

SECTION 16250
ENGINE GENERATORS: LIQUID PROPANE

PART 1 – GENERAL

1.1. Section Includes:

A. Engine-generator set

1. Town of Dolores WTP Standby Generator

B. Provide engine generator set including but not necessarily limited to the following:

1. Engine.
2. Cooling system.
3. Exhaust system.
4. Starting system.
5. Generator.
6. Associated fuel system
7. Control equipment and accessories.
8. Housing.
9. Output circuit breaker.

1.2 QUALITY ASSURANCE

A. Referenced Standards:

1. National Electrical Manufacturer's Association (NEMA).
2. National Fire Protection Association (NFPA)
3. Underwriter's Laboratories, Inc. (UL).

B. Testing:

1. Prototype Test: The manufacturer shall have successfully tested a prototype of each engine/generator set series offered. The tests performed shall include the following:
 - a. Maximum power test.
 - b. Maximum motor starting kVA.
 - c. Transient response, steady state governing, and voltage regulation.
 - d. Single step load pick-up per NFPA 110.
 - e. Three-phase short circuit test for mechanical and electrical strength.
 - f. Fuel consumption.

- g. Cooling system test.
 - h. Endurance run test.
2. Factory Tests: Prior to shipment, each unit shall be factory performance tested under load. Test results shall be certified and documented on a strip chart recorder. The tests shall be performed in accordance with the Manufacturer's standards and NFPA Standard 110. The following tests shall be performed:
- a. Stepped load test at 1/2, 3/4, and full load for 5 minutes each step.
 - b. Full single step block load.
 - c. Results documented shall include steady-state voltage and frequency analysis, transient response, maximum power analysis, and fuel consumption.
3. Field Tests: Each complete installation shall be tested for compliance with the plans and specifications following completion of all site work. Testing shall be conducted by a representative of the supplier. The Contractor shall supply fuel, and other equipment required for the test. The Owner and Engineer shall be notified in advance and shall have the option to witness the tests. The tests shall be repeated until the equipment performs as specified. The tests to be conducted on site shall be as follows:
- a. Cold Start Test: Perform a cold start test on the generator using the generator's actual load as a test load. A power failure shall be simulated by opening the normal power disconnect and the following information shall be recorded:
 - 1) Cranking on time.
 - 2) Time required to come up to speed.
 - 3) Voltage and frequency overshoot.
 - 4) Time to achieve steady state.
 - 5) Voltage, frequency, and amps at standby state.
 - 6) Oil pressure, water temperature, and battery charge rate at 5 minute intervals for the first 15 minutes and at 15 minute intervals thereafter for 2 hours.
 - b. Crank Cycle Test: Disable the generator from starting by a method approved by the Manufacturer and test the crank cycle by switching the generator to run.
 - c. Safety Shutdowns: Test all the generator safety shutdowns.

1.3 SUBMITTALS

- A. Verify dimensions, coordination and applicability of equipment furnished.

- B. Full detail for performing of engine testing required. Upon completion of engine testing prepare and submit final results along with all new data.
- C. Upon satisfactory completion of startup, secure a written statement from manufacturer that each engine generator is installed in accordance with manufacturer's recommendations, properly started up and is ready for operation by the Owner's personnel. Also certify that required operation and maintenance training has been fully satisfied.
- D. Wiring diagrams for each engine-generator set. Indicate clearly factory versus field wiring connections.
- E. Generator fault current at full rpm and main circuit breaker trip curves and fault interrupting rating.
- F. Operation and Maintenance Manuals

1.4 WARRANTY

- A. Minimum of one year warranty on all parts and labor.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. MTU Onsite Energy
 - 2. Cummins/Onan.
 - 3. Generac.
 - 4. Caterpillar
- B. Assure engine, generator and accessories are provided by the engine manufacturer and its authorized dealer.
- C. Assure local availability of service and replacement parts.

2.2 PERFORMANCE AND OPERATING REQUIREMENTS

- A. Operating Conditions: Provide complete generator sets, controls and accessories rated for the following conditions:
 - 1. Location: Dolores, CO.
 - 2. Altitude: 7,000 FT AMSL.
 - 3. Fuel: Liquid Propane.

