. Engine-generator set, including engine, radiator, alternator, circuit protection, fuel consumption, performance ratings, thermal ratings, heat generation.
 - 2. Engine controls, including starting controls.
 - 3. Generator instrumentation and controls.
 - 4. Catalog cuts, bill of materials, description data, spare parts list for specified equipment.
 - 5. Mounting arrangement, floor plans, elevations, overall dimensions including accessories, foundation, bedrail, and/or bolts, power and control conduit entrance space.
 - 6. Equipment pad details approved by the engine-generator manufacturers.
 - 7. Battery charger and regulator.
 - 8. Batteries, mounting rack, accessories.

9. Automatic transfer switch and accessories.
10. Exhaust equipment, flexible pipe, including method of mounting and overall height above floor.
11. Cooling system piping arrangement.
12. Wiring diagrams of all equipment, external and internal connections and interconnections.
13. Tests and field supervision reports as called for.
14. Load analysis to demonstrate generator system will start and operate loads, within generator ratings.
15. Record Drawings:
 - a) Provide record copies of all drawings, revised to reflect changes, corrections, modifications, etc., made to equipment prior to shipment or installed in the field.
 - b) Drawings shall accurately cover equipment at time of project closeout.
 - c) Submit at least five copies of record drawings.
16. Instruction Books:
 - a) Provide at least five copies of composite instruction books covering this equipment.
 - b) Composite Instruction Books Shall Include As A Minimum The Following:
 - (1) Instructions covering overall equipment.
 - (2) Instructions covering all major and serviceable components, and accessories.
 - (3) Recommended spare parts with current prices.
 - (4) Complete renewal parts information.
 - (5) Instructions, both individually and collectively, shall adequately describe receipt, handling, care, inspection, installation, operation, and maintenance of equipment.
 - (6) Instruction books shall be used for equipment installation, and submitted prior to project closeout.

PART 2 - PRODUCTS

2.2 ENGINE-GENERATOR

A. Engine –Natural GAS:

1. Single fuel carburetion for natural gas.
2. Minimum six cylinder, four stroke cycle, 1800 rpm, per manufacturer's standard.
3. Continuous stand-by rating shall be adequate to provide maximum kW output of generator under full load and motor starting kVA requirements.
4. Dual-fuel carburetor, secondary gas regulator, electric solenoid shutoff valve, strainer (fuel filter), gas shutoff cock.
5. Provide primary gas regulator if required by characteristics of local utility gas supply.
6. Full pressure lubrication system with gear type oil pump, full flow oil filter with replaceable filter element, equipped with spring-loaded bypass valve as an insurance against stoppage of lubricating oil in the event filter becomes clogged; watercooled oil cooler and thermostat.
7. One or more oil or dry type air cleaners of sufficient capacity to protect engine working parts from dust and dirt.
8. Water cooled with fresh water type radiator, belt-driven pusher fan, centrifugal water circulating pump, thermostat temperature control, liquid-cooled exhaust manifolds.
9. Provide 50/50 solution of ethylene glycol for engine closed loop cooling system.
10. Provide water jacket heater, thermostat and wiring, rated for 120 volt, single phase operation.
11. 12, 24 or 32 volt starting system per manufacturer's standard.
12. Electronic governor. Engine speed shall be controlled the governor to maintain alternator frequency with +/-1% from no load to rated alternator output and +/- 0.25% steady state. Adjustment of speed shall be from a locking screwdriver operated potentiometer on the control panel face.

B. Generator:

1. 120/208 volts, three phase, four wire, wye connected, 60 Hz.
 - a) 187.5kVA, 150 kW continuous stand-by rating at 0.8 power factor.
 - b) Four or six pole compatible with engine rpm, revolving field, amortisseur winding, static exciter, solid state voltage regulator..
 - c) Temperature compensated V/F voltage regulator and a

permanent magnet type excitation system capable of 300% rated current for 10 seconds. The generator shall be directly connected to the engine flywheel housing and the rotor shall be driven through a semi-flexible flange to ensure alignment. The insulation system shall be Class H as defined by NEMA MG-1. Temperature rise shall be within NEMA MGI-22.40 definition. Temperature rise shall not exceed 105 degrees C.

