

Doyon Utilities
Diesel Black Start Generator
Standard Specification

May 29, 2009

Doyon Utilities
Diesel BlackStart Generator

Summary of Changes

<i>Revision Number</i>	<i>Revision Date</i>	<i>Revision Description</i>
1	2009-04-27	Initial Electrical Revision
2	2009-05-4	Added Cat Specifications
<u>3</u>	<u>2009-05-06</u>	<u>Specified ATS Manufacturer</u>

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1 General

Doyon Utilities, Alaska (“DU”) is soliciting proposals for a complete diesel generator package (“package” or “unit”). The package shall include the diesel engine, generator, control system, and any other related components. All technical specifications and other requirements for the proposed package are contained or referenced in this document.

DU desire to work closely with the manufacturer, Caterpillar (“Contractor” or “Manufacturer”) to obtain the best possible diesel standby generator package for arctic conditions. Any aspects observed by each potential supplier that may improve the project relating to the cost, performance, package content, or delivery schedule are encouraged to be presented as an option to the base proposal. All inquiries should be directed to contacts below.

It is not the intent to specify all technical requirements, including all package components, nor to set forth those requirements adequately covered by applicable codes and standards. The Contractor’s product shall meet the requirements of this specification and the applicable industry standards for the equipment use as stated in this document. In addition, all engine/generator products must be manufactured by Caterpillar in order to be acceptable to DU.

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1.1 Scope of Work

1.1.1 Work Included

The work included within this request for proposals shall include all labor and materials required to deliver one complete unit for the [REDACTED]. Unit FOB delivery location shall be [REDACTED]. The Contractor shall be responsible for all taxes, fees and costs associated with the design, manufacture, testing, procurement and delivery of the units. The Contractor shall provide all required supervision, warranty services and training presented within this specification. The intent of the specification is for the Contractor to supply one blackstart diesel engine/generator and ancillary equipment in accordance with the contract documents and drawings. All equipment shall be U/L 2200 listed and labeled, factory tested, and delivered ready for field installation.

The Contractor shall be responsible for providing on-site start-up and technical assistance during the commissioning of the unit by others.

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1.1.2 Work Not Included

The Contractor shall not be responsible for the installation at the site. The Contractor shall not be responsible for lube-oil, fuel, glycol, and other consumables related to the operation and commissioning of the package.

1.2 Approved Manufacturer

The engine and generator shall be an ISO 9001 certified Caterpillar engine/generator set.

1.3 System Configuration/Operations

The electric power generating system including engine mounted radiator shall have a site configuration of:

- _____ kW
- _____ kVA ~ 0.8 PF, Standby Rating
- _____ Volts AC, Wye connected, 3-Phase, 60 Hz
- _____ Altitude (feet)
- _____ Maximum Engine Ambient Temperature (°F)
- _____ Maximum Outside Temperature (°F)
- _____ Gallon Fuel Storage Belly Tank

Fuel for the new package will be provided on skid via manual fill cap located on the generator skid belly tank. The generator will operate on Diesel No. 2 Ultra-low Sulfur Diesel (ULSD).

This unit will be used for various blackstart purposes. Minimal operating hours for exercising and running the unit are anticipated.

1.4 Scope of Supply

All material and equipment required by this specification shall be new, commercial quality. The material and equipment shall be currently in production, supportable, and meet the applicable standards and requirements of the appropriate state and federal agencies having jurisdiction.

The package shall include, but not be limited to the following:

1.4.1 New diesel engine/generator package

- Diesel engine (prime mover)
- AC synchronous generator
- **Outdoor Arctic rated engine/generator enclosure**
- Engine/Generator skid mounting/isolation equipment
- Engine/Generator control system (see options)
- Engine/Generator control/gauge panel (see options)
- Electric starting system

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- Electronic pre-heat system such as Kim Hot Start or equivalent
- Exhaust system with remote or packaged (when providing arctic rated enclosure roof mounted silencer)
- Packaged mounted radiator
- Ancillary equipment required for the operation and maintenance of the unit
- Battery Charger shall be dual rate 10 ampere, 120VAC single phase input, 24VDC output. It shall be fused on the AC input and DC output, incorporate current limiting circuitry, and include a DC ammeter and voltmeter. The charger shall include LED annunciation for low battery voltage, high battery voltage, battery charger malfunction, and AC failure; and dry contacts for battery charger malfunction and low battery voltage. Housing shall be NEMA 1 enclosure suitable for skid or wall mounting
- Twenty-four (24VDC) volt starting batteries; sized as recommended by the generator set manufacturer to comply with the starting and temperature specifications; battery cables, and base mounted battery rack shall be provided. The batteries shall be warranted by the gen set manufacturer.
- Generator control package with Modbus TCPIP interface. At a minimum, unit alarms, amps, volts, watts, fuel, temperatures, start/stop commands must be available through the Modbus interface.
- Generator skid mounted fuel belly tank

1.4.2 *Complete package factory functional testing*

The generator shall be load tested and certified as a complete, functional system, including the engine, generator and engine/generator control. "Typical" or type function testing is not acceptable. These test and controls shall include but not be limited to:

1. Operation at rated kW
2. Operation at rated kVA
3. Transient and steady state governing
4. Transient and steady state voltage regulation
5. Operation of all alarm and shutdown devices
6. Single step load pickup of rated kW
7. Operation at 125% overspeed

1.4.3 *Commissioning equipment spares*

The Contractor shall supply all spares required to fully commission and test the unit delivered and installed at the facility.

1.4.4 *Engine specific service and diagnostic tools*

The Contractor shall supply all service and diagnostic tools required for commissioning. All such tools and diagnostic tools required for commissioning shall be left at the project site during the warranty period of the engine.

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1.4.5 *Spare parts as specified*

Contractor shall provide all recommended maintenance materials required for the first 500 hours of operation as part of the base bid for the unit.

System engineering, service manuals, drawings and other documentation shall be provided in both hard and electronic copies (3 sets each). Unit drawings (electrical, mechanical, and structural) shall be specific to the unit being provided. Like, similar, or general unit schematics are not acceptable. General lunit drawings which have been marked to identify the exact components, configuration, and wiring are acceptable.

Contractor shall assist in the development of unit control interface, heat exchange interface and other interfaces that may be required to develop and install a fully functional installation.

1.4.6 *Warranty*

The Contractor shall provide terms and conditions of warranty. Warranty shall explicitly outline service provided, the location service will be provided from and any and all costs associated with travel and in/out charges of the warranty.

1.4.7 *Packaging of equipment for shipment*

Contractor shall be responsible for packaging of all equipment for overseas transportation. Contractor shall be responsible for damage due to improper packaging to the final installation site.

1.4.8 *Transportation to delivery location*

The contractor shall be responsible for all transportation to the facility. Final movement of the package to the station and setting the unit in its final resting place will be by others. Contractor shall be responsible for inspecting the final installation prior to commissioning and acceptance.

1.4.9 *Onsite startup, commissioning, and performance testing*

Contractor shall provide all start-up, commissioning and performance testing required to ensure the engine/generator meets the guaranteed performance specifications of the proposal. To the extent that metering, monitoring or other equipment is available during testing and commissioning, Contractor shall be afforded use of such equipment to complete these tests/commissioning procedures provided that the equipment has current calibration documentation from a certified testing laboratory. All test equipment shall be accurate. Testing contractor shall provide current calibration documentation from a certified testing lab for all testing equipment.

1.5 *Codes and Standards*

The package shall be manufactured in accordance with, but not limited to, the codes and standards found in the Appendix. This includes all amendments and revisions in effect at time of the Contract.

These codes and standards set forth minimum requirements necessary to assure satisfactory performance of the Contractor's package. Other internationally recognized

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codes and standards will be acceptable provided they meet or exceed the requirements of the listed codes and standards. It is the responsibility of the Contractor to demonstrate to the satisfaction of the Owner that any alternate codes and standards meet or exceed the requirements of the codes and standards listed.

In the event of any conflict between codes, standards, and this specification, the Contractor shall refer the conflict to DU for written resolution before start of design.

The Contractor shall provide a list of codes and standards used for the manufacture of the Contractor's package in effect at the time of the Contract.

All materials and equipment supplied under this specification shall meet the requirements of all Federal, State, and Local Statutes. All material and equipment shall be listed and/or labeled by a recognized and qualified testing laboratory approved by the authority having jurisdiction.

1.6 Package Design Criteria

In all respects, the equipment shall incorporate the highest quality of modern engineering, design and workmanship. It is not the intent to specify all details of design and construction therefore; the equipment shall be fabricated and equipped with accessories in accordance with industry standard practices when such practices do not conflict with this specification or are not specifically addressed in this specification.

All equipment, including auxiliaries, covered by this specification shall be designed and constructed for continuous power service for a minimum service life of twenty (20) years.

The package supplier shall assume responsibility for the engineering coordination of the equipment and all auxiliary systems included in the scope of the Contract.