4. Enclosure rating: Outdoors.
- B. Performance: Establish net rating of each generator set under operating conditions specified when equipped and fully loaded with all necessary operating accessories. Substantiate ratings with manufacturer's standard published curves and data.
1. Minimum ratings:
 - a. Standby rating (at 0.8 PF): 100 kW
 - b. Frequency: 60 Hz
 - c. Voltage and phase: 480/3
 - d. Engine speed, max (rpm): 1800
 - e. Maximum voltage dip: 20%
 2. The unit shall be required to maintain the above noted parameters while starting and running the loads listed at the end of this section. The loads will not be started simultaneously.

2.3 ENGINE

- A. Engine Construction: Provide liquid propane-type engine of heavy-duty construction, radiator and fan cooled.
1. Engines solid-state designed for cold quick start, capable of delivering full load output in 30 seconds.
 2. Engine must meet scheduled performance without turbo-charging or after-cooling.
 3. Provide exhaust manifolds.
- B. Lubrication:
1. Provide pressure-type lubrication system with gear-type oil pump and full flow filters fitted to engines. Provide level indicator or dipstick.
 2. Locate filter for convenient servicing.
 3. Oil drain piped to edge of skid with valve or cap.
- C. Air Cleaner:
1. Provide one or more dry-type replaceable element air cleaners suitable for high dust load operation.
 2. Equip each air cleaner with service indicator.
- D. Governor:
1. Provide a fully enclosed electronic governor.
 2. Frequency at any constant load shall not deviate more than plus or minus 0.5 percent of rated frequency.

3. The governor to provide adjustable frequency regulation from isochronous to 5 percent drop.

2.4 GENERATOR

- A. Construction: Provide brushless, revolving field type, synchronous generator coupled directly to engine flywheel through a flexible driving disc for positive alignment.
 1. Bolt generator housing directly to engine flywheel housing.
 2. Provide volts-per type voltage regulator of solid state 3-phase sensing, construction matching characteristics of each unit. Provide no load to full load regulation within ± 0.5 percent at rated voltage during steady state conditions.
 3. Provide permanent magnet generator to provide excitation power to the automatic voltage regulator.
 4. Provide shock-resistant mounting of regulators.

2.5 COOLING SYSTEM

- A. Provide unit-mounted radiator cooling system with sufficient capacity for cooling generator set at full rated load and operating conditions specified.
 1. Equip engine with engine-driven centrifugal-type water circulating pumps and thermostatic valve to maintain coolant temperature below 200 DegF.
- B. Coolant:
 1. Flush and drain cooling system.
 2. Fill with minimum 50 percent ethylene glycol and water solution.
 3. Assure radiator, engine block and related items protected to minus 50 DegF.
 4. Coolant drain piped to edge of skid with valve or cap.
- C. Jacket Water Heaters: Furnish one or more engine mounted thermal circulation type water heaters to maintain engine jacket water at 70 DegF at minimum ambient temperature specified.
 1. Include integral thermostatic controls to maintain desired temperatures.
 2. Rate heaters for 240 V, 1 PH, 60 HZ.

2.6 EXHAUST SYSTEM

- A. Exhaust Silencer. Provide a Critical-grade silencer and related hardware to include side inlet, standard 125-150 LB flange connections, companion-flanges, cleanouts, Type E support arrangement, and stainless steel bellows type flexible exhaust connectors at least 24 IN long.

1. Ensure silencers and related hardware are properly sized and installed according to the manufacturer's recommendation.
 2. The silencer shall be mounted horizontally such that its weight is NOT supported by the engine.
 3. Furnish and install exhaust pipe constructed of schedule 40 steel pipe with standard 125-150 LB flange connections as shown on the Drawings. Exhaust pipe size shall be sufficient to ensure that measured exhaust back pressure does not exceed 20 IN of water.
- B. Install insulation so that it does not interfere with the functioning of the flexible exhaust fitting.
- C. Provide a 20 foot flexible connection hose for connecting the generator exhaust to an outside port when the generator is running in a building.

2.7 STARTING SYSTEMS

- A. Starting Motors: Provide 24 V DC starting system with solenoid operated positive engagement drive.
- B. Batteries: Furnish lead acid batteries with each engine generator with sufficient capacity to crank engines for three 20-second cranking periods with a 30-second rest period between cranks without recharging.
1. Provide battery rack appropriately sized for the batteries furnished, painted with alkaline-resistant paint.
 2. Provide constant voltage, current limiting, full wave rectifier type battery chargers using silicon controlled rectifiers as the power controlling elements.
 3. Provide float and equalize charge rates. Rate charger for 120 V, 1 PH, 60 HZ with output current rating to recharge the battery from a 70 percent discharged condition to 95 percent charged condition in 12 HRS.
 4. Battery charger shall be 120V and shall be hardwired.
 5. Provide malfunction alarm contacts for actuation of alarm in the event of malfunction in the battery charging system.
 6. Provide DC voltmeter and ammeter, ac input and dc output circuit breakers.
 7. Provide cables, clamps and all other necessary connections.
 8. Size main cables to exhibit total circuit resistance of 0.005 ohm or less.
 9. Batteries and charger located in generator enclosure.
 10. Starting shall be initiated by a normally open, dry contact closure.