- d) Voltage regulation shall be within + -0.5% of rated voltage at 60 Hz from no load to full load. Instantaneous voltage dip no greater than 20% of rated voltage when full load at rated power factor is applied to generator. Recovery to stable operation shall occur within 7 seconds. A rheostat shall provide a minimum of 5% voltage adjustment from rated value.
- e) Sealed, prelubricated ball bearings.
- f) Direct-driven generator cooling blower.
- g) Provide extra large terminal box for cable connection to generator leads.
- h) Provide adequate wiring space for conduits. Power cables shall exit the top of the generator.
- i) Connection to engine shall be direct, through steel disc type flexible coupling; single bearing construction to eliminate dangers of field misalignment.

2. Engine/Generator Controls:

3. Provide generator output molded case circuit breaker, three pole, common trip, thermal magnetic type, to completely protect the generator from overloads; frame size as called for, otherwise, size according to NEC. Circuit breaker shall be mounted and connected in a guarded drip proof enclosure meeting NEMA 1, IP 22 and IEC 144,

- a) The generator set shall contain a complete solid state start/stop control which starts the engine on closing contact and stops the engine on opening start circuit after eight attempts to start the engine have failed.
- b) Provide a generator set control panel meeting the following:
 - (1) The shall control, protect, meter and annunciate all functions necessary to confirm the operational status of the generator set.
 - (2) It shall be designed and built by the engine - generator manufacturer, mounted on the generator with options of facing each side or rear.
 - (3) Incorporate 100% solid state microprocessor based control

circuitry, with circuitry, keypad controls, and digital metering.

- (4) Annunciation shall include individual alarm lights which will allow fault identification while retaining a view of generator operating parameters, and a silencable audible alarm.
 - (5) Fault condition set points shall be verified without exposing the generator set to the actual condition.
 - (6) Engine governing and overspeed fault circuitry shall utilize individual circuitry to assure speed control protection.
 - (7) Governor, voltage regulator, or complete panel shall be capable of mounting remotely, and shall be compatible with controls of various manufacturers.
 - (8) Circuitry shall be sealed in a dust tight and watertight module with sealed wire entries into the enclosure. Control panel shall not require panel heaters in outdoor or humid environments. Internal terminal strips shall be both crimped and soldered to assure circuit integrity.
 - (9) Panel module shall comply with IP 64 and NEMA 4 for environmental protection, while the total panel shall qualify for IEC 144, IP 22 and NEMA 12. Panel functions shall be identified by ISO labels.
- c) Provide output terminal voltage adjustment rheostat.
 - d) Provide a solid state 24 volt DC microprocessor alarm module mounted in the panel and including red and yellow flashing LEDs and silencable alarm horn to annunciate alarm conditions for high and low coolant temperature, low oil pressure, low DC voltage, and system not in automatic. The horn shall resound on subsequent alarms after silencing/acknowledgment, with the flashing LED displaying a solid light until the condition is corrected. Low fuel level alarm and two spare LEDs shall be available to accept remote switch inputs
 - e) Provide oil-tight heavy duty type control switches and pushbuttons
 - f) High water temperature, overspeed, and low lubricating oil pressure shutdown contacts.
 - g) Bell alarm for engine shutdown or overcranking.
 - h) Switch for selecting hand or automatic operation mounted on instrument panel.
 - i) Run-off-auto selector switch mounted on generator instrument panel.

- j) Provision for remote manual shutdown pushbutton.
- k) Provision for a remote communication module (CCM) shall allow distant computer control (via telephone line) of up to eight (8) paralleled generator sets, including start/stop operation, and viewing all system parameters available from the control panel. The CCM module shall be capable of remote mounting at least 300 m (1000 ft) from the control panel.
- l) Provide remote annunciation solid state panel which includes red and yellow indicating lights and silencable alarm horn for low oil pressure shutdown, low coolant temperature alarm, high coolant temperature shutdown, overcrank, overspeed shutdown, low fuel level alarm, battery charger malfunction (via charger switch), generator on load.

4. Engine-Generator Plant Mounting:

- a) Provide welded, self-supporting, structural steel frame subbase.
- b) Pre-drill subbase and provide all mounting hardware and anchors to floor supports.
- c) Vibration isolators shall isolate the engine and generator from the base to allow fast trouble free installation while providing at least 95% linear vibration. The isolators shall consist of a highly resilient rubber compound resistant to weather, heat, and age, and impervious to oil, water, antifreeze, and diesel fuel. The isolator shall incorporate a dual spring rate for non-abrupt displacement, and shall comply with Uniform Building Code (UBC) Seismic Zone 4 requirements.
- d) All oil and water shall be valved and piped to outside of skid
- e) All engine wiring shall be marked with specific wire number every six inches and encased in a sealed loom.