General package design criteria includes:

- The package must produce [REDACTED] kWe net dependable power at site conditions for standby operations.
- The package must comply with applicable emission standards under 40 CFR 60 Subpart IIII Standards of Performance for Compression Ignition Internal Combustion Engines.
- The generator/engine package shall be installed within a weather proof arctic rated enclosure. Minimum wall, roof, and floor insulation rating shall be R-38. The enclosure shall include the necessary accessories to provide adequate cooling and combustion air for the unit's proper operation.
- The Artic Pak shall be designed to operate at temperatures ranging from -65 degrees to +95 degrees without a degradation in the performance of the unit.
- The package shall include a complete control and monitoring system for both the mechanical and electrical systems. The control system must be able to interface with the station SCADA system.
- The cooling of the engine shall be by use of packaged mounted radiator(s).
- The package shall include an exhaust system with a remote mounted silencer, piping adapters, flex connectors, and other equipment as required. Silencer shall be provided with a minimum 2" of calcium silicate insulation with an aluminum jacket.

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- The packaged unit shall be pre-heat utilizing an engine mounted electric immersion heater type pre-heat system.
- Unit shall be provided with a crank case ventilator system which removes oil mist from the unit crank case vent and returns it to unit oil pan.

1.7 Proposal Requirements

All proposals must be submitted with the specified information requested in this RFP. All exceptions to the specifications and requirements contained in this RFP must be clearly communicated in the proposal. The proposals must be delivered to the contact person listed in this RFP and are due by [REDACTED]. Electronic (Microsoft Word or Adobe PDF) or hardcopy formats will be accepted.

Provide a listing of major components to be supplied with the package, including manufacturer and part number.

The additional qualification information submittals shall meet the following:

- 50 pages maximum. All printed pages count. Single sided pages count as one page and double-sided pages count as two pages.
- Front and back covers do not count
- Dividers do not count
- Cover letter if included
- Description of firm's qualifications and experience
- List of RFP exceptions
- Supplemental material if included

The additional qualification information package should include and describe the following as appropriate:

- A brief statement not to exceed two pages, citing up to ten specific reasons why your firm is best suited for the project.
- Management, engineering, supervision, equipment, "Quality Assurance" and manpower resources, insurance, and financial capability to undertake the project.
- Experience on similar type of project and description of past similar projects.
- Include preliminary drawings and technical description of the unit.
- Include emission and fuel rate consumption requested in the RFP
- Cost of spare parts for the first 24 months of standby operation
- Location and qualifications of nearest service center.
- Hourly cost of service personnel from Anchorage to facility location

1.8 Proposal Evaluation

Award shall be made to the responsible offeror whose proposal is determined to be the most advantageous to the Owner. The total package price and fuel efficiency are the primary evaluation factors. Emission rates, completeness of information provided in the

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RFP process, detail and clarity of qualifications, past experiences in this type of work, and other factors set forth in the submitted information will also be taken into consideration.

DU reserves the right to reject any proposal that does not meet the requirements of this RFP. Further, DU reserves the right to reject all proposals if the status of this project changes.

After evaluation, selection, negotiation and award, the Manufacturer shall be required to execute a contract with the Owner for the work.

2 Mechanical Requirements

2.1 General

The unit shall meet the following general requirements:

- Consist of a diesel engine directly coupled to a generator mounted on a common steel base. The steel base, including isolation pads, shall be designed to meet local seismic design conditions.
- Except as otherwise specified, all auxiliary equipment shall be unit/package mounted. Exception to this is the remote mounted exhaust silencer.
- All interconnecting piping and wiring, for equipment mounted within the package, shall be shop installed. Auxiliary equipment to be mounted outside of the package shall be shipped loose for installation after the packages arrival onsite by others. All items to be installed by others external to the module should be clearly defined in the response to the RFP.
- Delivered complete with all auxiliary equipment required to operate the unit locally.
- Designed for indoor installation
- The rating of the unit shall meet the load ratings specified. The Contractor shall verify that the unit rating is suitable for the loads indicated for the specified ambient conditions and site elevation.
- Ratings and performance guarantees shall include all parasitic loads for pumps and other auxiliary equipment.
- All couplings shall be guarded.
- All transformers, motor starters, and electrical control equipment required for operation of the unit as specified shall be furnished, installed, and wired.
- All piping and valves shall be designed, fabricated and tested in accordance with the requirements of ASME and NFPA Standards.
- The engine shall start and be available for loading within 2 minutes (or less) after initiation of a start command.
- When not in service, the engine shall be kept in a warm condition. The engine shall be capable of starting from the warm condition and of operating for a minimum of five minutes under load without AC power available for motor driven auxiliaries.
- An electric generator starting system shall be installed on engine and attached within the package. Refer to electrical for starting system electrical requirements.

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- All mechanical pipe connections shall be provided with mating flanges or meet the requirements of ANSI B16.5, Class 150, raised face requirements. Non-standard pipe sizes shall be provided with transitions to standard pipe sized in addition to mating/ANSI flange requirements. Non-standard pipe sizes include 2-1/2", 3-1/2", and 5".

2.2 Engine

2.2.1 General

- The engine shall be a turbo-charged diesel engine.
- The engine shall be furnished with all accessories required for a complete package and shall be the manufacturer's standard for this service.
- Normal operating speed shall not be greater than 1800 RPM.
- The engine shall be manufactured to operate on Diesel No. 1 and 2 ultra low sulfur diesel ("ULSD").

2.2.2 Engine Mounted Auxiliary Equipment

All auxiliary equipment (i.e., fuel, water, oil) provided in this set shall be engine mounted and/or gear driven (as required), unless otherwise specified, for maximum reliability and safety. These may include, but not limited to:

- Engine driven Jacket water pump(s)
- Engine driven after-cooler pump(s)
- Engine cooling water thermostatic control valve
- After-cooling circuit thermostatic control valve
- Lube oil system pump(s)
- Lube oil strainer/filter assembly
- Lube oil sump
- Crankcase explosion pressure relief system
- Fuel oil pump(s)
- Fuel oil filter,
- Turbocharger
- Turbocharger lube oil filter
- Turbocharger priming/post lube oil system including pump, filter and controls

2.2.3 Auxiliary Equipment

Additional auxiliary support equipment shall be mounted within the package. Interconnection to other equipment, including radiators and exhaust silencer shall be completed by others. All equipment is to be installed in and accessible and easily

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serviceable location within the package. This equipment shall include, at a minimum, the following components:

- Engine lube oil cooler
- Thermometers for cooling water and lube oil inlet and outlet temperatures
- Alarm sensors for high cooling water and high lube oil temperature to be used for alarm/shutdown signals to engine control panel
- Complete lube oil, fuel oil and water piping between all devices and the engine
- Any other equipment required by unit manufacturer for its successful operation.

2.3 Cooling System

The unit shall be provided with one packaged mounted engine cooling radiator, radiator assembly, and support structure for installation indoors in a engine generator room. The cooling system shall include the following properties and components:

- The radiator shall be manufacturer standard, vertical, corrosion resistant coated core unit.
- The structure of the radiator assembly shall be designed to meet the environmental conditions to which it will be subjected.
- The system shall be cooled by an engine drive, direct or belt drive, fan.
- The system shall be equipped with a surge/expansion tank, fan and core guards, and shall be designed to allow proper cooling of the engine at the specific jobsite conditions.
- Packaged radiator shall be provided with a duct attachment flange. Radiator shall be provided with duct attachment/mounting flange . Ducts /louver/dampers required for conveying cooling air to, from, and around the unit will be provided by others. Radiator shall be supplied with an expansion tank sized for the correct unit operation.
- The packaged unit shall be pre-heated utilizing an engine mounted electric immersion heater pre-heat system. System shall be Kim Hot Start or manufacturer standard. System shall be installed by the contractor

2.4 Lubrication System

The lubrication system shall provide a positive pressure lubrication system for the engine. The system shall include the following properties and components (when required by engine manufacturer):

- Engine driven oil pump, system pressure regulator, oil sump, full flow oil filter, lube oil cooler, pressure and temperature switches, and indicators.
- The lube oil cooler shall be designed to utilize the engine coolant as the cooling medium.
- The oil cooler shall be mounted on the unit base and completely interconnected to the engine systems.
- In addition to the AC pre-lube/circulation pump(s) provided, DC motor driven pre-lube oil pump shall be provided for black start capability.

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- Oil sampling port (dipstick)

2.5 Fuel System

The package shall be provided with an integral double wall skid mounted “belly” tank.

Fuel cooling, if required, shall consist of a package mounted radiator core. The radiator core may be integral to the engine cooling water radiator system.