2.8 CONTROLS

- A. Control Panel:

1. Provide NEMA 1 enclosed control panel mounted on each generator terminal box with vibration isolators.
 2. Construct dead front panel with 14 GA steel.
 3. Include the following devices in panel:
 - a. Engine coolant temperature gage.
 - b. Engine lube oil pressure gage.
 - c. Engine lube oil temperature gage.
 - d. Engine running hour meter.
 - e. Battery charging indicators.
 - f. Voltmeter.
 - g. Ammeter with true RMS output, supplied by 3 CT's at generator output leads.
 - h. Ammeter and voltmeter phase selector switch or switches.
 - i. Frequency meter.
 - j. Manual and automatic starting controls.
 - k. Panel illumination lights and switch.
 - l. Voltage level adjustment rheostat.
 - m. Fault indicators including low oil pressure, high water temperature, overspeed and overcrank. Provide dry contacts for common annunciation of fault conditions.
 4. Multifunction digital device incorporating all above functions will be acceptable.
- B. Main Line Circuit Breaker: Provide main circuit breaker for generator set, sized for appropriately to protect the generator.
1. Breakers are to operate both manually for normal switching function and automatically during overload and short circuit conditions.
 2. The trip unit for each pole of each breaker is to have elements providing inverse time delay during overload conditions and instantaneous magnetic tripping for short circuit protection.
 3. Provide breakers to interrupt bolted 3 PH fault from generator at full rpm at load terminals.
 4. Provide a NEMA 1 enclosure for circuit breakers and mount on generator using suitable vibration isolators.

2.10 SPARE PARTS

- A. Furnish Owner the following extra parts and supplies for each generator set:

1. One set of filters, i.e., fuel, oil, and air for each unit.
 3. Oil for one complete oil change for each unit.
 4. Complete replacement set of all fuses.
- B. Spare parts shall be packaged with labels indicating contents of each package.

PART 3 - EXECUTION

3.1 MOUNTING AND ENCLOSURE

- A. Base: Mount engine, generator and cooling system on a common structural steel subbase. Equip subbase with spring-type vibration isolators.
- B. Propane tank and piping between tank and generator to be provided by others.
- C. Flexible Connections: Provide stainless steel flexible fittings on all engine piping and electrical conduits.
1. Engine control conduit.
 2. Fuel connection: Braided metallic.
 3. Exhaust connector bellows: Stainless steel.
 4. Coolant water pipes: Braided metallic.
- D. Enclosure:
1. Equip engine generator set with a factory assembled ventilated sheet steel enclosure.
 2. Provide weatherproof enclosure with an external critical grade silencer with rain cap.
 - a. Provide housing with hinged side-access doors and a rear control door.
 - b. All access doors to be lockable.
 - c. Treat entire enclosure and skid assembly with an electro deposition primer process prior to finish painting for maximum durability.
 - d. Equip the set with lifting eye.
 - e. Enclosure shall be a sound attenuating enclosure and shall reduce the sound to a Level 1 sound attenuation. The level 1 sound attenuation shall reduce the sound to a maximum of 89dB at 7 meters distance with the generator fully loaded.

3.2 FIELD QUALITY CONTROL

- A. Employ and pay for services of equipment manufacturer's field service representative(s) to:
1. Inspect equipment covered by these Specifications.

2. Supervise any adjustments and installation checks.
3. Conduct initial start up of equipment and perform operational checks at jobsite. Conduct field tests as specified.
4. Provide instruction to Owner's personnel on training in operation and maintenance of equipment for a 4 hours period.

Load List:

Dolores WTP				
Load list				
Description	HP/KW	Volts	Amperes	KVA
40hp Motor (VFD)	40 HP	480	52.00	43.2
Remaining Load		480	58.19	48.3
Total Load		480	110.19	91.5

END OF SECTION

CONCRETE PAD

1. Concrete pad for Dolores WTP Standby Generator
2. The Generator will be placed outside of the WTP.
3. Proposals should be structurally designed and built according to the generator manufacturers specifications.

