



**OREGON STATE UNIVERSITY
REQUEST FOR QUOTE (RFQ)**

		ISSUE DATE:	December 29, 2016		
RFQ #	DL186304Q	RFQ DUE DATE:	January 11, 2017, 3 PM		
DELIVER TO:		REQUESTED BY / RETURN QUOTE TO:			
DEPARTMENT:	OSU Electric Shop	NAME:	Debora Lauer		
ADDRESS:	Oregon State University	E-MAIL:	Debora.Lauer@oregonstate.edu		
CITY, STATE ZIP:	Corvallis, OR 97331	TELEPHONE:	541-737-7343		
REQUIRED DELIVERY DATE:	2/15/17	FAX:	541-737-2170		
ITEM	DESCRIPTION	QTY	UNIT	UNIT PRICE	TOTAL PRICE
1	26 32 14 Diesel Generator Set (Standby)	1	Unit		
	See Attached Specification Requirements				
	Shipping MUST be included in Pricing				
Delivery is f.o.b. destination, prepaid and allowed. Shipping, freight and handling must be included in quoted prices. Additional costs for such are disallowed.				TOTAL	
DELIVERY TIME AFTER RECEIPT OF ORDER:				PRICES VALID THROUGH:	
SPECIAL INSTRUCTIONS:		VENDOR INFORMATION:			
1. Unless otherwise specified, all items quoted are to be new, unused and not remanufactured in any way. 2. Brand names are for the purpose of describing and establishing the characteristics desired and are not intended to limit or restrict competition. Quoters may submit quotes for substantially equivalent products unless the RFQ provides that a specific brand is necessary because of compatibility requirements, etc. All such brand substitutions shall be subject to approval by OSU. 3. Quoters must clearly identify all products quoted. Brand name and model or number must be shown. 4. Only documents issued as addenda by OSU serve to change the RFQ in any way. 5. OSU reserves the right to make the award by item, partial or whole lots, groups of items or entire quote, whichever is in the best interest of OSU. 6. OSU may reject any Quote not in compliance with the RFQ, attachments, and addenda, or if it is in the best interest of OSU. 7. This RFQ form must be completed, signed and returned with all required documents.		COMPANY:			
		ADDRESS:			
		CITY, STATE, ZIP:			
		CONTACT NAME:			
		E-MAIL:			
		TELEPHONE:			
		FAX:			
		VENDOR SIGNATURE:			
		<i>By signature below the undersigned certifies that they are authorized to act on behalf of the quoter and will comply with all aspects of the quote herein.</i>			
		SIGNATURE:			
		NAME/TITLE:			

This procurement is subject to the indicated Oregon State University Standard Terms and Conditions for: Goods Services Purchase Order Construction Software. The indicated terms and conditions may be viewed at <http://pacs.oregonstate.edu/terms-and-conditions>

26 32 14 DIESEL GENERATOR SET (STANDBY)

Specification Requirements

PART 1 GENERAL

1.01 REFERENCES

- A. The current edition of the publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only:
1. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
 - a. ANSI C39.1 *Requirements for Electrical Analog Indicating Instruments*
 - a. ASME B16.3 *Malleable Iron Threaded Fittings, Classes 150 and 300*
 - b. ASME B16.5 *Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard*
 - c. ASME B16.11 *Forged Steel Fittings, Socket-Welding and Threaded*
 2. ASTM INTERNATIONAL (ASTM)
 - a. ASTM A106/A106M *Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service*
 - b. ASTM A135/A135M *Standard Specification for Electric-Resistance-Welded Steel Pipe*
 - c. ASTM A181/A181M *Standard Specification for Carbon Steel Forgings, for General-Purpose Piping*
 - d. ASTM A234/A234M *Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service*
 - e. ASTM A53/A53M *Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless*
 - f. ASTM D975 *Standard Specification for Diesel Fuel Oils*
 3. INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)
 - a. IEEE C2 *National Electrical Safety Code*
 4. INTERNATIONAL CODE COUNCIL (ICC)
 - a. ICC UBC *Uniform Building Code*
 5. NATIONAL ELECTRICAL INSTALLATION STANDARD (NEIS)
 - a. NECA/EGSA 404-2014 *Standard for Installing Generator Sets.*
 6. MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)
 - a. MSS SP-58 *Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation*
 - b. MSS SP-80 *Bronze Gate, Globe, Angle and Check Valves*
 7. ELECTRICAL GENERATING SYSTEMS ASSOCIATION (EGSA)
 - a. EGSA 101P *Performance Standard for Engine Driven Generator Sets*
 8. INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)
 - a. IEEE 519 *Recommended Practice and Requirements for Harmonic Control in Electric Power Systems*
 9. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

26_32_14 DIESEL GENERATOR SET (STANDBY)

