



Pipeline Reconfiguration

Power Generation System

The Strategic Reconfiguration project will make significant changes to the power systems at the electrified pump stations. The existing mainline pumps are driven by gas turbines, and the pumps at Pump Stations 1, 3, 4, and 9 will be replaced with electric-motor-driven pumps requiring a large amount of electric power not currently available at the pump stations.

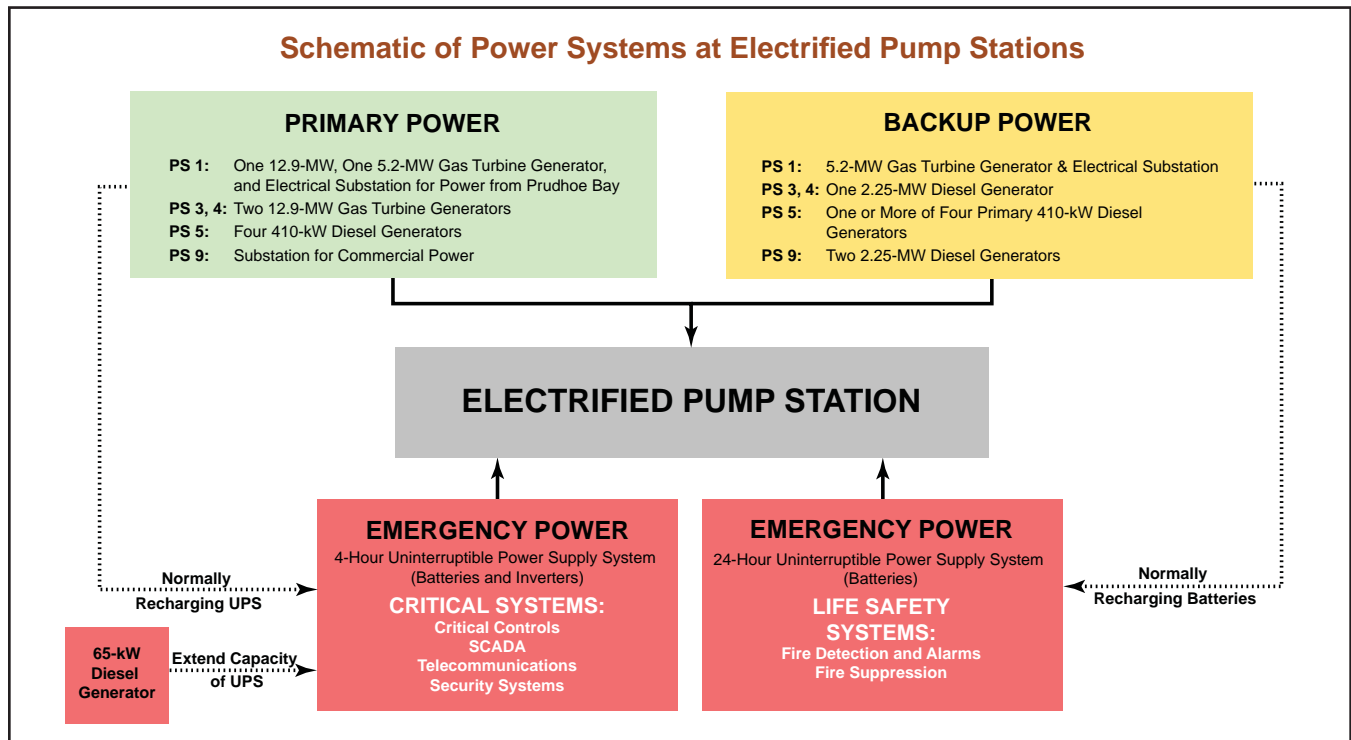
Primary, backup, and emergency sources of power will be installed at the stations. Two gas-turbine generators will provide the primary power at Pump Stations 3 and 4. A combination of two gas-turbine generators and the Prudhoe Bay power grid will power PS 1, while PS 9 will rely on the local electric utility for primary power. Four reciprocating diesel generators at PS 5 will provide both primary and backup power for this relief station. Medium-sized diesel

generators will provide backup power at Pump Stations 3, 4, and 9 (PS 1 will have backup from the grid).