SECTION 16280
480 VOLT AUTOMATIC TRANSFER SWITCH

PART 1 GENERAL

1.1 SUMMARY

- A. This section covers the furnishing and installation of a 480 volt automatic transfer switch (ATS) for use with the generator. The ATS shall be provided by the generator supplier. The ATS enclosure shall be rated NEMA 3R for installation outside. The ATS current rating shall be as noted on the drawings.

1.2 SYSTEM DESCRIPTION

- A. This equipment will be connected to a 480 volt, 3 phase, 4 wire, solidly grounded system. A fully rated neutral lug shall be included in the ATS enclosure for connection of all the neutral conductors.
- B. The ATS shall be an open transition style transfer switch.

1.3 REFERENCES

- A. All equipment to be furnished under this section shall be designed, constructed, and tested in accordance with the latest applicable requirements of the standard specifications and codes of ANSI, NEMA, IEEE, and other such regularly published and accepted standards, as well as state and local codes and the USERC standards required by the local utility.

1.4 SUBMITTALS

- A. Submittals shall be required as noted in section 16050 and 16900.

1.5 QUALITY ASSURANCE

- A. Supplier's qualifications
 - 1. The entire system shall be designed, coordinated, and supplied by a qualified Supplier who is regularly engaged in the business of ATS equipment. The Supplier shall meet the following qualifications.
 - a. The Supplier shall have and shall maintain a qualified technical staff and design office. The qualifications and experience of key project personnel shall be acceptable to the Engineer.
 - b. The Supplier shall have the physical plant and fabricating personnel to complete the work specified.
 - c. The Supplier shall employ competent service personnel to service the equipment furnished. The geographic location of service personnel for this project shall be acceptable to the Engineer.
 - d. The Supplier shall provide a "Statement of Qualifications" indicating that they have successfully provided similar work for at least 5 years.

1.6 WARRANTY

- A. The Supplier shall warrant the hardware for a period of one year from the date of system acceptance.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. All equipment furnished under this section shall be selected by the Supplier for its superior quality and intended performance. Unless indicated otherwise, all equipment and material shall be new, undamaged and meet the requirements of UL. Where UL requirements are not applicable, equipment and material shall be identified as such by the supplier and approved by the Engineer before purchase and installation. Equipment and materials used shall be subject to review and shall comply with the following requirements.
 - 1. Acceptable Manufacturers. Subject to compliance with Contract Documents, the following manufacturers are acceptable.
 - a. MTU Onsite Energy
 - b. Generac Power Systems.
 - c. Kohler Power.
 - d. Cummins Power Generation.
 - e. Or accepted substitution
 - 2. The ATS shall be supplied by the engine generator supplier who shall be responsible for the design, manufacture, coordination, and proper installation and operation of the automatic transfer switch.

2.2 MATERIALS AND EQUIPMENT

- A. Automatic Transfer Switch
 - 1. Each automatic transfer switch shall consist of a power transfer module and a control module, interconnected to provide complete automatic operation. The ATS shall be mechanically held and electrically operated by a single solenoid mechanism energized from the source to which the load is to be transferred. The switch shall be rated for continuous duty and be inherently double throw. The switch shall be mechanically interlocked to ensure only one of two possible positions, normal or emergency.
 - 2. The automatic transfer switch shall conform to the requirements of NEMA Standard ICS 2-447 and UL's UL 1008 and shall be UL listed for use in standby systems in accordance with Articles 517, 700, 701, and 702 of the NEC.
 - 3. The automatic transfer switch shall be rated as shown on the drawings.
 - 4. All main contacts shall be of silver composition. They shall be protected by arcing contacts. The operating transfer time in either direction shall not exceed 1/6 of a second.
- B. Control.