5. Acceptable Manufacturers:

- a) Generac
- b) Cummins/Onan
- c) Caterpillar
- d) Approved equal

2.3 STARTING CONTROLS

A. Provide Engine Automatic Starting Control As Follows:

- 1. Starting cycle initiated by auxiliary contact in automatic transfer switch panel.
- 2. Open fuel pump and cooling water supply solenoid valves.

3. Synchronous motor-driven or pneumatic timer providing adjustable number of cranking cycles (1 to 4) of ten seconds crank and ten seconds rest, or continuous cranking cycle of up to 75 seconds.
4. Positive cranking disconnect relay preventing cranking after engine fires.
5. Automatic engine shutdown.
6. Close fuel pump and cooling water supply solenoid valves.
7. If high water temperature, overspeed, low lubricating oil pressure, or engine overcranking lockout contacts operate, one audible alarm must operate and there must be visual indication of particular contact that operated; reset button.
8. Common fault contacts, 10 ampere contact rating, number as required, wired to terminal board for remote alarm signal.
9. Incorporate in engine-generator control cabinet.

2.4 SAFETY SHUTDOWN AND ALARM CIRCUITS

- A. Provide safety shutdown circuits with common reset switch, individual fault-lamp relay, indicating lamps, auxiliary relays, and common fault contacts for local and remote alarm functions wired to terminal boards; fault indication as follows:
 1. Shut down conditions.
 2. Overspeed.
 - a) Low lube oil pressure.
 - b) High water temperature and low water temperature
 - c) Overcranking.
 3. Alarm conditions;
 - a) AC battery charger failure.
 - b) DC battery charger failure.
 - c) Overload (circuit breaker trip).
 - d) Low fuel in day tank.

2.5 BATTERY CHARGER

- A. Provide Battery Charger And Regulator As Follows:
 1. Automatic battery charge sensing device.
 2. Automatic charging at rate necessary to maintain battery at full charge; with full charge in 24 hours after 5 minutes of cranking.
 3. Automatically disconnects from battery during engine starting.
 4. Test switch to allow manual sensing of battery charge
 5. Alarm relays for low DC voltage, high DC voltage, AC power failure and a summary contact for charger failure.
 6. Sheet steel NEMA 1 enclosure for wall mounting. Battery charger shall be

- 7. mounted and wired inside enclosure.
- 7. Charger shall operate on 120 volts AC.
- 8. Design equipment: LaMarche
- 9. Acceptable Manufacturers:: Exide, LaMarche, or approved equal

2.6 BATTERIES

A. Provide Batteries as Follows:

- 1. Lead acid type.
- 2. Shipped dry, with electrolyte in separate container.
- 3. Provide corrosion-resistant battery mounting rack, battery interconnecting cables and terminals, hydrometer, etc.
- 4. Provide thermostatically controlled battery pad heaters (80 watt, 120 volt each) in a vented steel battery box

2.7 AUTOMATIC TRANSFER SWITCH

A. Description:

- 1. Constructed in accordance with UL Standard 1008.
- 2. Double throw, mechanically and electrically interlocked.
- 3. Operated by momentary energization of a single coil or double coil with mechanical latching in both normal and emergency positions.
- 4. Operating voltage for transfer obtained from source to which load is to be transferred.
- 5. Three phase, four wire, three pole, solid neutral 480 volt normal and emergency power source contacts.
- 6. Ampere rating as called for.
- 7. Provide magnetic blowout coils and arc barriers on each pole.
- 8. Provide voltage supervisory relays on each phase, such that transfer and engine start is effected should any one phase of the three phase supply be below 70% of normal voltage.
- 9. Minimum 3 cycle short circuit and withstand ratings, in rms symmetrical amperes, shall be as follows:

Switch Ampere Rating	Closing and Withstand Rating
100 – 400	42,000
600 – 800	65,000
1000 – 1200	85,000
1600 - 4000	100,000

- 10. Terminals front connected.