PAGE 2 OF 19

- a. NEMA ICS 2, *Standard for Controllers, Contactors, and Overload Relays Rated 600V*
 - b. NEMA ICS 6 *Enclosures*
 - c. NEMA MG 1 *Motors and Generators*
 - d. NEMA PB 1 *Panelboards*
 - e. NEMA/ANSI C12.11 *Instrument Transformers for Revenue Metering, 10 kV BIL through 350 kV BIL (0.6 kV NSV through 69 kV NSV)*
10. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
- a. NFPA 30 *Flammable and Combustible Liquids Code*
 - b. NFPA 37 *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*
 - c. NFPA 70 *National Electrical Code*
 - d. NFPA 99 *Health Care Facilities Code*
 - e. NFPA 110 *Standard for Emergency and Standby Power Systems*
11. SAE INTERNATIONAL
- a. SAE ARP892 *Generator, Engine, General Specification for DC Starter*
 - b. SAE J537 *Storage Batteries*
12. UNDERWRITERS LABORATORIES (UL)
- a. UL 1236 (2015) *Standard for Battery Chargers for Charging Engine-Starter Batteries*
 - b. UL 489 *Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures*

1.02 SYSTEM DESCRIPTION

- A. NFPA 110 Level 1 Application.
- B. Provide and install each engine-generator set complete and totally functional, with all necessary ancillary equipment to include air filtration; starting system; battery charger; local and remote generator controls, protection, and isolation; instrumentation; lubrication; fuel system; cooling system; and engine exhaust system.
- C. Each engine-generator set satisfy the requirements specified in the Engine-Generator Parameter Schedule below.
- D. Submit certification that the engine-generator set and cooling system function properly in the ambient temperatures specified.
- E. Provide each engine-generator set consisting of one engine, one generator, and one exciter, mounted, assembled, and aligned on one base prior to shipping; all other necessary ancillary equipment which may be mounted separately.
- F. Set components environmentally suitable for the locations shown and the manufacturer's standard product offered for commercial or industrial use.
- G. Provide a generator strip heater for moisture control when the generator is not operating.
- H. Subscription services not allowed.
- I. Engine-Generator Parameter Schedule:

1. Service Load: 450 kVA (360kW +/-)
 2. Power Factor: 0.8
 3. Motor Starting kVA (maximum): Submit Manufacturer's standard capacity for verification.
 4. Maximum Speed: 1800 rpm
 5. Engine-Generator Application: Stand Alone
 6. Engine Cooling Type: Water/Ethylene Glycol
 7. Heat Exchanger Type: Fin Tube
 8. Electronic Governor Type: Droop
 9. Governor Frequency Bandwidth Percent Steady State: + 0.4%
 10. Frequency Regulation (droop) (No load to full load): 3% Max
 11. Voltage Regulation (droop) (No load to full load): 1% Max
 12. Voltage Bandwidth (steady state): +/- 2 percent
 13. Frequency: 60 Hz
 14. Voltage: 480 volt
 15. Phases: Three (3) Phase (Wye)
 16. Max Time to Start and be Ready to Assume Load: 10 seconds
 17. Max Summer Outdoor Temp (Ambient): 110° F
 18. Min Winter Outdoor Temp (Ambient): 0° F
 19. Installation Elevation: 300' above sea level
- J. Output Capacity: Provide each generator set with power equal to the sum of service load plus the machine's efficiency loss, associated ancillary equipment loads, and any oversizing required.
- K. Power rating: Standby ratings; EGSA 101P.
- L. Engine-Generator Set Enclosure:
1. Corrosion resistant, fully weather resistant, contain all set components, and provide ventilation to permit operation at rated load under secured conditions.
 2. Provide doors for access to all controls and equipment requiring periodic maintenance or adjustment. Provide removable panels for access to components requiring periodic replacement.
 3. Capable of being removed without disassembly of the engine-generator set or removal of components other than exhaust system.
 4. Reduce the noise of the generator set to within the limits specified.
 5. Provide structural loading required for the geographic area (wind loads, snow loads, etc.).
- M. Vibration Limitations:
1. Provided engine-generator with vibration-isolation in accordance with the manufacturer's standard recommendation.
 2. Where the vibration-isolation system does not secure the base to the structure floor or unit foundation, provide seismic restraints in accordance with the seismic parameters specified.
- N. Torsional Analysis: Submit torsional analysis including prototype testing or calculations which certify and demonstrate that no damaging or dangerous torsional

26_32_14 DIESEL GENERATOR SET (STANDBY)

PAGE 4 OF 19

vibrations will occur when the prime mover is connected to the generator, at synchronous speeds, plus/minus 10 percent.

- O. Performance Data: Submit vibration isolation system performance data for the range of frequencies generated by the engine-generator set during operation from no load to full load and the maximum vibration transmitted to the floor. Also submit a description of seismic qualification of the engine-generator mounting, base, and vibration isolation.

1.03 SUBMITTALS

A. Shop Drawings

- 1. Detailed dimensioned drawings including plan and elevation.
- 2. Connections and required clearances.
- 3. Electrical characteristics and electrical connection requirements.
- 4. Electrical diagrams including schematic and interconnection diagrams.

B. Detailed Drawings

- 1. Submit detailed drawings showing the following:
 - a. Base-mounted equipment, complete with base and attachments including anchor bolt template and recommended clearances for maintenance and operation.
 - b. Starting system.
 - c. Fuel system.
 - d. Cooling system.
 - e. Exhaust system.
 - f. Electric wiring of relays, breakers, programmable controllers, and switches including single line and wiring diagrams.
 - g. Lubrication system, including piping, pumps, strainers, filters, heat exchangers for lube oil and turbocharger cooling, electric heater, controls and wiring.
 - h. Location, type, and description of vibration isolation devices.
 - i. The safety system, including wiring schematics.
 - j. One-line schematic and wiring diagrams of the generator, exciter, regulator, governor, and all instrumentation.
 - k. Panel layouts.
 - l. Mounting and support for each panel and major piece of electrical equipment.
 - m. Engine-generator set rigging points and lifting instructions.