1. The automatic transfer switch shall be controlled by a microprocessor-based programmable controller specifically designed for this function to provide rapid, reliable transfer of power between emergency and normal power conditions. The programmable controller shall be programmable from buttons on the front of the unit with an alphanumeric display for indication of entered values and any fault conditions.
 2. Manual operation of the switch shall also be possible, as well as manual lockout.
 3. The following control shall be incorporated into the transfer switch:
 - a. Voltage sensing shall be provided on all phases. The pickup voltage shall be adjustable from 85% to 100% of nominal, and the dropout voltage shall be adjustable from 75% to 90% of the pickup value. The transfer to the emergency power supply will be initiated upon reduction of normal source to 85% of nominal voltage, and the retransfer to normal shall occur when normal source restores to 90% of nominal.
 - b. A time delay shall be provided to override momentary normal source outages to delay all transfer switch and engine starting signals. The time delay shall be field adjustable from 0.5 to 30 seconds and factory set at 10 seconds.
 - c. A time delay on retransfer to normal source shall be provided. The time delay shall be automatically bypassed if the emergency source fails and normal source is available. The time delay shall be field adjustable from 0 to 30 minutes and factory set at 10 minutes.
 - d. A timer shall be provided for the unloaded running time delay for emergency generator cool down. The time delay shall be field adjustable from 0 to 10 minutes and factory set a 5 minutes.
 - e. A contact shall be provided that closes when the normal source fails. This contact is for initiating the engine starting sequence. The contact shall be rated 10 amperes at 32 volts dc.
 - f. A white signal light shall be provided to indicate when the automatic transfer switch is connected to the normal source. A red signal light shall be provided to indicate when the automatic transfer switch is connected to the emergency source.
 - g. Two auxiliary contacts shall be provided that are closed when the automatic transfer switch is connected to normal and two auxiliary contacts shall be provided that are closed when the automatic transfer switch is connected to emergency. Contacts shall be rated 1 ampere, 240 volts, 60 Hz.
 - h. In phase monitoring to allow for in-phase switching controls shall be provided to delay transfer from one active power source to another until the transfer can be done without causing nuisance tripping of circuit breakers and damage to the equipment.
 - i. A selector switch shall be provided for selecting manual or automatic retransfer to normal.
 - j. An engine generator automatic exercising timer shall be provided with the option of selecting to exercise under load or no-load conditions.
- C. Switching Components. The automatic transfer switch shall be rated to withstand 30,000 RMS symmetrical short circuit current at the automatic transfer switch terminals with the type of overcurrent protection and voltage as shown on the drawings.

1. Automatic transfer switches utilizing components of molded case circuit breakers, contactors, or parts thereof are not acceptable.
- D. Control Pad Cover. The ATS control display shall be covered with a stainless steel box that is hinged on one side to prevent the sun from deteriorating the display. The box shall be lockable and easily opened with the lock removed.

PART 3 EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. General Requirements

1. It shall be the Contractor's responsibility to ensure that the entire electrical equipment is installed in a satisfactory condition per these specifications and the manufacturer's requirements.

B. Inspection.

1. Inspect materials and equipment for signs of damage, deterioration or other deleterious effects of storage, transportation, handling, or defects in manufacture or assembly.
 - a. Replace with identical new materials or equipment or repair to like new condition any materials or equipment showing such effects to the satisfaction of the Engineer and Owner.

C. Equipment Installation.

1. Handle, install, connect, clean, condition, align and adjust products and equipment in strict accordance with manufacturer's instructions and in conformity with specification requirements.
 - a. Separate sheet metal junction boxes, equipment enclosures, sheet metal raceways, etc., mounted on water or earth-bearing walls or wall-mounted outdoors 1/4" from wall be corrosion resistant spacer.
 - b. Seal the base of all outdoor switchgear, motor control center, and similar equipment with grout.
 - c. Screen or seal with flexible sealing compound all openings into outdoor equipment to prevent the entrance of rodents, wasps, and mud-daubers.
 - d. Electrical work shall conform to the construction schedule and progress of other trades.
 - e. Maintain one complete set of manufacturer's installation instructions at the jobsite during installation and until installation is accepted by the Engineer and Owner.
 - f. Perform all work in accordance with manufacturer's instructions.
 - i) Do not omit any preparatory step or installation procedure unless specifically modified or exempted by contract documents.
 - ii) Should job conditions or specification requirements conflict with manufacturer's instructions, consult with Engineer prior to proceeding.
 - iii) Field Wiring. Field wiring materials and installation shall conform to the requirements of the electrical section.

3.2 OPERATION AND TRAINING

- A. Step-by-step detailed instructions shall be furnished by the ATS supplier for the operation of the transfer switch. A minimum of 2 hours of training on the operation and maintenance of the ATS shall be provided at the site at a time mutually agreeable to the owner's personnel and the manufacturer during normal business hours.

3.3 FIELD SUPERVISION AND TESTS

- A. The Contractor shall furnish the services of a competent manufacturer's technical representative to check the installation, make all necessary adjustments, and in the presence of the Owner's representative, test the transfer switch to determine whether the equipment conforms to specified requirements and properly controls the engine generator.

END OF SECTION