11. Provide dual transfer switch operator with adjustable time delay 1-300 seconds set at 3 seconds (2d) to allow motor loads to be demagnetized between the time that the closed source is opened and the open source closed.
- B. Provide pilot lights as follows:
1. Oil-tight, transformer operated, six volt long life bulb.
 2. Green, indicating normal switch position.
 3. Red, indicating emergency switch position.
 4. Fuse for each light.
- C. Provide the following accessory features:
1. Adjustable time delay before engine starting
 2. Adjustable time delay on retransfer to normal field adjustable 0 to 25 minutes, with five minute engine unloaded running time
 3. Oil-tight test switch, engine start and transfer, key pad operated.
 4. Pushbutton to bypass accessory
 5. Engine start contact, including voltage-frequency relay
 6. Oil-tight pilot lights
 7. Time clock exerciser with transfer. Retransfer shall be automatic at end of exercise period, unless bypass switch is pressed.
 8. Auxiliary contacts on shaft. No common wires for auxiliary contacts. Bring wires to terminal block, suitably labeled. Provide minimum of 8 auxiliary contacts which are programmable to close upon activation of transfer switch.
 9. Provide ground studs to enclosure for Burndy, long-barrel, two-hole, Hydent cable lugs for copper cables, provide size and quantity as required.
 10. Provide any other accessories as may be required to achieve operation as described in this specification.
 11. Provide box of spare fuses and lamps for pilot lights.
 12. Provide NEMA 1 sheet metal enclosure for wall mounting, front door hinged.
 13. All time delay relays shall be microprocessor based and shall be field adjustable and shall show the actual setting time in minutes or seconds.
 14. A three phase digital LCD voltage readout, with 1% accuracy shall display

all three separate phase to phase voltages simultaneously, for both the normal and emergency source.

15. A digital LCD frequency readout with 1% accuracy shall display frequency for both normal and emergency source.
16. An LCD readout display shall display normal source and emergency source availability.
17. Design Equipment: Russelectric RMTD Series

D. Acceptable Manufacturers

1. Asco
2. Onan
3. Generac
4. Approved Equal

2.8 WEATHERPROOF ENCLOSURE:

- A. Provide a weather protected type sound attenuated level 2 generator set enclosure complete in every detail and not requiring additional field modifications or assembly. The enclosure shall be accurately dimensioned to provide ease of maintenance and proper operation of the diesel generator set while under load conditions.
- B. The weather protected enclosure shall be of an extruded aluminum frame with prepainted aluminum exterior panel construction as required to house the generator and its auxiliary items. The design and construction shall be modular. The roof shall be strengthened to support the critical grade exhaust silencer as recommended by the engine manufacturer for this application as well as snow loads.
- C. All louvers to be designed to prevent the entrance of driving rainwater, but to have sufficient free area to allow for 120% of the total engine-generator cooling air requirements used in this application. All louvers shall include birdscreens to prevent the entrance of foreign objects.
- D. The critical grade exhaust silencer specified shall be horizontally mounted and all piping to be complete. Roof penetrations for piping shall be absolutely weatherproofed. The design shall prevent the entrance of rain and allow for thermal expansion and vibration of the exhaust piping without chafing or stress to the exhaust system.
- E. The enclosure shall be mounted directly to the engine base or a heavy duty subbase containing both the engine-generator package and the enclosure. The engine-generator-enclosure package shall be deliver to the jobsite in one piece. Drop over enclosures shipped to the jobsite separately are not acceptable.
- F. A 90 degree elbow with flipper cap will be provided to direct the exhaust discharge upwards. A skirt will be provided to prevent rain and snow from entering the enclosure. The skirt will be provided at all roof penetrations.

- G. The enclosure shall utilize all hinged side access doors. A minimum of (2) doors per side and (1) rear door shall be provided. Door hinges and pins shall be of stainless steel.
- H. The enclosure shall be equipped with single entry point for commercial power supply circuits and wiring by the Contractor for the battery charger, jacket water heater and battery pad heaters. The box shall be mounted within the enclosure and allow for site condition conduit entry. All internal wiring and runs to the auxiliary equipment supplied with the package shall be pre-wired at the factory by the manufacturer in conduit or sealtight.
- I. Generator to be placed on concrete pad as dimensioned on drawings. Electrical conduits and conductors shall be roughed to generator within enclosure.
- J. Provide flexible connections to all components field mounted to the generator.