2.6 Intake/Exhaust System

The intake/exhaust system shall include the following properties and components:

- The Contractor shall provide a dry type intake filter and silencer with intake piping of adequate size to prevent excessive pressure drop. The filter/silencer assembly shall be designed to draw either outside air or air from within the package.
- The Contractor shall provide the proper expansion joints for connection of the air inlet filter to the engine air intake.
- The Contractor shall provide a **standard or critical** grade exhaust silencer designed for use with the engine furnished. The silencer will be designed to be mounted inside and remotely mounted within the generator room. The silencer shall also be provided with a low point drain and isolation valve. Silencer shall be insulated with a minimum of 3 inches calcium silicate insulation with an aluminum protective shell. Silencer connections shall be manufacturer standard.
- The package shall include an exhaust system with a remote or packaged (if unit provided in arctic rated enclosure) roof mounted silencer, piping adapters, flex connectors, and other equipment as required. Silencer shall be provided with a minimum 2” of calcium silicate insulation with an aluminum jacket.
- At a minimum, the Contractor shall provide one or more as required, stainless steel flexible connector(s) to allow for expansion and vibration of the exhaust piping without chafing or stress to the engine mounted exhaust turbo(s).
- The Contractor shall provide mounting detail drawings submitted for approval by the Owner.

2.7 Structural

The base and mounting system shall include the following properties and components:

- The package shall be mounted and shipped to the job site on a structural steel sub-base. The Contractor shall supply all vibration pads, sole plates/sub-sole plates and shims for installation of the common steel base on the foundation. Provision for crane unloading of the complete unit shall be designed into the base of the unit.

Contractor as part of the proposal shall provide information/recommendations as to the package foundation design requirements.

- The completely assembled unit weight consisting of engine, generator, radiator (loose or as part of package), base, and all other specified items including all liquids (i.e., fuel oil, lube oil, and cooling water) shall be calculated by the manufacturer. The base of the unit shall be engineered, designed, and manufactured as a heavy-duty, welded steel construction with four point lifting provisions. Details and

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manufacturer's certification of the base construction shall be included with the drawings submitted for approval by the Owner.

- Provide unit with spreader-bar lifting device for picking unit with crane. Provide maximum shipping weight for each module (generator/engine, auxiliary skid, radiators, etc.).
- The skid base shall contain all leaks and spills from the engine, generator, and auxiliary systems. Drains shall be piped to a common drain system.
- The system shall be designed and certified for the seismic area in which the unit will be installed, according to the IBC (current version). As a critical facility, the Fort Wainwright substation is deemed to have an importance factor of 1.5.

The vibration system requirements shall include the following properties and components:

- Harmful vibration stresses shall not occur during acceleration, deceleration and at rated speed.
- Harmful torsional vibration stresses shall not occur within a range from 10 percent below rated idle speed and from 5 percent above to 5 percent below rated synchronous speed.
- Vibration isolators (spring type), in addition to, skid/generator mounting rubber isolators.

Moving parts shall be designed to withstand, without damage, the level of overspeed that is caused by the following:

- Full short-time load rejection; plus margin to allow the overspeed device to be set sufficiently high to guarantee that the unit will not trip on full load rejection.
- As a minimum, the engine, generator, exciter, and flywheel shall be designed to withstand an overspeed of 25 percent without damage.

3 Electrical Requirements

3.1 Generator

The generator shall include the following properties and components:

- The unit shall include a four wire, synchronous grounded WYE-connected generator designed to be direct coupled to the engine and to provide power at (120/208, 277/480) V.
- The unit must produce a minimum of [REDACTED] kWe net dependable power at site conditions, standby operation. It is anticipated that the unit will run a maximum 500 hours per year for duration of normal power interruptions.
- The Arctic Pak shall contain all station service electrical distribution from the 480 V bus such that no external station service connections or power are required by others, other than the connection to the 480 V step-up transformer.
- Ground fault current sensing transformer (CT) for over 1000A rating.

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- Phase current sensing transformers (Three Phases).
- The generator system shall be protected against surges.
- The generator shall conform in all aspects to NEMA standards for synchronous generators. The generator and exciter shall be provided suitable for installation indoors.
- The generator and excitation system must be capable of providing the full electrical power rating of the engine at 0.8 P.F.
- The generator shall include an Automatic Transfer Switch (ATS), as specified under separate section, which can provide both blackstart and paralleling operation automatically or manually.
- Rotor and stator windings shall be vacuum pressure impregnated with epoxy based material. All insulating material such as blocks, wedges, ties, leads, etc. shall be selected to produce a minimum Class H (130°C rise by resistance over 40°C ambient), non-hygroscopic, insulation system. The generator shall be sized such that full load operation produces no greater than a Class F (130°C rise by resistance over 40°C ambient) temperature rise. The insulation system shall be sealed in accordance with the requirements of NEMA MG 1 standards for humidity and wash down.
- The generator bearings shall be of adequate size, with suitable grease lubrication. One bearing shall be insulated to prevent flow of induced electric current through shaft and bearing. Generator direction of rotation shall be marked on the bearing end cover. Provide one RTD for each bearing to monitor bearing temperature via the control system.
- The stator frame shall be electrically connected to the unit's skid. Suitable bolts shall be provided at not less than four points for adjusting the frame in a horizontal plane. Dowel pins shall be provided to prevent stator frame from shifting. Stator windings shall be bar or form type. Slots shall be fully open and with end turns effectively braced against distortion and movement during short circuit and large motor starting. Winding shall be wye connected and phase rotation shall be clearly marked on the nameplate.
- A complete space heater control system shall be furnished as an integral part of the generator unit. The space heater control system shall include an interlock with the generator unit so that the heaters are de-energized at all times when the generator is energized. Space heaters shall also be controlled by an adjustable indicating thermostat, factory set to close on falling temperature at 85°F (30°C) (ON) and open on rising temperature at 93°F (34°C) (OFF).

3.2 Generator Breaker

The generator breaker shall be 3-pole, main line circuit breaker provided to protect the generator against external faults and provide a positive disconnect device at the generator output terminals. The breaker shall be UL listed with shunt trip device connected to engine / generator safety shutdowns. The breaker shall be mounted [RH] or [LH] on the generator in a NEMA 1P22 guarded dripproof enclosure which provides direct access for cable from the top or bottom.

3.3 Exciter

The exciter shall be of the rotating brushless type. The voltage regulator shall have over-excitation and under-excitation protection and field forcing, and shall be a standard Basler production model or approved equivalent. The exciter capacity shall be sufficient for operating the generator at rated voltage and kVA without exceeding the specified total "hot spot" temperature. The AC exciter frame shall be mounted on the generator frame. The AC exciter rotor and the rectifier bridge assembly shall be mounted on the generator shaft. All rectifier diodes shall be metallic, hermetically sealed, silicon type, and conservatively rated for long life. Diodes shall be mounted on heat sinks to effectively dissipate diode heat. A surge suppressor shall be connected across the rectifier bridge output to protect the diodes from transient surge voltage. The ceiling voltage of the exciter shall be selected to fulfill voltage drop requirements as specified herein.

A 3 phase permanent magnet (PMG) generator shall provide the source of excitation to the exciter to increase immunity to non-linear loads and to maintain 300% of rated current for 10 seconds during shortcircuit conditions.

3.4 Current Transformers

Generator current transformers shall be window type, with 5A secondary windings and with a primary rating which is the nearest ANSI standard above that which corresponds to 115 percent of rated generator current. Ratio and phase angle correction curves or secondary excitation curves shall be furnished for each current transformer as applicable.

3.5 General

Terminal boxes shall be provided for the generator main leads, exciter leads, and for control and instrumentation leads. Terminal blocks shall be provided for all motor power circuits, space heater circuits, monitoring and control circuits, current transformers, and protective relay circuits. All wiring and raceway required between devices mounted within or on the unit base shall be shop installed.

Each end of the unit shall be supplied with one NEMA 2-hole brass or stainless steel contact surface and ground conductor clamp for connection of an Owner supplied ground cable.

No electrical equipment other than rigid conduit shall be located less than 12 inches (305 mm) above the bottom of the skid.

AC power required for operation of skid mounted, auxiliary motors and loads shall be provided by Contractor from auxiliary transformers provided from the Owner provided station service.

DC motors shall be shunt or compound wound and shall be furnished with starters.

4 Automatic Transfer Switch (ATS)

Furnish the automatic transfer switch to automatically transfer between the normal and emergency power source. The transfer switch shall be supplied as part of the engine/generator package for system responsibility.

4.1 APPLICABLE STANDARDS

The automatic transfer switches covered by these specifications shall be designed, tested, and assembled in strict accordance with all applicable standards of ANSI, U.L., IEEE and NEMA.

4.2 SUBMITTALS

Manufacturer shall submit shop drawings for review, which shall include the following, as a minimum:

1. Descriptive literature
2. Plan, elevation, side, and front view arrangement drawings, including overall dimension, weights and clearances, as well as mounting or anchoring requirements and conduit entrance locations.
3. Schematic diagrams.
4. Wiring diagrams.
5. Accessory list.