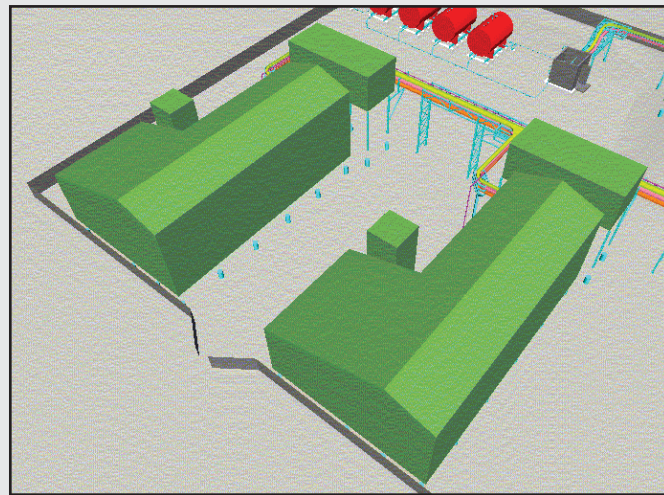
If primary power fails, emergency power will run life safety systems (fire and other critical systems such as critical controls, SCADA, telecommunications, and security systems) until backup power can be brought online. Dedicated batteries for the fire systems will provide at least 24 hours of power. Other critical systems will have up to 4 hours of emergency power via an uninterruptible power supply (UPS) system, which can be extended by a small 65-kilowatt (kW) diesel generator.

Diagrams showing the generator modules can be found on the next page, while page 4 contains descriptions of the power system for each pump station.

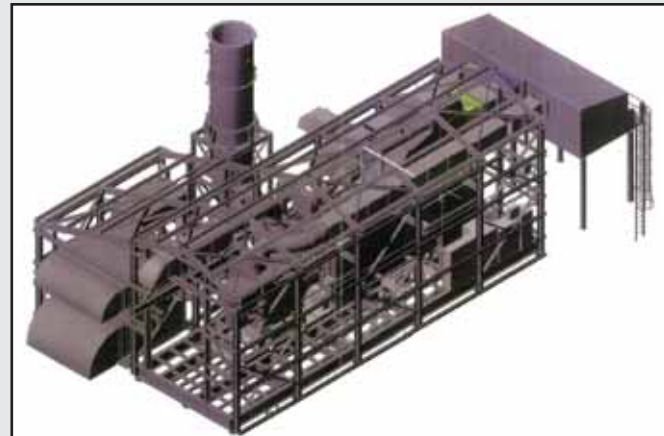
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Turbine Generator



The drawing above shows the two turbine generator modules which are being installed at Pump Station 3. Below is a “skeleton” schematic of a turbine generator module showing the frame of the arctic enclosure and the interior components of the module. The photo at the bottom shows the interior of the Siemens Cyclone turbine during assembly at the Siemens facility in Houston.