2.9 EXHAUST SYSTEM

- A. Muffler:
 - 1. Quiet, spark arrester, Critical (25 dB(a) attenuation) classification. Size as recommended by engine manufacturer.
 - 2. Provide four bracket supports welded to sides of muffler for horizontal installations.
 - 3. Stainless flexible exhaust connector
 - 4. Design equipment: Maxim
 - 5. Acceptable Manufacturers: Burgess, Maxim or approved equal .
- B. Exhaust Piping: Sections of seamless, stainless steel flexible exhaust piping between engine and muffler.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS:

- A. Completely coordinate installation, assure that elements of the system are compatible, operational and correct.
- B. Provide rigging to unload, move, and set in place engine-generator.
- C. Provide rigging to unload, move, and set in place engine-generator. Field verify, before bidding, rigging method to be used to install generator in building. Provide all necessary cutting and patching of existing walls to rig generator into building. If necessary provide factory authorized representative to disassemble and reassemble generator to rig unit into building.
- D. Provide miscellaneous bolts, washers, nuts, clips, lockwashers, small hardware, etc., of durium or equal rust resistant material, to make installation complete.

- E. Fill cooling system with 50 percent glycol (anti-freeze) solution, per manufacturer's recommendations.
- F. Refer to "Grounding" section of specifications.
- G. Install equipment plumb, level, and true.
- H. Leave maximum space available in front, along side, etc., all items of equipment, to allow easy access and servicing of serviceable components. Meet NEC requirements.

3.2 FIELD SUPERVISION

- A. Provide field supervision/service at no additional cost to cover inspection, test, and start-up of this equipment.
- B. Submittal shall state the amount of field supervision/service recommended by vendor to cover critical points of installation, inspection, test, and start-up.
- C. The complete installation shall be checked for procedural and operational compliance by a representative of the system manufacturer's authorized local dealer. The engine lubricating oil and antifreeze, as recommended by the system manufacturer, shall be provided by the generator set dealer. If switchgear and generator sets are furnished by different manufacturers, technical representatives of both manufacturers' authorized dealers shall verify the installation meets requirements. Any deficiencies shall be noted and corrected by the Contractor.
- D. The system manufacturer's dealer representative shall be present to assist the Contractor during start-up, systems check, adjusting, and any site testing required after the installation is complete.

3.3 WARRANTY

- A. Standby electric generating system components, complete electric plant, and controls shall be warranted by the manufacturer against defects in materials and factory workmanship for a period of (2) years. Such defective parts shall be repaired or replaced at manufacturer's option, free of charge for a period of (2) years with travel time and mileage free of charge for the first year of operation. The warranty period shall commence when the standby power system is first placed in service.

3.4 INSTRUCTION & TRAINING

- A. Provide verbal and written instructions to Owner appointed personnel in the proper and safe manner of operating equipment.
- B. Instruction shall include proper maintenance, testing and trouble shooting techniques and methods.
- C. Instruction shall be given by a manufacturer certified technicians or mechanics.

- D. Provide representatives for each piece of equipment in the system.

3.5 LOAD COORDINATION

- A. Generator ratings specified are minimum acceptable capacity. Vendor shall provide larger size set if required to properly operate the load.
- B. Provide load analysis demonstrating generator set will properly start, operate and carry on a standby basis, all loads called to receive emergency power.
- C. The DDC system provided by the Division 23 contractor will provide sequenced or delayed start for certain loads. The system supplier shall coordinate delayed start requirements with the division 15 contractor and DDC system supplier. Otherwise, loads shall start immediately upon transfer to the emergency source.

3.6 WIRING

- A. Provide all required power and control wiring and raceways between engine-generator set, transfer switch, battery charger, louvers, dampers, controls, coolers, batteries, day tank, heaters and all other various and related equipment.
- B. Comply with Manufacturer's Instruction Books.
- C. Provide Burndy, long-barrel, Hy-dent cable lugs for all normal and emergency power cables.
- D. Maintain phasing standards as called for.
- E. Color code and identify control and power wires and cables as called for.
- F. Provide copper, 600 volt insulation minimum, control wiring; do not splice.
- G. Provide "crimp-on" type terminals for control wire terminations, as called for.
- H. Provide liquid-tight jacketed flexible conduit for all connections to engine, generator, and to day tank.
- I. Provide green ground conductor in each conduit run.