4.3 ACCEPTABLE MANUFACTURERS

- A. Caterpillar

4.4 CONSTRUCTION

General

1. The automatic transfer switch shall be furnished as shown on the drawings. Voltage and continuous current ratings and number of poles shall be as shown.
2. On 3 phase, 4 wire systems exceeding 1,000A, utilizing ground fault protection, a true 4 pole switch shall be supplied with all four poles mounted on a common shaft. The continuous current rating and the closing and withstand rating of the fourth pole shall be identical to the rating of the main poles.
3. When a solid neutral is required, a fully rated bus bar with required AL-CU neutral lugs shall be provided.
4. The transfer switch shall be mounted in a NEMA 1 enclosure, unless otherwise indicated. Enclosures shall be fabricated from 12 gauge steel.
5. The enclosure shall be sized to exceed minimum wire bending space required by UL 1008.
6. The transfer switch shall be equipped with an internal welded steel pocket, housing an operations and maintenance manual.
7. The transfer switch shall be top and bottom accessible.
8. The main contacts shall be capable of being replaced without removing the main power cables.
9. The main contacts shall be visible for inspection without any major disassembly of the transfer switch.
10. All bolted bus connections shall have Belleville compression type washers.

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11. Control components and wiring shall be front accessible. All control wires shall be multiconductor 18 gauge 600 volt SIS switchboard type point to point harness. All control wire terminations shall be identified with tubular sleeve-type markers.
12. The switch shall be equipped with 90 degrees C rated copper/aluminum solderless mechanical type lugs.
13. The complete transfer switch assembly shall be factory tested to ensure proper operation and compliance with the specification requirements. A copy of the factory test report shall be available upon request.

Automatic Transfer Switch (ATS)

The ATS shall transfer the load without interruption (closed transition) by momentarily connecting both sources of power only when both sources are present and acceptable. The maximum interconnection time is 100 milliseconds. The ATS shall operate as a conventional break-before-make (open transition) switch when the power source serving the load fails.

1. The transfer switch shall be electrically operated and mechanically held. The electrical operator shall be a momentarily energized, solenoid mechanism. Main operators which include overcurrent disconnect devices, linear motors or gears shall not be acceptable.
2. The transfer switch shall be equipped with a safe load break external manual operator, designed to prevent injury to operating personnel. The manual operator shall provide the same contact to contact transfer speed as the electrical operator to prevent a flashover from switching the main contacts slowly. The external manual operator shall be safely operated from outside of the transfer switch enclosure while the enclosure door is closed.

Automatic Transfer Switch Controls

1. The transfer switch shall be equipped with a microprocessor based control system, to provide all the operational functions of the automatic transfer switch. The controller shall have two asynchronous serial ports. The controller shall have a real time clock with Nicad battery back-up.
2. The CPU shall be equipped with self diagnostics which perform periodic checks of the memory I/O and communication circuits, with a watchdog/power fail circuit 3. The controller shall use industry standard open architecture communication protocol for high speed serial communications via multidrop connection to other controllers and to a master terminal with up to 4000 ft of cable, or further, with the addition of a communication repeater. The serial communication port shall be RS422/485 compatible.
3. The serial communication port shall allow interface to either the manufacturer's or the owner's furnished remote supervisory control.
4. The controller shall have password protection required to limit access to qualified and authorized personnel.
5. The controller shall include a 20 character, LCD display, with a keypad, which allows access to the system.

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6. The controller shall include three phase over/under voltage, over/under frequency, phase sequence detection and phase differential monitoring on both normal and emergency sources.
7. The controller shall be capable of storing the following records in memory for access either locally or remotely:
 - a. Number of hours transfer switch is in the emergency position (total since record reset).
 - b. Number of hours emergency power is available (total since record reset).
 - c. Total transfer in either direction (total since record reset).
 - d. Date, time, and description of the last four source failures.
 - e. Date of the last exercise period.
 - f. Date of record reset.

Sequence of Operation

1. When the voltage on any phase of the normal source drops below 80% or increases to 120%, or frequency drops below 90%, or increase to 110%, or 20% voltage differential between phases occurs, after a programmable time delay period of 0-9999 seconds factory set at 3 seconds to allow for momentary dips, the engine starting contacts shall close to start the generating plant.
2. The transfer switch shall transfer to emergency when the generating plant has reached specified voltage and frequency on all phases.
3. After restoration of normal power on all phases to a preset value of at least 90% to 110% of rated voltage, and at least 95% to 105% of rated frequency, and voltage differential is below 20%, an adjustable time delay period of 0-9999 seconds (factory set at 300 seconds) shall delay retransfer to allow stabilization of normal power. If the emergency power source should fail during this time delay period, the switch shall automatically return to the normal source.
4. After retransfer to normal, the engine generator shall be allowed to operate at no load for a programmable period of 0-9999 seconds, factory set at 300 seconds.

Automatic Transfer Switch Accessories

1. Programmable three phase sensing of the normal source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout out at 110% of rated voltage. Programmable frequency pickup at 95% and dropout at 90% and over frequency to pickup at 110% and dropout at 105% of rated frequency. Programmable voltage differential between phases, set at 20%, and phase sequence monitoring.
2. Programmable three phase sensing of the emergency source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout out at 110% of rated voltage programmable frequency pickup at 95% and dropout at 90% and over frequency to pickup at 110% and dropout at 105% of rated frequency. Programmable voltage differential between phases set at 20%, and phase sequence monitoring.
3. Time delay for override of momentary normal source power outages (delays engine start signal and transfer switch operation). Programmable 0-9999 seconds. Factory set at 3 seconds, if not otherwise specified. 4. Time delay to control contact transition

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time on transfer to either source. Programmable 0-9999 seconds, factory set at 3 seconds.

4. Time delay on retransfer to normal, programmable 0-9999 seconds, factory set at 300 seconds if not otherwise specified, with overrun to provide programmable 0-9999 second time delay, factory set at 300 seconds, unloaded engine operation after retransfer to normal.
5. Time delay on transfer to emergency, programmable 0-9999 seconds, factory set at 3 seconds.
6. A maintained type load test switch shall be included to simulate a normal power failure, keypad initiated.
7. A remote type load test switch shall be included to simulate a normal power failure, remote switch initiated.
8. A time delay bypass on retransfer to normal shall be included. Keypad initiated.
9. Contact, rated 10 Amps 30 volts DC, to close on failure of normal source to initiate engine starting.
10. Contact, rated 10 Amps 30 volts DC, to open on failure of normal source for customer functions.
11. Light emitting diodes shall be mounted on the microprocessor panel to indicate switch is in normal position, switch is in emergency position and controller is running.
12. A plant exerciser shall be provided with (10) 7 day events, programmable for any day of the week and (24) calendar events, programmable for any month/day, to automatically exercise generating plant programmable in one minute increments. Also include selection of either "no load" (switch will not transfer) or "load" (switch will transfer) exercise period. Keypad initiated.
13. Provision to select either "no commit" or "commit" to transfer operation in the event of a normal power failure shall be included. In the "no commit position," the load will transfer to the emergency position unless normal power returns before the emergency source has reach 90% of it's rated values (switch will remain in normal). In the "commit position" the load will transfer to the emergency position after any normal power failure. Keypad initiated.
14. Two auxiliary contacts rated 10 Amp, 120 volts AC (for switches 100 to 800 amps) 15 amp, 120 volts AC (for switches 1000 to 4000 amps), shall be mounted on the main shaft, one closed on normal, the other closed on emergency. Both contacts will be wired to a terminal strip for ease of customer connections.
15. 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.
16. A digital LCD frequency readout with 1% accuracy shall display frequency for both normal and emergency source.
17. An LCD readout shall display normal source and emergency source availability.
18. Include (2) time delay contacts that open simultaneously prior to transfer in either direction. These contacts close after a time delay upon transfer. Programmable 0-9999 seconds after transfer.

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19. Two position selector to provide either automatic or manual retransfer operation (with pushbutton).

Approval

1. As a condition of approval, the manufacturer of the automatic transfer switches shall verify that their switches are listed by Underwriters Laboratories, Inc., Standard UL-1008 with 3 cycle short circuit closing and withstand as follows:

RMS Symmetrical Amperes 480 VAC

Current Limiting

Amperes Closing and Withstand Fuse Rating

100-400 42,000 200,000

600-800 65,000 200,000

1000-1200 85,000 200,000

1600-4000 100,000 200,000

2. During the 3 cycle closing and withstand tests, there shall be no contact welding or damage. The 3 cycle tests shall be performed without the use of current limiting fuses. The test shall verify that contacts separation has not occurred, and there is contact continuity across all phases. Test procedures shall be in accordance with UL-1008, and testing shall be certified by Underwriters' Laboratories, Inc.
3. When conducting temperature rise tests to UL-1008, the manufacture shall include post-endurance temperature rise tests to verify the ability of the transfer switch to carry full rated current after completing the overload and endurance tests.
4. The microprocessor controller shall meet the following requirements:
 - Storage conditions - 25 degrees C to 85 degrees C
 - Operation conditions - 20 degrees C to 70 degrees C ambient
 - Humidity 0 to 99% relative humidity, noncondensing
 - Capable of withstanding infinite power interruptions
 - Surge withstand per ANSI/IEEE C-37.90A-1978
5. Manufacturer shall provide copies of test reports upon request.