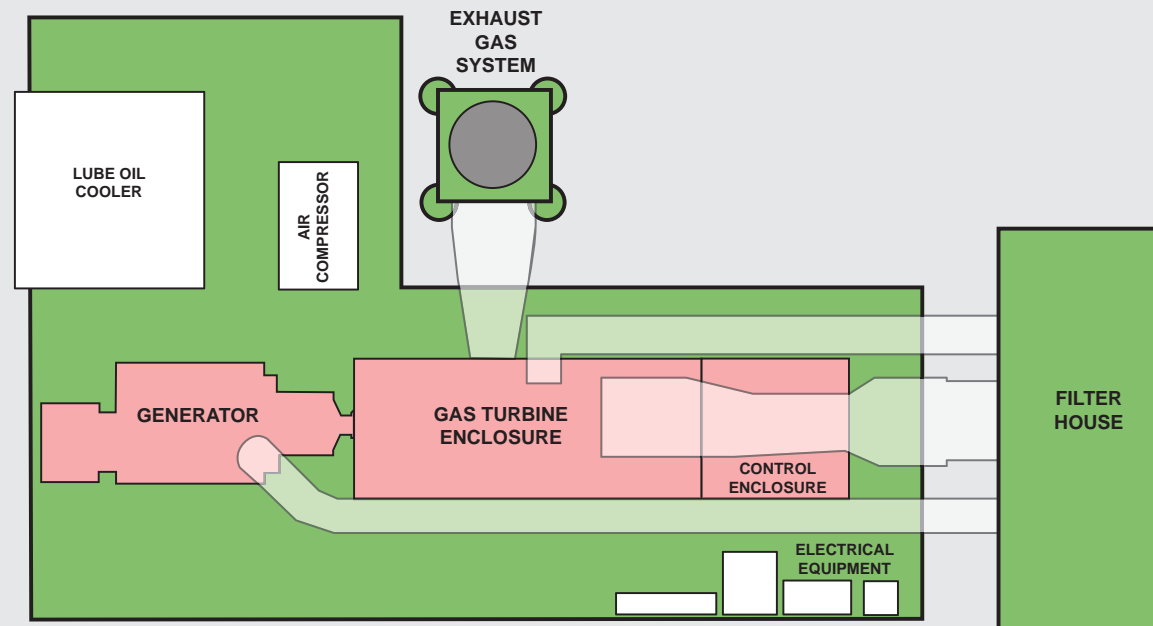


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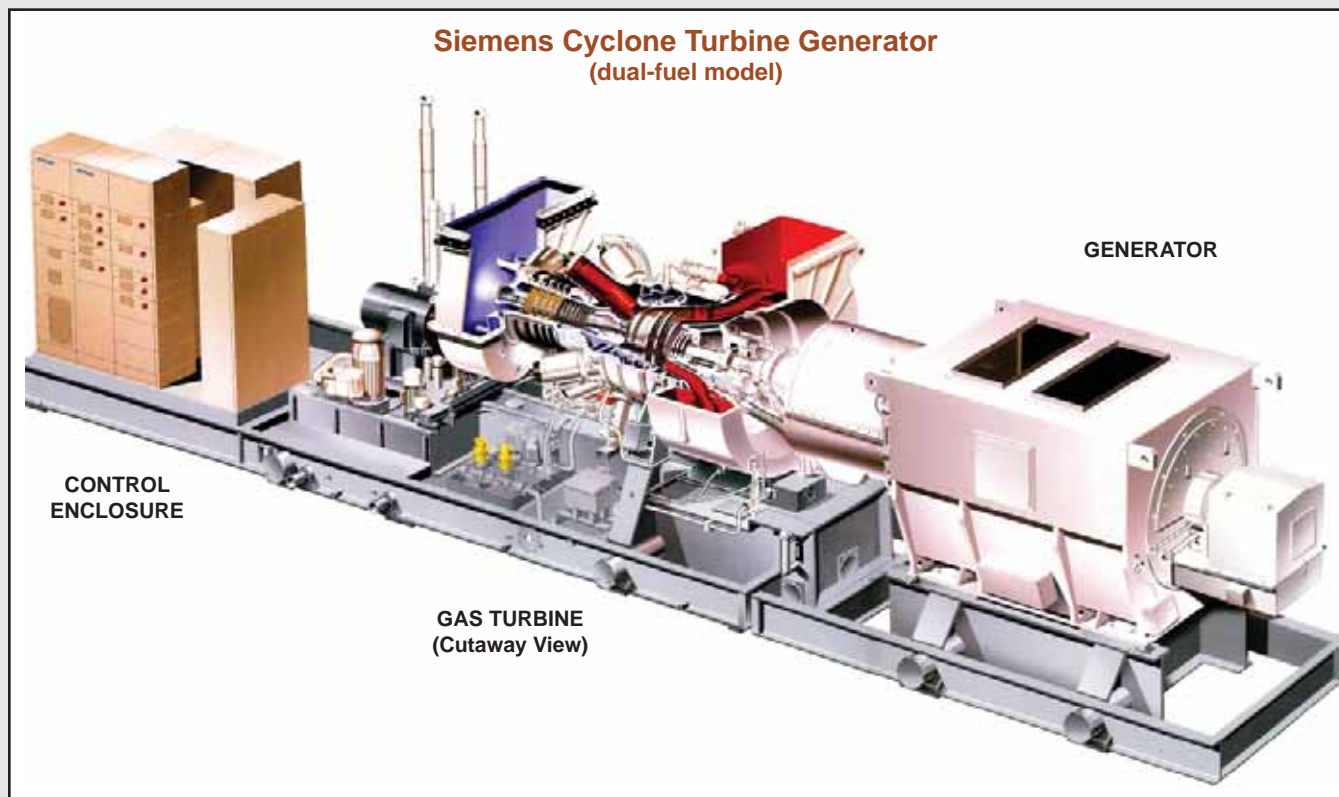
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Anatomy of a Generator Module