C. Product Data

- 1. Manufacturer's Catalog
- 2. Instructions
- 3. Experience
- 4. Field Engineer
- 5. Site Welding
- 6. General Installation

- D. Design Data:
 - 1. Sound Limitations
 - 2. Generator
 - 3. Integral Main Fuel Storage Tank
 - 4. Day Tank
 - 5. Ventilation and Combustion Air Requirements
 - 6. Power Factor
 - 7. Heat Exchanger
 - 8. Time-Delay on Alarms
 - 9. Cooling System
 - 10. Vibration Isolation
- E. Test Reports:
 - 1. Performance tests
 - 2. Onsite Inspection and Tests
- F. Certificates
 - 1. Certify that products meet or exceed specified requirements.
- G. Operation and Maintenance Data
 - 1. Operation Manual
 - 2. Maintenance Manual
 - 3. Extra Materials

1.04 QUALITY ASSURANCE

- A. Experience
 - 1. Submit a statement showing and verifying these requirements:
 - a. Component manufacturers: minimum of three (3) years successful experience in the manufacture, assembly and sale of components used with stationary diesel engine-generator sets for commercial and industrial use.
 - b. Engine-generator set manufacturer/assembler: minimum of three (3) years successful experience in the manufacture, assembly and sale of stationary diesel engine-generator sets for commercial and industrial use.
- B. Field Engineer: engine-generator set manufacturer or assembler furnish a qualified Field Engineer to:
 - 1. Supervise the complete installation of the engine-generator set.
 - 2. Assist in the performance of the onsite tests, and instruct personnel as to the operational and maintenance features of the equipment.
 - 3. Field engineer: Attended the engine-generator manufacturer's training courses on installation and operation and maintenance for engine-generator sets.
 - 4. Submit a letter listing the qualifications, schools, formal training, and experience of the field engineer.
- C. Seismic Requirements:
 - 1. Designed for Seismic Risk Area.
 - 2. Provide Oregon Structural Specialty Code Seismic Certification.
- D. Comply with NFPA 70.

26_32_14 DIESEL GENERATOR SET (STANDBY)

PAGE 6 OF 19

1.05 DELIVERY, STORAGE AND HANDLING

- A. Properly protect materials and equipment in accordance with the manufacturers recommended storage procedures, before, during, and after installation. Protect stored items from the weather and contamination. During installation, cap piping and similar openings to keep out dirt and other foreign matter.

1.06 MAINTENANCE SERVICE

- A. Submit the operation and maintenance manuals and have them approved prior to commencing onsite tests.

1.07 EXTRA MATERIALS

- A. Provide two sets of special tools and two sets of filters required for maintenance. Special tools are those that only the manufacturer provides, for special purposes, or to reach otherwise inaccessible parts.
- B. Provided one handset for each electronic governor when required to indicate and/or change governor response settings.
- C. Supply two complete sets of filters in a suitable storage box in addition to filters replaced after testing.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Cummins Engine Company.
- B. Caterpillar Inc.
- C. Generac.
- D. Approved Equal.

2.02 NAMEPLATES

- A. For each major component of this specification provide the manufacturer's name, type or style, model or serial number, and rating number on a plate secured to the equipment. As a minimum, provide nameplates for: Engines; Relays; Generators; Day tanks; Transformers (CT & PT); Regulators; Pumps and pump motors; Governors; Generator Breaker; Economizers; Heat Exchangers (other than base-mounted).
- B. Where the following equipment is provided as a standard component by the diesel-engine-generator set manufacturer, the nameplate information may be provided in the maintenance manual in lieu of nameplates.
 - 1. Battery charger
 - 2. Heaters
 - 3. Exhaust mufflers
 - 4. Exciters
 - 5. Switchgear

6. Silencers
7. Battery

2.03 SAFETY DEVICES

- A. Insulated, fully enclose, guard, or fit with other types of safety devices any exposed moving parts, parts that produce high operating temperatures, parts which may be electrically energized, and parts that may be a hazard to operating personnel during normal operation. Install safety devices so that proper operation of the equipment is not impaired.

2.04 MATERIALS AND EQUIPMENT

- A. Materials and equipment as specified. Submit a letter certifying that where materials or equipment are specified to comply with requirements of UL, or other standards, written proof of such compliance has been obtained. The label or listing of the specified agency, or a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency are acceptable as proof.
 1. Circuit Breakers, Low Voltage: UL 489.
 2. Filter Elements: (Fuel-oil, Lubricating-oil, and Combustion-air) Manufacturer's standard.
 3. Instrument Transformers: NEMA/ANSI C12.11.
 4. Pipe: (Fuel/Lube-oil, Compressed-Air, Coolant and Exhaust) ASTM A53/A53M, ASTM A106/A106M or ASTM A135/A135M, steel pipe. Pipe smaller than 2 inches: Schedule 80. Pipe 2 inches and larger: Schedule 40.
 5. Pipe Flanges and Flanged Fittings: ASTM A181/A181M, Class 60, or ASME B16.5, Grade 1, Class 150.
 6. Pipe Welding Fittings: ASTM A234/A234M, Grade WPB or WPC, Class 150, or ASME B16.11, 3000 lb.
 7. Threaded Fittings: ASME B16.3, Class 150.
 8. Valves: MSS SP-80, Class 150.
 9. Gaskets Manufacturers: Standard.
 10. Pipe Hangers: MSS SP-58.
 11. Electrical Enclosures General: NEMA ICS 6.
 12. Panelboards: NEMA PB 1.
 13. Electric Motors: Electric motors conform to the requirements of NEMA MG 1. Sealed ball bearings, a maximum speed of 1800 rpm and integral automatic or manual reset thermal overload protectors. Outdoor motors totally enclosed.
 14. Motor Controllers. Motor controllers and starters conform to the requirements of NFPA 70 and NEMA ICS 2.