Manufacturer

1. The transfer switch manufacturer shall employ a nationwide factory-direct, field service organization, available on a 24-hour a day, 365 days a year, call basis.
2. The manufacture shall include an 800 telephone number, for field service contact, affixed to each enclosure.
3. The manufacturer shall maintain records of each transfer switch, by serial number, for a minimum 20 years.

4.5 INSTALLATION

Automatic Transfer Switches shall be provided with adequate lifting means for ease of installation of wall or floor mounted enclosures by others.

4.6 ADJUSTMENTS

Tighten assembled bolted connections with appropriate tools to manufacturer's torque recommendations prior to first energization.

5 Controls & Instrumentation Requirements

5.1 General

The unit shall be designed and equipped for automatic unattended operation as well as local manual control. It shall be equipped with all necessary instrumentation to provide adequate surveillance of the unit in all operating conditions. The package shall be able to operate as a component in the control system without the need for any additional equipment, control parameters, or operating procedures.

All critical functions including engine generator starting, control and shutdown shall be provided from the skid mounted 24 VDC or manufacturer standard system. Mounting adjacent to the unit and on the slab shall be considered equivalent to skid mounting for the engine control/starting system. If skid mounted, sufficient vibration control/damping shall be utilized so as to not subject the controls to engine vibrations.

Protective controls shall be provided to initiate a unit shutdown for any condition that, if unit operation continued, would result in damage to the engine or generator.

The control system furnished by the Contractor shall conform to the general requirements of this section as to functional control, but shall include all additional controls required by the Contractor to ensure safe and reliable operation of the diesel engine-generator unit.

- When the engine is shut down and the control switch is in the "OFF" position, an alarm shall be sent from the switch to the remote monitoring system, and the engine shall be incapable of starting either manually or automatically.
- When the engine is shut down and the control switch is in the "LOCAL" position, the unit shall be capable of manual starting.
- When the engine is shut down and the control switch is in the "REMOTE" position, the Owner's start signal shall start, warm up, and accelerate the unit to normal speed and either manually or automatically transfer the generator to the station service loads through an ATS. Under black start conditions, the Owner's start signal shall start and accelerate the unit to normal speed and automatically close the ATS. In "AUTO" the unit shall accept the load applied to it up to the continuous rating and shall automatically control the voltage and frequency during loading and unloading.
- The unit controls shall have both a normal unload, as well as an emergency stop (E-Stop) unload, as defined by the contractor. The normal and E-Stop unload procedures shall be provided to the Owner as a submittal for approval.

5.2 Speed & Excitation Systems

The speed and excitation control systems shall be designed to permit the operation of the unit without exceeding the active and reactive power limitations of the engine and generator.

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A standard Basler automatic voltage regulator ("AVR") shall be provided for controlling the exciter field current. The AVR shall receive its voltage sensing input from the generator potential transformers. The AVR shall include provision for the protection of the generator against underexcitation (excessive negative reactive), overexcitation (excessive field current) and saturation (excessive volts per hertz).

An overspeed shutdown device, operating independently of the governor, shall be provided. This device shall operate in both the manual and automatic modes of operation of the unit.

These systems shall be designed to maintain the frequency and voltage within the stated limits for the following loading conditions:

- Frequency regulation shall be Isochronous, regulated to within +/- 0.25 % from no load to full load.
- Voltage regulation shall be +/- 0.5% for any steady state load between no load and full load.
- At no time during any loading sequence shall the voltage fall below 90 percent of rated or the frequency fall below 95 percent of rated. The time interval for voltage to be restored to 95 percent of rated and the frequency to at least 98 percent of rated shall be provided and guaranteed by the Contractor.
- Rejection of the total load shall not cause an overspeed trip, nor shall rejection of the largest single load, when the unit is carrying the maximum load, cause a speed rise in excess of the lower of 15 % of rated speed or 75% of the difference between the overspeed trip set point and rated speed.

5.3 Control Panel

A local control panel is to be provided containing, at a minimum, the engine indication and controls listed below and required by the manufacturer and current or anticipated safety regulations.

The unit control panel shall be capable of communication with HMI or other PLC devices utilizing the following communications protocols:

- MODBUS-TCP

The unit control panel shall at a minimum contain the following:

- Engine control selection switch with three positions and escutcheon marked "OFF-REMOTE-LOCAL".
- Engine control switch with three position, spring return to center, with escutcheon marked "STOP (Blank) START". Two indicating lights shall be provided with this control switch.
- Emergency engine shutdown switch.
- Indicating lights provided shall utilize multiple LEDs for illumination.

5.3.1 Alarms

Alarm devices shall be provided for all abnormal conditions that may endanger the unit or prevent its starting or running satisfactorily. Alarm contacts shall be rated 125V DC, 5A make and carry or 0.5A non-inductive interrupting duty.

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Other miscellaneous alarms, as required for safe operation and as required by the design, shall be provided. All alarms shall be provided for use by the Owner's SCADA system.

The alarms that will cause nuisance alarming during known system operating conditions, such as system startup and shutdown, shall be interlocked to avoid these nuisance alarms. The means of interlocking shall be acceptable to the Owner.

Conditions alarmed for the unit shall include, but not be limited to, the following:

- Coolant water temperature low
- Coolant water level low
- Coolant water temperature high
- Engine over-speed
- Start failure
- Lube oil pressure low
- Lube oil temperature high
- Lube oil level low
- Engine crankcase pressure high
- Low starting air pressure
- Battery charger trouble (high and low voltage)
- Emergency stop
- Cylinder temperature high
- Turbo air temperature high
- Turbo air pressure high
- Day tank level hi/low
- Bearing temperature high
- Stator temperature high
- Fuel filter differential pressure high
- Oil filter differential pressure high

5.4 Indication Panel

5.4.1 Engine

Indicators shall be mounted on the control panel insert. All pressure devices (pressure gauges, switches, etc.) on the system shall be provided with root shutoff valves to allow isolation of the device from the system with the engine running, and to allow calibration and/or testing of the device while in place. Temperature devices shall wherever possible be installed in thermowells to enable removal and

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replacement without draining the fluid system. The following devices shall be provided as a minimum:

- Lube oil pressure at engine inlet
- Lube Oil Temperature, inlet and outlet
- Jacket water temperature, inlet and outlet
- After-cooler Water temperature inlet and outlet
- Fuel oil tank level (located on tank)
- Engine speed
- Intake manifold or boost air pressure
- Air filter differential pressure
- Individual cylinder temperatures
- Oil and fuel filter differential pressures
- Turbo air pressure and temperature

5.4.2 *Generator*

The following indicators shall be provided on the control panel in addition to those indicated elsewhere. Multifunction indicating meters are acceptable.

- A - Generator AC ammeter, 3 phase
- V - Generator AC voltmeter, 3 phase
- W, WH, VAR - Watt, Watthour, and VAR meters, 2 element, 3 phase, 3 wire
- F - Frequency meter

5.5 *Instrumentation*

Instrumentation and Control:

- Instrumentation selected shall be suitable for the application. Process fluid corrosion effects, pressure surges, and ambient temperature ranges (winterization) shall be considered in material and housing selection so as to provide safe design margin.
- Instrumentation furnished shall be mounted and piped and shall include accessories such as drain and isolation valves.
- Pressure, level and temperature switches shall be manufacturer's standard and acceptable to the Owner.
- All interconnecting instrument tubing shall be furnished and pre-piped.
- Instrument tubing, valves, and fittings shall be stainless steel, Swagelok or equal as acceptable to the Owner.
- Swagelok isolation valves shall be provided at each instrumentation device to allow for maintenance and replacement of these devices without interrupting the operation of the package.

Thermal Detectors:

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- All temperature detectors shall be ungrounded with detector leads wired to terminal blocks furnished in the accessory terminal housing or to terminals furnished in the bearing detector heads or condulets. A grounding terminal for each temperature detector shall be included with the detector lead terminals. The grounding terminals shall be provided with internal wiring to a common ground connection in each terminal box, head, or condulet. The internal wiring shall be removable.
- Resistance type temperature detectors shall be platinum, 100 ohms at 0°C. Detectors shall be non-inductively wound, annealed after winding to ensure accuracy and stability, and be insensitive to vibration and strain. Each detector shall be furnished with three leads.
- Two resistance type temperature detectors per phase shall be furnished for the generator windings. All detectors shall be wired out to terminal blocks. Temperature detector and detector lead insulation class shall be the same as the stator coil insulation class. Detector leads shall be provided with protective brass interlocked spiral armor external to the slot.