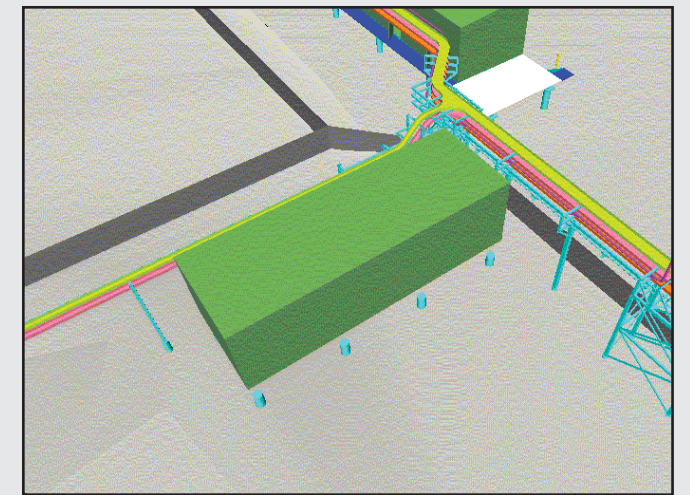
The plan view above shows one of the turbine generator modules to be installed at Pump Stations 1, 3 and 4. This drawing depicts the configuration for the modules containing a Siemens Cyclone gas turbine, a manufacturer’s drawing for which is shown below. This graphic depicts the dual-fuel units to be installed at Pump Stations 3 and 4. These particular units can run on either liquid turbine fuel or natural gas.

Siemens Cyclone Turbine Generator (dual-fuel model)



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Diesel Generator



The diesel generator module for Pump Station 3 is shown in the drawing above. Pump Station 3 will have a single 2,250-kW diesel generator to serve as backup power supply. The photos below shows a Caterpillar 410-kW diesel generator and the module in which it was being installed for Pump Station 5.



Primary and Backup Power

Pump Station 1

Pump Station 1 will have two gas-turbine-driven generators installed on site for primary power sources. One of the turbine generators will be a 12.9-megawatt (MW*) Siemens Cyclone unit; the other will be a 5.2-MW Solar Taurus 60.

Another source of primary and backup power will be the Prudhoe Bay Central Power Station (CPS). A new tie line operating at 69 kilovolts (kV) will connect the CPS with a new substation at Pump Station 1. This substation will provide up to 21 MW from the CPS grid at the required 13.8 kV. The normal draw will be 3 MW, but up to 21 MW will be available for short times during planned or unplanned maintenance.

Pump Station 1 will normally operate with approximately 15 MW of power — 12 to 14 MW from the turbines and the remaining from the CPS. The Cyclone alone will provide enough power for the station to pump around 800,000 barrels per day and carry other station loads. The Taurus alone will be able to carry station loads and allow for pumping of approximately 300,000 barrels per day. An 800-kW diesel-fueled turbine generator will make it possible to restart the Cyclone without assistance from an external power source (a process called “blackstart”).

Pump Stations 3 and 4

Pump Stations 3 and 4 will have identical power systems. Primary station power will be supplied by two 12.9-MW Cyclones, one of which will be able run on either natural gas (the norm) or liquid fuel.

A single 2,250-kW diesel generator fueled on arctic-grade diesel will provide backup power at each station. The unit will be equipped with a 24-volt battery that will provide blackstart capability. The diesel generator will automatically start if primary power fails and will supply enough power to keep the station warm, to run critical systems, and to provide blackstart for the two Cyclones.

*The power ratings for the Cyclone and Taurus are the “ISO ratings” for the generators. ISO is the International Organization for Standardization. The prefix “mega-” means million, while “kilo-” means thousand.

Pump Station 5

Pump Station 5 will continue to serve as a relief station with no installed mainline pumps. Four new 410-kW diesel generators will provide power. Normally, two of these generators will be on standby, and one or both of them will automatically start if there is a problem with one of the operating units. A generator may also be started at times of high power draws such as when a pipeline re-injection pump is run after relief events.

Pump Station 9

Primary power for Pump Station 9 will be supplied through a 138-kV tie-line from the Golden Valley Electric Association (GVEA) local utility. A new substation at PS 9 will provide up to 22 MW of power at the required 13.8 kV.

Two 2,250-kW diesel generators packaged in a single arctic module will supply 4.5 MW of station backup power. The units will be fueled by arctic-grade diesel. Each unit will have a 24-volt battery system that will allow for blackstart. If power from GVEA is lost, the two 2,250-kW generators will automatically start and come on-line. These generators can supply enough power for station loads and a pipeline throughput of about 300,000 barrels per day.

Emergency Power

Loss of both primary and backup power at an electrified pump station will prevent the pumping of oil. However, the emergency power system will provide at least 24 hours of operation for the fire alarm and suppression systems and 4 hours for other critical equipment and systems. Dedicated batteries provide the 24-hour supply for the fire systems, while a battery UPS serves as the 4-hour supply for the other critical systems. A new 65-kW diesel generator at each pump station will start automatically if primary and backup power are lost. This generator extends the capacity of the UPS system.

During normal operations, primary station power will keep the batteries of the emergency power system fully charged. If primary power fails, the emergency system takes over until the station’s backup power is on-line. The batteries and station UPS would then recharge and be available for any subsequent failures of primary power. If backup power is lost, the emergency system takes over.