2.05 ENGINE

- A. Each engine:
 1. Operate on a No. 2-D diesel conforming to ASTM D975, be designed for stationary applications, and be complete with ancillaries.

26_32_14 DIESEL GENERATOR SET (STANDBY)

PAGE 8 OF 19

2. Standard production model described in the manufacturer's catalog data, which describes and depicts each engine-generator set and all ancillary equipment in sufficient detail to demonstrate specification compliance.
 3. Naturally aspirated, scavenged, supercharged or turbocharged.
 4. Four-stroke-cycle and compression-ignition type.
 5. Vertical inline, V-type, or opposed-piston type, with a solid cast block or individually cast cylinders.
 6. Minimum of two cylinders. Opposed-piston type engines: no less than four cylinders. Provide coolant drain port at each block. Each engine equipped with an over-speed sensor.
- B. Provide engine shutdown on low coolant level, low fuel level, high oil temperature, low oil pressure, over-speed and engine over-crank. Limits as selected by Manufacturer.

2.06 FUEL SYSTEM

- A. Conform to the requirements of NFPA 30 and NFPA 37 and contain the following elements.
1. Main Pump: Engine driven to supply fuel at a minimum rate sufficient to provide the amount of fuel required to meet the performance indicated within the parameter schedule. fuel flow rate based on meeting the load requirements and all necessary recirculation.
 2. Filter: minimum of one full flow fuel filter for each engine; accessible and capable of being changed without disconnecting the piping or disturbing other components with plainly marked inlet and outlet connections.
 3. Relief/Bypass Valve: Provide a relief/bypass valve to regulate pressure in the fuel supply line, return excess fuel to a return line, and prevent the build-up of excessive pressure in the fuel system.
 4. Integral Main Fuel Storage Tank: Provide each engine with a factory installed integral main fuel tank. Provide each tank with connections for fuel supply line, fuel return line, local fuel fill port, gauge, vent line, float switch assembly, and fuel return line cooler as recommended by the manufacturer and assembler. Provide fuel returning to the tank at a temperature below the flash point of the fuel. Mount tank within the weatherproof enclosures with the fuel fill line accessible without opening the enclosure.
 5. Capacity: Supply fuel to the engine for an uninterrupted 24-hour period at 100 percent rated load without being refilled.
 6. Local Fuel Fill: Provide each port on the day tank with a screw-on cap.
 7. Fuel Level Controls: At each tank provide a float-switch assembly to perform the following functions:
 - a. Activate the "Low Fuel Level" alarm at 70 percent of the rated tank capacity.
 - b. Activate the "Overfill Fuel Level" alarm at 95 percent of the rated tank capacity.

8. Fuel supply line from the tank to the manufacturer's standard engine connection: welded pipe.

2.07 LUBRICATION

- A. Lubrication: Separate lube-oil system conforming to NFPA 30 and NFPA 37. Pressurized by engine-driven oil pumps. Furnished with a relief valve for oil pressure regulation (for closed systems) and a dip-stick for oil level indications. Vent crankcase in accordance with the manufacturer's recommendation except not be vented to the engine exhaust system. Provide readily accessible system for service such as draining, refilling, etc. Each system allow addition of oil and have oil-level indication with the set operating. Utilize a lubrication system oil cooler as recommended by the engine manufacturer.
- B. Filter: provided one full-flow filter for each pump, readily accessible and capable of being changed without disconnecting the piping or disturbing other components with inlet and outlet connections plainly marked.
- C. Lube-Oil Sensors: equip each engine with lube-oil pressure sensors. Locate downstream of the filters and provide signals for required indication and alarms.

2.08 COOLING SYSTEM

- A. Each engine cooling system operate automatically while the engine is running. Each cooling system sized for the maximum summer outdoor design temperature and site elevation. Water-cooled system coolant: use a combination of water and ethylene-glycol sufficient for freeze protection at the minimum winter outdoor temperature specified. Max temperature rise of coolant across engine: no more than that recommended and submitted.
 1. The maximum and minimum allowable inlet temperatures of the coolant fluid
 2. The maximum allowable temperature rise in the coolant fluid through the engine
 3. The minimum allowable inlet fuel temperature.
- B. Coolant Pumps: Centrifugal type with each engine having an engine-driven primary pump. Secondary pumps: electric motor driven and have automatic controllers.
- C. Heat Exchanger: size and capacity to limit the maximum allowable temperature rise in the coolant across the engine to that recommended and submitted in accordance with paragraph SUBMITTALS for the maximum summer outdoor design temperature and site elevation. Each heat exchanger corrosion resistant, suitable for service in ambient conditions of application. Submit manufacturers data to quantify heat rejected to the space with the engine-generator set at rated capacity.
- D. Fin-Tube-Type Heat Exchanger (Radiator): Heat exchanger may be factory coated with corrosive resistant film providing that corrosion measures are taken to restore the heat rejection capability of the radiator to the initial design requirement via oversizing, or other compensating methods. Internal surfaces compatible with liquid fluid coolant used. Materials and coolant are subject to approval by the Contracting Officer. Heat exchangers pressure type incorporating a pressure valve, vacuum valve and a cap. Caps designed for pressure relief prior to removal. Each heat exchanger and the entire cooling system capable of withstanding a minimum pressure of 7 psi.