6 Miscellaneous Requirements

6.1 Environmental

6.1.1 Location

The unit will be located at _____, approximately _____ road miles from Anchorage/Fairbanks, Alaska. Ambient Air temperatures range from -65° F to 10° F in the winter and summer temperatures range from 75° – 100° F. The unit elevation is approximately _____' above sea level. The area is within an active seismic zone (formally IBC Zone 4). All exhaust flow rates and emission rates (in lb/hr) are to be stated at standard conditions; dry gas at 680 F and an absolute pressure of 760 mm of mercury.

6.1.2 Fuel

The units will be fueled using Diesel No. 1 ultra low sulfur diesel ("ULSD") for installations at Forts Wainwright and Greely and Diesel No. 2 ultra low sulfur diesel ("ULSD") at Fort Richardson. The specification for each fuel can be found in the Appendix of this report.

6.1.3 Air Quality Control - Emissions

The size of unit must be specified at a minimum of 8 months prior to installation, and this information submitted to Doyon Utilities Environmental. Doyon Utilities will evaluate the impact of air emissions and determine if an air permit is required. If an air permit is required, the regulatory approval process can take up to 6 months. No construction can begin until the air permit is received.

The unit must comply with applicable emission standards under 40 CFR 60 Subpart IIII Standards of Performance for Compression Ignition Internal Combustion Engines. This includes the requirement to be fueled using diesel with 500 ppm sulfur, and beginning in October 2010 fueled using diesel with 15 ppm sulfur

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6.1.4 *Insulation Requirements*

At a minimum, the Arctic Pak enclosure must be rated for an insulation level of -65 degrees, including floors and ceilings. This includes all doors and entrances/exits to the building.

6.2 *Experience*

The Contractor must be an Authorized Distributor or Representative of the equipment proposed and the Contractor themselves must have at least 5 years of successful experience in the design and manufacture of packaged power generation equipment utilizing the equipment proposed. The Contractor shall supply the proper documentation from the equipment manufacturer confirming the authorization and experience.

The Contractor shall have the ability to demonstrate five similar installations. Three installations confirming the supply, installation, and commissioning of equipment similar to that offered shall be presented in the proposal. Alaskan installations are preferred. Contacts at these sites including the user's business name, contact person's name, address, telephone, fax and e-mail (if available) shall be included. The contact person must be English speaking, available for telephone interview, and have a position with detailed knowledge of the operation and maintenance of the applicable system.

It is not the intent of this section to require the supplier to have identical installations, but to demonstrate experience in Alaska or other locations with medium, medium to high speed, diesel fueled engines operating as a standby powered units.

6.3 *Documentation*

Following an award for the unit, the Contractor shall provide the following documentation:

- Drawings to include plan, elevation, structural, electrical wiring diagrams, and piping diagrams
- System design engineering support
- Factory and commissioning test reports
- Packing and shipping procedures
- System engineering, instruction, and service manuals applicable to the equipment furnished and specifically identified as such by project and Contract numbers. Instruction manuals shall include complete instructions for installing, operating, and maintaining the equipment. Outline drawings and a parts identification list shall accompany each set of instructions. The parts identification list shall include sectional and/or outline prints or illustrations as necessary to identify all equipment components.

Contractor shall supply the following submittals:

- Preliminary (30%) Engineering Drawings & Documentation Submittal
- Basic (60%) Engineering Drawings & Documentation Submittal
- Detailed (100%/Final) Engineering Drawings & Documentation Submittal

Contractor shall provide a minimum of 5 complete hardcopy sets and one electronic copy of the final documents:

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- System Engineering Manuals
- Service Manuals (Operation & Maintenance, System, Parts, etc.)
- Drawings
- Other Documentation

All documentation shall be submitted in accordance with the Owner's general scheduling requirements as stated in this RFP. All drawings shall be provided in AutoCAD 2004 or other format as approved by the DU. All other documentation shall be provided in Microsoft Word, Excel, or Adobe PDF format.

6.4 Quality, Guarantee, Warranty

6.4.1 Quality Assurance

The Contractor shall have a Quality Assurance ("QA") program in effect at all times to verify that all items and services, including those subcontracted, comply with all requirements of the Contract and its attachments. When requested, the Contractor shall submit a controlled copy of the QA or Quality Systems Manual for review and acceptance by the Owner. In addition, the Contractor shall submit copies of any associated implementing procedures and/or instructions.

The Owner shall have the right to establish witness points for which the Contractor shall give prior notification. In addition, the Owner may establish temporary witness points to ensure resolution of temporary quality problems. Witness points are defined as predetermined points during fabrication when equipment or activities may be inspected or witnessed for compliance with the Contract, specification, and quality requirements.

Hold points are defined as predetermined points during fabrication when equipment must be inspected and accepted by the Owner or the Owner's representative prior to continuing manufacturing, testing or release for shipment. Final inspection prior to shipment will be a hold point.

The Owner shall have the right to perform inspection of the equipment and work performed for this Contract. The inspections may include, but are not limited to, surveys, in-process inspections, audits, witnessing tests, document review, and final inspection.

The Owner shall be provided written notice of upcoming witness or hold points by the Contractor at least 21 working days in advance of the scheduled time of performance. In addition, the Contractor shall reconfirm the scheduled notification or hold point 5 working days (excluding weekends and holidays) in advance of the previously indicated date.

The Owner will provide a representative to witness the event or will authorize the Contractor to proceed without the Owner's witnessing of the activity, test, or event. The Contractor is not required to stop work for notification points providing the 21 day/5 day notice is given. For hold points, however, the work must be stopped pending inspection by the Owner or written authorization to proceed by the Owner. If after notification, the Contractor requires a postponement of the scheduled notification or hold point, they should immediately contact the Owner to discuss a new, mutually agreeable date.

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6.4.2 *Performance Guarantee*

The Contractor shall adhere to the engine performance standard stated in this specification guaranteeing emission rates and maximum fuel and lube oil consumption rates. The Owner's air quality operating requirements will be, in part, based on the guaranteed emission numbers submitted by the Contractor. The Manufacturer shall run factory performance tests for emissions agreed to and witnessed by the Owner. Failure to meet any of the guaranteed emission rates will constitute nonconformance of the contract. Refer to the Deviations and Nonconformance sections for clarification.

Factory performance testing is required to confirm fuel and lube oil consumption.

6.4.3 *Warranty*

The Contractor shall warrant all systems and components supplied and provided under this contract for a period of 12 months from the date of acceptance by the Owner. The Contractor shall demonstrate and guarantee 24-hour response time for warranty claims in Anchorage/Fairbanks, Alaska. That is, the Contractor shall guarantee that, weather permitting, within 72-hours of notification of a warranty problem in the [REDACTED] facility, the Contractor shall provide proof of shipment of all materials needed to repair or replace warranty components within the engine. If the extent and nature of the warranty issue cannot be determined remotely, the manufacturer shall have a qualified representative in the [REDACTED] facility within 72-hours, weather permitting, of notification of a warranty issue by the Owner.

Acceptance by the Owner shall be deemed that point after which the unit has completed its acceptance testing. Acceptance testing consists of completing three successful performance tests, details of test to be determined by Owner's representative and the Contractor, of the installed package. During the performance period, any failure of the system shall constitute a failure of the operating test and the test will commence from time zero following corrective action by the Owner/Contractor.

6.5 *Deviations and Nonconformance*

Any departure from any requirement of this specification, unless documented in the proposal, is considered a deviation or nonconformance. Examples include physical defects in equipment, test failures, equipment out-of-tolerance, or deviations from specification, inspection, or test procedures. No deviation or nonconformance from this specification shall be accepted until approved in writing by the Owner.

6.6 *Subsupplier*

If the Contractor proposes to purchase from another supplier any of the equipment, material, or services specified herein, the Contractor shall identify the subsupplier and the specific equipment, material, or services in the proposal. The Contractor shall be directly responsible for assuring that all materials and services provided by subsuppliers satisfy the requirements of this specification.

6.7 *Training*

The Contractor shall provide training for four facility personnel at the manufacturer's school or appropriate facility. The supplier shall provide travel to/from [REDACTED]

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training facility, transportation at the training facility, lodging, and tuition or fees. The training shall be scheduled for **two** separate sessions.

6.8 Review/Coordination

The Contractor shall review the design and specifications to assure that the machine being supplied is properly integrated into the station. The Contractor shall coordinate with the Owner's Engineer to ensure a complete design for the selected engine. The Contractor shall supply requested information concerning the electrical, mechanical and structural requirements for the unit and its ancillary equipment in a timely manner. This design review shall include reviewing all aspects of the electrical, mechanical, civil, environmental, and architectural design. The review shall clearly state, by discipline, if the provided design will adequately integrate the supplied unit, or if modifications to the design are required. No design is required of the supplier if there are deficiencies identified.