3.7 ENGINE-GENERATOR INSTALLATION

- A. Install where shown on plans. Provide an equipment pad and foundation. The approximate pad dimensions are shown on the plans. The contractor shall obtain the approval of the engine-generator manufacturer for the pad and foundation prior to installation.
- B. Provide necessary anchor bolts at proper locations, place by templates if required, for proper setting of engine-generator.
- C. Perform full operational test of complete system at full connected load. Provide notification of tests to be conducted in presence of Owner's Representative, in accordance with manufacturer's instructions.

- D. Entire system shall be complete and operational and shall be test operated, including simulated loss of normal power, all control devices shall be operated to test their function.
- E. Determine exact requirements, verify locations, and comply with applicable regulations in installing equipment.
- F. Provide the services of the manufacturer's representative to check out the system and instruct the Owner in the operation of the system. Furnish written statement to the Owner's Representative that the check-out and instruction service has been provided. Include statement that system operates properly, as called for. Submit statement as a submittal for review.

3.8 FUEL PIPING

- A. Plumbing trade shall provide complete fuel piping to engine-generator and make final connection.
- B. Furnish fuel filter, fuel solenoid valve, secondary regulator, gas shutoff cock, flexible fuel piping and fuel piping diagram.
- C. Coordinate fuel piping size with these items. The division 22 contractor and system manufacturer are responsible for determining the final size of the fuel piping.

3.9 EXHAUST SYSTEM

- A. Electrical trade shall provide complete exhaust piping system, including stack supports to floor or structure, including flexible connection at engine and muffler.
- B. Install thermal insulation products in accordance with manufacturer's written instructions and in compliance with recognized industry practices to ensure that insulation serves its intended purpose.
- C. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gapping joints and excessive voids resulting from poor workmanship.
- D. Do not apply insulation to hot equipment.
- E. Apply insulation using the staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.
- F. Coat insulated surfaces with layer of insulating cement, troweled in workmanlike manner, leaving smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.
- G. Cover insulated surfaces with aluminum jacketing neatly fitted and firmly secured. Lap seams at least two inches. Provide neatly beveled edge at interruptions of insulation.

- H. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- I. Protection - insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period to avoid damage and deterioration.

3.10 GROUNDING

- A. Provide equipment grounding connections, sufficiently tight to assure a permanent and effective ground, for system components as indicated.
- B. Refer to section 264500-Grounding for additional requirements.

3.11 EQUIPMENT PROTECTION

- A. Provide repair or replacement for all damage and defacement, whether functional or nonfunctional, to all equipment from the time it is unloaded, during installation, and during period of beneficial use, and until installation is accepted.

3.12 ACCEPTANCE TESTING

- A. After substantial completion punch list items have been finished, the contractor and manufacturers representative will provide the following tests, in the presence of the Owner's head of facilities and engineer:

1. Prestart Checks:

- a) oil level
- b) water level
- c) battery connection and charge condition
- d) air start supply pressure (if so equipped)
- e) engine to control interconnects
- f) engine generator intake/exhaust obstructions
- g) engine room ventilation obstructions
- h) removal of all packing materials

2. Operation tests:

- a) Load - One-hour operation at 80% of full load rating. Two hours operation at 100% of full load rating. After the first half-hour stabilization period at full load, the following shall be recorded at fifteen minute intervals:
 - (1) Voltage and amperage (3 phase), frequency
 - (2) Fuel pressure, oil pressure and water temperature
 - (3) Exhaust gas temperature at engine exhaust outlet
Ambient temperature
 - (4) Kilowatts, Power Factor, Kvars
 - (5) Generator Temperature
 - (6) Proper operation of controls, engine shutdown, and safety devices shall be demonstrated.
 - (7) The manufacturer's representative shall provide inductive

load banks and field engineer for the test. Building load shall not be used.

- (8) Should these tests indicate that the equipment does not meet the specified performance requirements, National Electric Code and Local codes, the cost of all corrective measures shall be borne by the contractor.

3.13 OWNER TRAINING

- A. The system manufacturer's representative(s) shall provide a complete orientation for the owner's engineering and maintenance personnel. Orientation shall include both classroom and hands-on instruction of a total of not less than 4 hours. Topics covered shall include control operation, schematics, wiring diagrams, meters, indicators, warning lights, shutdown system and routine maintenance.
- B. This training shall include all system components provide manufactures representatives from all components in the complete emergency power system.
- C. Provide an additional 4 hours of training 6 months after the system acceptance.

END OF SECTION

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