26_32_14 DIESEL GENERATOR SET (STANDBY)

PAGE 10 OF 19

Each heat exchanger protected with a strong grille or screen guard. Provide at least two tapped holes at each heat exchanger. One tapped hole in the heat exchanger equipped with a drain cock, the rest plugged.

- E. Ductwork: Use flexible connection at duct to the diesel engine radiator. Material for the connection wire-reinforced glass. Connection rendered practically airtight.
- F. Temperature Sensors: Each engine equipped with coolant temperature sensors. Temperature sensors provide signals for pre-high and high indication and alarms.

2.09 SOUND LIMITATIONS

- A. Noise generated by the diesel generator not to exceed **OSHA safety requirements**.

2.10 AIR INTAKE EQUIPMENT

- A. Provide filters and silencers in locations that are convenient for servicing. Silencer high-frequency filter type, located in the air intake system as recommended by the engine manufacturer. Silencer capable of reducing the noise level at the air intake to a point below the maximum acceptable levels specified in paragraph SOUND LIMITATIONS. A combined filter-silencer unit meeting requirements for the separate filter and silencer items may be provided. Expansion elements in air-intake lines copper.

2.11 EXHAUST SYSTEM

- A. Separate and complete for each engine. Piping supported to minimize vibration.
- B. Where a V-type engine is provided: V-type connector with necessary flexible sections and hardware connecting the engine exhaust outlets.
- C. Flexible section at each engine and an expansion joint at each muffler, flanged connections. Flexible elements made of convoluted seamless tube without joints or packing. Expansion joints bellows type. Expansion and flexible elements stainless steel suitable for diesel-engine exhaust gas at the maximum exhaust temperature that is specified by the engine manufacturer. Expansion and flexible elements capable of absorbing vibration from the engine and compensation for thermal expansion and contraction.
- D. Exhaust Muffler
 - 1. Chamber type exhaust muffler constructed of welded steel and designed for outside vertical mounting. Eyebolts, lugs, flanges, or other items provided as necessary for support in the location and position indicated. Pressure drop through the muffler not to exceed the recommendations of the engine manufacturer. Outside mufflers zinc coated or painted with high temperature 400 degrees F resisting paint. The muffler and exhaust piping together reduce the noise level to less than the maximum acceptable level listed for sound limitations in paragraph SOUND LIMITATIONS. Drain valve, nipple, and cap at the low-point of the muffler.
- E. Exhaust Piping

1. Slope horizontal sections of exhaust piping downward and away from the engine to a condensate trap and drain valve. Changes in direction: long-radius. Provided exhaust piping, mufflers and silencers installed vertically with a hinged, gravity operated, self-closing, rain cover.

2.12 EMISSIONS

- A. Finished installation comply with Federal, state, and local regulations and restrictions regarding the limits of emissions.
- B. Submit a certification from the engine manufacturer stating that the engine exhaust emissions meet federal, state, and local regulations and restrictions specified. At a minimum, include emission factors for criteria pollutants including nitrogen oxides, carbon monoxide, particulate matter, sulfur dioxide, non-methane hydrocarbon, and for hazardous air pollutants (HAPs).

2.13 STARTING SYSTEM

- A. starting system for standby engine-generator sets used in emergency applications in accordance with NFPA 99 and NFPA 110.
- B. Provide engine control switch with functions including:
 1. run/start (manual), off/reset, and automatic mode.
- C. Provide Start-stop logic for adjustable cycle cranking and cool down operation. The logic arranged for manual starting and fully automatic starting.
- D. Provided adjustable cranking limit device to limit cranking periods from 1 second up to the maximum duration.
- E. Capacity: Starting system sufficient capacity, at the maximum outdoor summer temperature specified, to crank the engine without damage or overheating. The system capable of providing a minimum of three cranking periods with 15-second intervals between cranks. Each cranking period have a maximum duration of 15 seconds.
- F. Functional Requirements: Starting system manufacturers recommended DC system utilizing a negative circuit ground. Starting motors in accordance with SAE ARP892.
- G. Battery:
 1. Provide a starting battery system including the battery, battery rack, inter-cell connectors, and spacers. Battery in accordance with SAE J537. Critical system components (rack, protection, etc.) sized to withstand the seismic acceleration forces specified. Nickel-cadmium type battery, with sufficient capacity, at the minimum outdoor winter temperature specified to provide the specified cranking periods.
- H. Battery Charger
 1. Provide a current-limiting battery charger, conforming to UL 1236, to automatically recharge the batteries.
 2. Charger capable of an equalize charging rate for recharging fully depleted batteries within 24 hours and a float charge rate for maintaining the batteries in prime starting condition.
- I. Starting Aids

26_32_14 DIESEL GENERATOR SET (STANDBY)

PAGE 12 OF 19

1. Jacket-Coolant Heaters: A thermostatically controlled electric heater mounted in the engine coolant jacketing to automatically maintain the coolant within plus or minus 3 degrees of the control temperature. Operate heater independently of engine operation so that starting times are minimized. Control temperature: recommended by the engine manufacturer to meet the starting time specified.