6.9 Delivery

All materials included in the Scope of Supply shall be delivered, FOB **_____**. The supplier is responsible for coordinating with the installation contractor to insure that the unloading operation and equipment staging does not interfere with other shipping operations and schedules at the facility.

6.10 Schedule

It is the intent of the Owner to award a contract for the Scope of Supply within 90 days following the bid opening. It is anticipated that the final unit selection will be in **_____** with delivery of the units to the site as early as **_____**.

7 Contractor Supplied Information

The following information is to be supplied with the proposal. Provide all information in the units requested or, if omitted, industry standard units are to be used. Unless otherwise specified, all quantities must correspond to the continuous rating of the unit.

7.1 General

Unit manufacturer's name: _____

Unit model number: _____

Expected useful life of unit at rated continuous load (years): _____

Total unit cost FOB Fort Wainwright, Alaska (\$US): _____

Delivery time after commitment by Owner (weeks): _____

Total unit cost FOB Fort Wainwright, Alaska (alternative delivery) (\$US): _____

Delivery time after commitment by Owner (alternative delivery) (weeks): _____

7.2 Physical

Overall unit dimensions (LxWxH, inches): _____

Total shipping weight of unit with all accessories (lbs): _____

Weight of largest single shipping container (lbs): _____

Total number of containers: _____

Net weight of complete unit (wet) (lbs): _____

Net weight of engine only (lbs): _____

Net weight of generator only (lbs): _____

Exhaust pipe diameter dimension (inches): _____

Exhaust silencer dimensions (DxL, inches): _____

Air intake pipe and silencer dimensions (DxL, inches): _____

Fuel oil day tank dimensions (LxWxH, inches): _____

Fuel oil day tank capacity (gallons): _____

7.3 Mechanical

7.3.1 General Engine Data

Rated engine speed (RPM): _____

Engine continuous rated power (bHP): _____

Engine standby rated power (bHP): _____

Engine emergency rated power (bHP): _____

Number of cylinders: _____

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Cylinder bore (inches): _____
Cylinder stroke (inches): _____
Piston displacement (inches³): _____
Piston speed at rated engine speed (inches/min): _____
BMEP at full load and rated speed (lb/in²): _____
Maximum compression pressure (PSI): _____
Maximum firing pressure (PSI): _____
Method of piston cooling: _____

7.3.2 Supply Air System

Combustion air flow (SCFM): _____
Intake air is cooled by jacket or intercooler coolant?: _____
Type of scavenging blower (or super charger): _____
Scavenging air pressure (PSI): _____

7.3.3 Exhaust Gas System

Exhaust gas temperature (°F): _____
Heat rejected to exhaust gas (total), (BTU/min): _____
Exhaust gas flow rate, (SCFM): _____
Maximum exhaust gas back pressure, (in-H₂O): _____

7.3.4 Jacket Water Cooling System

Heat rejected to jacket water, (total) (BTU/min): _____
Jacket water flow rate, (GPM): _____
Jacket water nominal and maximum outlet (engine) temperature (°F): _____
Jacket water minimum inlet (engine) temperature (°F) _____
Maximum jacket water head loss (FT): _____
Quantity of jacket water in provided equipment (gal): _____
Radiator airflow (ft³/min): _____
Warm Up Jacket Water Flow Rate nominal and maximum (GPM) _____
Warm Up Jacket Water nominal and maximum inlet water temperature (F) _____
Required engine block warm up temperature (F) _____

7.3.5 Intercooler Cooling System

Heat rejected to intercooler water, (BTU/min): _____
Intercooler coolant flow rate, (GPM): _____
Maximum intercooler water head loss (FT): _____

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Quantity of intercooler water in provided equipment (gal): _____

7.3.6 Fuel Oil System

Type of governor: _____

Type of fuel injection: _____

Heat rejected into fuel oil, (BTU/min): _____

Fuel oil supply flow rate, (GPM): _____

Fuel oil return flow rate, (GPM): _____

7.3.7 Lube Oil System

Quantity of lube oil in provided equipment (gal): _____

Oil is cooled by jacket or intercooler coolant?: _____

Type of lubricating system: _____

7.4 Electrical

Unit continuous rated power at generator terminals (kW): _____

Unit standby rated power at generator terminals (kW): _____

Unit emergency rated power at generator terminals (kW): _____

7.4.1 Generator

Manufacturer's name: _____

Model number: _____

Voltage rating (kV): _____

Power rating (kVA): _____

Power factor rating (%): _____

Frequency rating (Hz): _____

Current at rated winding temperature rise (A): _____

Maximum excitation required, (if applicable) (V): _____

Insulation of stator (Class): _____

Rated temperature rise of stator insulation (oC): _____

Insulation of rotor (Class): _____

Rated temperature rise of rotor insulation (°C): _____

Rotor voltage/current full load (V/A): _____

Winding Capacitance to Ground (3 phase) (uF): _____

Inertia Constant, H (J/VA): _____

Short circuit ratio: _____

Full load synchronizing Coefficient (kW/rad): _____

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No load synchronizing Coefficient (kW/rad): _____

Type of bearings: _____

Number of stator RTDs: _____

Stator RTD resistance value (Ohms): _____

Stator RTD material: _____

Pitch: _____

7.4.2 Generator Reactance

Generator kVA base (kVA): _____

Direct axis synchronous, X_d (pu): _____

Quadrature axis synchronous, X_q (pu): _____

Direct axis transient, X'_d (pu): _____

Quadrature axis transient, X'_q (pu): _____

Direct axis subtransient, X''_d (pu): _____

Quadrature axis subtransient, X''_q (pu): _____

Direct axis subtransient reactance to resistance ratio, X''_d/R (pu): _____

Negative sequence, X_2 (pu): _____

Zero sequence, X_0 (pu): _____

7.4.3 Time Constants at 75 C

Direct axis transient open circuit, T'_{do} (sec): _____

Direct axis transient short circuit, T'_d (sec): _____

Direct axis subtransient open circuit, T''_{do} (sec): _____

Direct axis subtransient, short circuit, T''_d (sec): _____

Armature, T_a (sec): _____

7.4.4 Exciter

Manufacturer's name: _____

Model number: _____

Power rating (kW): _____

Nominal voltage rating (V): _____

Maximum voltage rating (V): _____

Nominal current rating (A): _____

Maximum current rating (A): _____

Exciter time constant T_e (sec): _____

Exciter constant related to self excited field, K_e : _____



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Response ratio: _____

Field flashing voltage requirement (if required) (V): _____

Field flashing current requirement (if required) (A): _____

Field flashing duration requirement (if required) (sec): _____

7.4.5 Voltage Regulator

Manufacturer's name: _____

Model number: _____

Current rating (A): _____

Response characteristics: _____

Gain, KA: _____

Amplifier time constant, TA (sec): _____

Stabilizing circuit time constant, TF (sec): _____

Stabilizing circuit gain KF: _____

7.4.6 Current Transformers:

Neutral end number of CT's: _____

Neutral end ratio: _____

Neutral end accuracy class: _____

Line end number of CT's: _____

Line end ratio: _____

Line end accuracy class: _____

7.5 Performance - Operations

Guaranteed starting time (from close of starting contact to rated speed) (sec): _____

Time from reaching rated speed to accept full load (sec): _____

Steady state speed regulation, no load to full load, percent of rated speed (%): _____

Momentary maximum speed regulation, corresponding to instantaneous change from no load to full load, and full load rejection, in percent of rated speed (%): _____

Recommended minimum loading (%): _____

Maximum duration of no load at rated speed (hours): _____

Recommended idling speed (RPM): _____

Maximum duration of idling (hours): _____

Voltage regulation for steady state, no load to full load at 0.8 pf at rated speed (with voltage regulator) (%): _____

Maximum excitation required for above steady state and transient conditions (kW): _____

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Guaranteed Maximum Frequency Variation and Restoration Time (Function of applied load in 25% increments)				
Engine Load	kW	bHP	%	Sec.
100%				
75%				
50%				
25%				
Table 1				

Guaranteed Maximum Net Generator Efficiency			
Engine Load	kW	bHP	%
100%, 1.0 PF			
100%, 0.8 PF			
75%, 1.0 PF			
75%, 0.8 PF			
50%, 1.0 PF			
50%, 0.8 PF			
Table 2			

7.6 Performance - Fuel Consumption/Emissions

The following tables shall be completed based on the two fuel specifications found in the Appendix. The expected values shall be taken from actual test results for the same unit model proposed. The “kW” values shall be the electrical power measured at the generator terminals. The “bHP” values shall be the gross break engine power.