2.14 GOVERNOR

- A. Provide a governor for each engine which maintains the frequency within a bandwidth of the rated frequency, over a steady-state load range of zero to 100 percent of rated output capacity. Configure for safe manual adjustment of the speed/frequency during operation of the engine-generator set, without special tools, from 90 to 110 percent of the rated speed/frequency, over a steady state load range of zero to 100 percent of rated capacity. Droop governors: maintain the midpoint of the frequency bandwidth linearly for steady-state loads over the range of zero to 100 percent of rated output capacity, with 3 percent droop.

2.15 GENERATOR

- A. Each generator of the synchronous type, one or two bearing, conforming to NEMA MG 1, equipped with winding terminal housings in accordance with NEMA MG 1, equipped with an amortisseur winding, and directly connected to the engine.
- B. Insulation: Class F.
- C. Generator design protect against mechanical, electrical and thermal damage due to vibration, 25 percent overspeeds, or voltages and temperatures at a rated output capacity of 100 percent. Generator ancillary equipment meet the short circuit requirements of NEMA MG 1. Frames the drip-proof type. Submit each generator KW rating and short circuit capacity (both symmetric and asymmetric).
- D. Current Balance: At 100 percent rated load, and load impedance equal for each of the three phases, the permissible current difference between any two phases not-to-exceed 2 percent of the largest current on either of the two phases. Submit manufacturer's certification that the flywheel has been statically and dynamically balanced and is capable of being rotated at 125 percent of rated speed without vibration or damage.
- E. Voltage Balance: At any balanced load between 75 and 100 percent of rated load, the difference in line-to-neutral voltage among the three phases not-to-exceed 1 percent of the average line-to-neutral voltage. For a single-phase load condition, consisting of 25 percent load at unity power factor placed between any phase and neutral with no load on the other two phases, the maximum simultaneous difference in line-to-neutral voltage between the phases not-to-exceed 3 percent of rated line to neutral voltage. Single-phase load requirement valid utilizing normal exciter and regulator control. The interpretation of the 25 percent load for single phase load conditions means 25 percent of rated current at rated phase voltage and unity power factor.

- F. Waveform: The deviation factor of the line-to-line voltage at zero load and at balanced full rated load at 0.8 power factor not-to-exceed 10 percent. RMS of all harmonics less than 5.0 percent and that of any one harmonic less than 3.0 percent at full rated load. Each engine-generator designed and configured to meet the total harmonic distortion limits of IEEE 519.

2.16 EXCITER

- A. Brushless type. Semiconductor rectifiers with a minimum safety factor of 300 percent for peak inverse voltage and forward current ratings for all operating conditions, including 110 percent generator output at 104 degrees F ambient. Exciter and regulator in combination maintain generator-output voltage within the limits specified.

2.17 VOLTAGE REGULATOR

- A. Provide generator with a solid-state voltage regulator, separate from the exciter. Maintain voltage within a bandwidth of the rated voltage, over a steady-state load range of zero to 100 percent of rated output capacity. Configure regulator for safe manual adjustment of the engine-generator voltage output without special tools, during operation from 90 to 110 percent of the rated voltage over the steady state load range of zero to 100 percent of rated output capacity. Regulation drift not-to-exceed plus or minus 0.5 percent for an ambient temperature change of 20 degrees C 36 degrees F. Maximum voltage regulator droop of 2 percent of rated voltage over a load range from 0 to 100 percent of rated output capacity and automatically maintain the generator output voltage within the specified operational bandwidth.

2.18 GENERATOR PROTECTION

- A. Provide short circuit and overload protection for the generator. The generator circuit breakers (IEEE Device 52) ratings consistent with the generator rated voltage and frequency, with continuous, short circuit and interrupting current ratings to match the generator capacity. The manufacturer determines the short circuit current interrupting rating of the breaker. The breaker engine-generator base mounted by the engine-generator set manufacturer. Molded case breakers. Surge protection provided for each phase of the generator, to be mounted at the generator terminals.
- B. Provide protection for existing 400 amp and 150 amp transfer switches.

2.19 SAFETY SYSTEM

- A. Provide devices, wiring, remote panels, local panels, etc., and install as a complete system to automatically activate the appropriate signals and initiate the appropriate actions. Provided safety system with a self-test method to verify its operability. Provide manual acknowledgement and reset devices for all alarm signals. Reactivate alarm signal systems for new signals after acknowledgment is given to any signal. configure the system so that loss of any monitoring device is dealt with as an alarm on that system element.
 1. Audible Signal:

26_32_14 DIESEL GENERATOR SET (STANDBY)

PAGE 14 OF 19

- a. sound audible alarm at a frequency of 70 Hz at a volume of 75 dB at 10 feet.
- b. Sound continuously activated upon alarm and silenced upon acknowledgment.
- c. Signal devices located as directed by Owner's Authorized Representative(OAR).
2. Visual Alarm Signal:
 - a. Panel light.
 - b. Light normally off, activated to blink upon alarm.
 - c. Change to continuously light upon acknowledgement.
 - d. If automatic shutdown occurs, maintain activated display status to indicate the cause of failure. reset after cause of alarm has been cleared and/or restored to normal condition.
 - e. Shutdown alarms red; all other alarms amber.
3. Alarms and Action Logic:
 - a. Shutdown: Simultaneous activation of the audible signal, activation of the visual signal, stopping the engine, and opening the generator main circuit breakers.
 - b. Problem: Activation of the visual signal.
4. Local Alarm Panel:
 - a. Provide a local alarm panel with NFPA 110 Level 1 alarm functions mounted either on or adjacent to the engine-generator set.
5. Time-Delay on Alarms:
 - a. For startup of the engine-generator set, time-delay devices installed bypassing the low lubricating oil pressure alarm during cranking, and the coolant-fluid outlet temperature alarm. The lube-oil time-delay device return its alarm to normal status after the engine starts. Return coolant time-delay device alarm to normal status 5 minutes after the engine starts. Submit the magnitude of monitored values which define alarm or action set-points, and the tolerance (plus and/or minus) at which the device activates the alarm or action.
6. Remote Alarm Panel:
 - a. Remote alarm panel: Level 1, NFPA 99, NFPA 110

2.20 ENGINE-GENERATOR SET CONTROLS AND INSTRUMENTATION

- A. Provide devices, wiring, remote panels, local panels, etc., installed as a complete system to automatically activate the appropriate signals and initiate the appropriate actions.
- B. Controls: local control panel with controls in accordance with NFPA 110 level 1 mounted either on or adjacent to the engine-generator set. Remote control panel with fully redundant to the local control panel.
- C. Engine-Generator Set Metering and Status Indication

1. Provide a local panel with devices in accordance with NFPA 110 level 1 mounted either on or adjacent to the engine-generator set. Provide a remote control panel with devices as indicated fully redundant to the local control panel.

2.21 PANELS

- A. Each panel of the type necessary to provide specified functions. Panels mounted on the engine-generator set base by vibration/shock absorbing type mountings. Instruments mounted flush or semi-flush. Convenient access to the back of instruments provided to facilitate maintenance. Instruments calibrated using recognized industry calibration standards. Each panel with a panel identification plate which clearly identifies the panel function as indicated. Each instrument and device on the panel provided with a plate which clearly identifies the device and its function as indicated. Panels except the remote alarm panel can be combined into a single panel.
- B. Enclosures designed for the application and environment, conforming to NEMA ICS 6, and provided with locking mechanisms which are keyed alike.
- C. Analog electrical indicating instruments in accordance with ANSI C39.1 with semi-flush mounting. Switchgear, and control-room panel-mounted instruments have 250 degree scales with an accuracy of not less than 1 percent. Unit-mounted instruments manufacturer's standard with an accuracy of not less than 2 percent. The instrument's operating temperature range minus minus 4 to plus 130 degrees F. Distorted generator output voltage waveform of a crest factor less than 5 not affect metering accuracy for phase voltages, hertz and amps.
- D. Electronic indicating instruments true RMS indicating, 100 percent solid state, microprocessor controlled to provide all specified functions. Control, logic, and function devices compatible as a system, sealed, dust and water tight, and utilize modular components with metal housings and digital instrumentation. An interface module provided to decode serial link data from the electronic panel and translate alarm, fault and status conditions to set of relay contacts. Instrument accuracy not less than 2 percent for unit mounted devices and 1 percent for control room, panel mounted devices, throughout a temperature range of minus 20 to plus 65 degrees C minus 4 to plus 130 degrees F. Data display utilize LED or back lit LCD. Additionally, the display provide indication of cycle programming and diagnostic codes for troubleshooting. Numeral height 1/2 inch.
- E. Parameter Display: Indication or readouts of the lubricating-oil pressure, ac voltmeter, ac ammeter, frequency meter, and coolant temperature.
- F. Provide exerciser and verify compatibility with automatic transfer switch.

2.22 SURGE PROTECTION

- A. Protect from, or design to withstand the effects of surges from switching and lightning on electronic components.

2.23 MANUAL ENGINE-GENERATOR SET SYSTEM OPERATION

26_32_14 DIESEL GENERATOR SET (STANDBY)

PAGE 16 OF 19

- A. Provide complete facilities for manual starting and testing of each set without load, loading and unloading of each set.

2.24 BASE

- A. Constructed of steel. Designed to rigidly support the engine-generator set, ensure permanent alignment of all rotating parts, be arranged to provide easy access to allow changing of lube-oil, and ensure that alignment will be maintained during shipping and normal operation.
- B. Construct to permit skidding in any direction during installation, withstand and mitigate the effects of synchronous vibration of the engine and generator, and Provide suitable holes for foundation anchor bolts and jacking screws for leveling.

2.25 THERMAL INSULATION

- A. Thermal insulation for mechanical systems: Class H.

2.26 PAINTING AND FINISHING

- A. Clean, prime, and paint with the manufacturer's standard colors and practices.