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Guaranteed Maximum Fuel/Lube Oil Consumption (No. 2 Diesel ULSD)						
Engine Load	Fuel Oil					Lube Oil
	kW	bHP	g/kWh	gal/hr	kWh/gal	gal/hr
120%						
110%						
100%						
85%						
75%						
50%						
25%						
Idle						
Table 3						

Expected Fuel/Lube Oil Consumption (No. 2 Diesel ULSD)						
Engine Load	Fuel Oil					Lube Oil
	kW	bHP	g/kWh	gal/hr	kWh/gal	gal/hr
120%						
110%						
100%						
85%						
75%						
50%						
25%						
Idle						
Table 4						



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Guaranteed Maximum Emissions (No. 2 Diesel ULSD)						
Engine Load	kW	bHP	NOx	SO2	CO	PM
120%						
110%						
100%						
85%						
75%						
50%						
25%						
Idle						
Table 7						

Expected Emissions (No. 2 Diesel ULSD)						
Engine Load	kW	bHP	NOx	SO2	CO	PM
120%						
110%						
100%						
85%						
75%						
50%						
25%						
Idle						
Table 8						

7.7 Maintenance

Maintenance information shall be provided for all levels including level description, major parts listing, estimated equipment cost (2008 dollars), and total number of man hours required. This information shall be presented for a minimum of 20 years of operation (500 hr/year) and grouped by year.



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An optional lifecycle cost analysis is encouraged to be provided. The major input parameters shall include the following values:

1. Running Hours: 500 hr/year
2. Operating Term: 20 Years
3. Average Load: 100% standby rating
4. Fuel Oil Type: No. 2 Diesel ULSD (see Appendix)
5. Fuel Oil Cost: \$4.00/gal
6. Lube Oil Cost: \$9.50/gal
7. Labor Rate: \$120/hr
8. Fuel/Lube Oil Consumption: Guaranteed values presented in the proposal

A No. 1 Diesel ULSD Fuel Specification



B No. 2 Diesel ULSD Fuel Specification



C Codes and Standards

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- ANSI C12.11 Instrument Transformers for Revenue Metering, 10 KV BIL through 350 KV BIL (0.6kV NSV through 69 kV NSV)
- ANSI C37.06 AC High-Voltage Circuit Breakers Rated on a Symmetrical Basis – Preferred Ratings and Related Required Capabilities
- ANSI C50.10 Rotating Electrical Machinery-Synchronous Machines
- ANSI C80.1 Specification for Rigid Steel Conduit Zinc Coated
- ANSI AWS D1.1 Structural Welding Code

ASME INTERNATIONAL (ASME)

- ASME B1.20.1 General Purpose Pipe Threads
- ASME B16.11 Forged Fittings, Socket-Welding and Threaded
- ASME B16.3 Malleable Iron Threaded Fittings
- ASME B16.5 Pipe Flanges and Flanged Fittings
- ASME B16.11 Forged Steel Fittings, Socket Welded and Threaded
- ASME B16.34 Valves – Flanged, Threaded and Welded End
- ASME B31.1 Power Piping

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

- AEIC CS8 Extruded Dielectric Shielded Power Cables Rated 5 through 46 KV

ASTM INTERNATIONAL (ASTM)

- ASTM A 106/A 106M Seamless Carbon Steel Pipe for High- Temperature Service
- ASTM A 181/A 181M Carbon Steel Forgings, for General-Purpose Piping
- ASTM A 234/A 234M Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
- ASTM A 53/A 53M Pipe, Steel, Black and Hot-dipped, Zinc Coated, Welded and Seamless
- ASTM B 395/B 395M U-Bend Seamless Copper and Copper Alloy Heat Exchanger and Condenser Tubes
- ASTM D 975 Diesel Fuel Oils

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ELECTRICAL GENERATING SYSTEMS ASSOCIATION (EGSA)

- EGSA 101P Engine Driven Generator Sets

INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)

- IEEE C2 National Electrical Safety Code
- IEEE C37.04 Standard Rating Structure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
- IEEE C37.11 Standard Requirements for Electrical Control of AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
- IEEE C37.18 Requirement for Field Discharge Circuit Breakers for Rotating Machinery
- IEEE C37.20.2 Standard for Metal-Clad Switchgear
- IEEE C37.90 Standard for Relays and Relay Systems Associated with Electric Power Apparatus
- IEEE C57.12.01 Standard General Requirements for Dry Type Distribution and Power Transformers Including Those with Solid-Cast and/or Resin Encapsulated Windings
- IEEE C57.13 Standard Requirements for Instrument Transformers
- IEEE C57.13.1 Guide for Field Testing of Relaying Current Transformers
- IEEE C62.11 Standard for Metal Oxide Surge Arresters for AC Power Circuits
- IEEE C62.22 Guide for Application of Metal Oxide Surge Arresters for AC Systems
- IEEE Std 1 General Principles for Temperature Limits in the Rating of Electric Equipment and for the Evaluation of Electrical Insulation
- IEEE Std 43 Testing Insulation Resistance of Rotating Machinery
- IEEE Std 48 Test Procedures and Requirements for Alternating- Current Cable Terminations 2.5KV through 765 KV
- IEEE Std 81 Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Ground System (Part 1) Normal Measurements
- IEEE Std 115 Test Procedures for Synchronous Machines: Part I: Acceptance and Performance Testing; Part II: Test Procedures and Parameter Determination for Dynamic Analysis
- IEEE Std 119 Temperature Measurements as Applied to Electrical Apparatus
- IEEE Std 120 Master Test Guide for Electrical Measurements in Power Circuits
- IEEE Std 404 Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500V through 500 000 V
- IEEE Std 485 Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications

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- IEEE Std 519 Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems

THE INSTRUMENTATION, SYSTEMS, AND AUTOMATION SOCIETY (ISA)

- ISA MC96.1 Temperature Measurement Thermocouples

MANUFACTURER'S STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

- MSS SP-58 Pipe Hangers and Supports- Materials, Design and Manufacture
- MSS SP-69 Pipe Hangers and Supports- Selection and Application
- MSS SP-80 Bronze Gate, Globe, Angle and Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- NEMA AB 3 Molded Case Circuit Breakers and Their Application
- NEMA ICS 1 Industrial Controls and Systems – General Requirements
- NEMA ICS 2 Standard for Industrial Control and Systems: Controllers, Contactors and Overload Relays Rated Not More Than 2000 V AC or 750 V DC: Part 8- Disconnect Devices for Use in Industrial Control Equipment
- NEMA ICS 4 Industrial Control Equipment and Systems: Terminal Blocks
- NEMA ICS 6 Industrial Control and Systems: Enclosures
- NEMA MG 1 Motors and Generators
- NEMA MG 2 Safety Standard for Construction and Guide for Selection, Installation, and Use of Electric Motors and Generators
- NEMA SG 6 Power Switching Equipment
- NEMA WC 55 Instrumentation Cables and Thermocouple wire (ICEA S-82-552)
- NEMA WC 57 Standard for Control Cables (ICEA S-73-532)
- NEMA WC 70 Nonshielded Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy (ICEA S-95-658)
- ICEA S-66-524 Cross Linked Thermosetting, Polyethylene Insulated Wire and Cable for Transmission and Distribution of Electric Energy
- ICEA S-68-516 Ethylene Propylene Rubber Insulated Wire and Cable for the Transmission and Distribution of Electric Energy
- NEMA 250 Enclosures for Electrical Equipment

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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- NFPA 30 Flammable and Combustible Liquids Code
- NFPA 37 Installation and Use of Stationary Combustion Engines and Gas Turbines
- NFPA 70 National Electrical Code
- NFPA 110 Emergency and Standby Power Systems

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

- SAE J537 Storage Batteries

UNDERWRITERS LABORATORIES (UL)

- UL 44 Thermoset-Insulated Wires and Cables
- UL 50 Standard for Safety Enclosures for Electrical Equipment
- UL 467 Grounding and Bonding Equipment
- UL 489 Molded Case Circuit Breakers, Molded Case Switches and Circuit Breakers Enclosures
- UL 508 Electric Industrial Control Equipment
- UL 1236 Battery Chargers for Charging Engine- Starter Batteries

FEDERAL OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

- OSHA CFR Title 29, Chapter XVII, Part 1910

ENVIRONMENTAL PROTECTION AGENCY (EPA)

- EPA CFR 40 CFR 60 Subpart IIII

STANDARD PRACTICES FOR STATIONARY DIESEL AND GAS ENGINES (DEMA)

- Exhaust Emission Measurement Procedures for Internal Combustion Engines

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

- PA1 Shop, Field and Maintenance Painting
- PA2 Measurement of Dry Film Thickness with Magnetic Gauges
- SP1 Solvent Cleaning
- SP2 Hand Tool Cleaning
- SP3 Power Tool Cleaning

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- SP4 White Metal Blast Cleaning
- SP10 Near-White Metal Blast Cleaning

INTERNATIONAL STANDARDS ORGANIZATION (ISO)

- ISO 8528 Reciprocating internal combustion engine driven alternating current generating sets
- ISO 3046 Reciprocating Internal Combustion Engines
- ISO 10816 Mechanical vibration - Evaluation of machine vibration by measurements on non-rotating parts
- ISO 8178 Reciprocating internal combustion engines. Exhaust emission measurement