2.27 FACTORY INSPECTION AND TESTS

- A. Perform factory inspection and tests on each engine-generator set proposed to meet this specification section. Complete Inspections and necessary repairs prior to testing. Inspect for leaks, looseness, defects in components, and proper assembly.
- B. Factory testing: NEMA MG 1 routine tests and manufacturer's routine tests.
- C. Submit certification that each engine-generator set passed the factory tests and inspections and a list of the test and inspections.

PART 3 EXECUTION

3.01 GENERAL INSTALLATION

- A. Submit a complete copy of the manufacturer's installation procedures and a detailed description of the manufacturer's recommended break-in procedure.
- B. Configure installation of pipe, duct, conduit, and ancillary equipment to facilitate easy removal and replacement of major components and parts of the engine-generator set.
- C. Provide the services of manufacturer's representative to prepare and start system.
- D. Provide field inspection and testing in accordance NFPA 110.
- E. Provide full load test utilizing portable test bank for four hours minimum. Simulate power failure including operation of transfer switch, automatic starting cycle, and automatic shutdown and return to normal.
- F. Test alarm and shutdown circuits by simulating conditions.
- G. Emergency power within 10-seconds after power failure (or voltage/phase out of range specified).

H. Adjust generator output voltage and engine speed.

3.02 ONSITE INSPECTIONS AND TESTING

A. Submittal Requirements.

1. A detailed description of the Contractor's proposed procedures for onsite tests including the test including the test plan and a listing of equipment necessary to perform the tests.
2. A letter giving notice of the proposed dates of all onsite inspections and tests at least 14 days prior to beginning tests.
3. Two (2) copies of the onsite test data:
 - a. A description of the procedures for onsite tests.
 - b. A list of equipment used, with calibration certifications.
 - c. A copy of measurements taken, with required plots and graphs.
 - d. The date of testing.
 - e. The parameters verified.
 - f. The condition specified for the parameter.
 - g. The test results, signed and dated.
 - h. A description of all adjustments made.

B. Contractor Supplied Items.

- a. Provide all equipment and supplies required for inspections and tests including fuel, test instruments, and loadbanks at the specified power factors.

C. Sequence.

- a. sequence testing as specified in the approved testing plan unless variance in authorized by the Contracting Officer.
- b. Perform field testing in the presence of the Owner's Authorized Representative (OAR). Tests may be scheduled and sequenced in order to optimize run-time periods; however, follow the general order of testing: Construction Tests; Inspections; Safety run Tests; and Performance Tests and Final Inspection.

3.03 INSPECTIONS

1. Inspections performed jointly by the Owner's Authorized Representative (OAR) and the Manufacturer's Representative after complete installation of each engine-generator set and its associated equipment, and prior to startup of the engine-generator set.
2. Perform checks applicable to the installation. Document and submit as a letter certifying that all facilities are complete and functional, that each system is fully functional, and that each item of equipment is complete, free from damage, adjusted, and ready for beneficial use.
3. Verify that equipment type, features, accessibility, installation and condition are in accordance with the contract specification. Manufacturer certify provision of features which cannot be verified visually.

26_32_14 DIESEL GENERATOR SET (STANDBY)

PAGE 18 OF 19

3.04 SAFETY RUN TESTS

- A. Perform and record engine manufacturer's recommended prestarting checks and inspections.

3.05 PERFORMANCE TESTS

- A. Submit calculations of the engine and generator output power capability, including efficiency and parasitic load data.

3.06 AUTOMATIC OPERATION TESTS FOR STAND-ALONE OPERATION

- A. Test the automatic loading system to demonstrate automatic starting, and loading and unloading of each engine-generator set. Utilize the actual loads to be served.
- B. Perform this test for a minimum of two successive, successful tests.

3.07 ONSITE TRAINING

- A. Conduct training course for operating staff concurrent with field testing.

3.08 FINAL INSPECTION AND TESTING

- A. Start the engine, record the starting time, make and record all engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.
- B. Increase the load in steps no greater than the maximum step load increase to 100 percent of service load, and operate the engine-generator set for at least 30 minutes. Measure the vibration at the end bearings (front and back of engine, outboard end of generator in the horizontal, vertical, and axial directions. Verify that the vibration is within the same range as previous measurements and is within the required range.
- C. Remove load and shut down the engine-generator set after the recommended cool down period. Perform the pre-test inspections and take necessary corrective actions.
- D. Remove the lube oil filter and have the oil and filter examined by the engine manufacturer for excessive metal, abrasive foreign particles, etc. Verify any corrective action for effectiveness by running the engine for 4 hours at service load, then re-examining the oil and filter.
- E. Remove the fuel filter and examine the filter for trash, abrasive foreign particles, etc.
- F. Visually inspect and check engine and generator mounting bolts for tightness and visible damage.
- G. Replace air, oil, and fuel filters with new filters.

3.09 MANUFACTURER'S FIELD SERVICE

- A. Furnish a qualified representative to supervise the installation of the engine-generator-set, assist in the performance of the onsite tests, and instruct personnel as to the operational and maintenance features of the equipment.

3.10 INSTRUCTIONS

- A. Provide two sets of Manufacturer's standard Operations and Maintenance manuals.

3.11 ACCEPTANCE

- A. Final acceptance of the engine-generator set will not be given until the Contractor has successfully completed all tests and after all defects in installation material or operation have been corrected.

END OF SECTION