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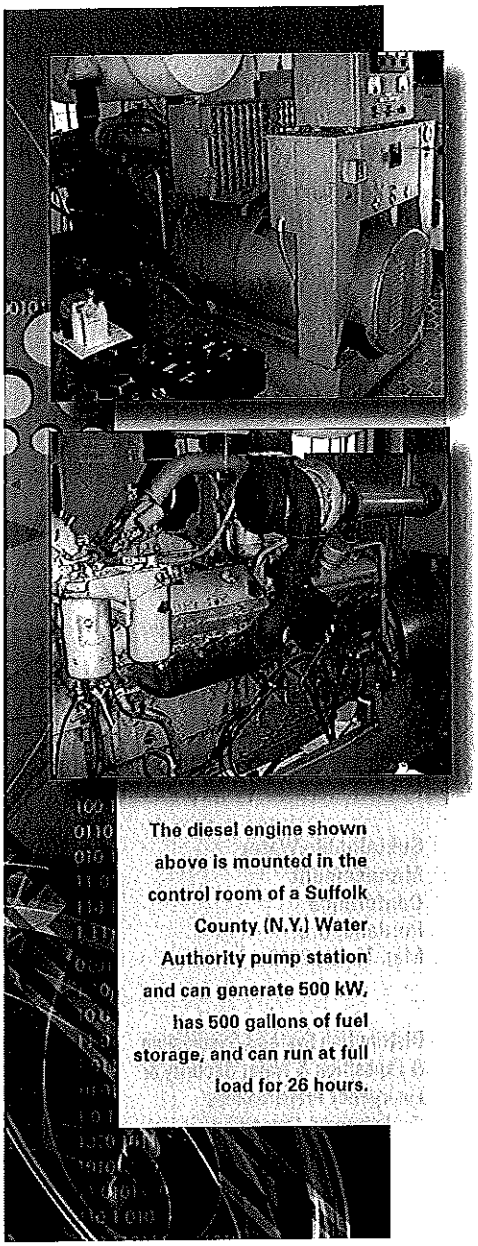
Standby Power Generation: A Key Part of an Emergency Plan



The diesel engine shown above is mounted in the control room of a Suffolk County (N.Y.) Water Authority pump station and can generate 500 kW, has 500 gallons of fuel storage, and can run at full load for 26 hours.

Power outages are everyday occurrences in the United States. They may last for a few hours or, in the event of a major disaster, for weeks or even months. Events such as the Northeast Blackout of 2003 and Hurricane Katrina in 2005 have shown that we cannot rely solely on power suppliers and the national distribution grid for uninterrupted power. After a disaster, water providers are called on to restore services quickly, a task that requires a reliable source of power. As such, standby power generation should be a key component of any water utility's emergency operations plan, regardless of its size. Planning for sufficient standby power to maintain adequate water pressure for firefighting and sanitation in all sections of a distribution area is key.

DETERMINING COVERAGE NEEDS

The Suffolk (N.Y.) County Water Authority (SCWA) has a unique operational environment of 245 pump stations, 41 booster stations, and 603 wells divided into 44 pressure zones. Some of these zones are small, with only one pump station, whereas other zones have 40 or more. With this many remote sites, uninterrupted power is critical. SCWA maintains a 40% or greater coverage rate in each pressure zone for stations with standby power. These coverage rates were determined by working with the county health department and using average daily pumpage rates. This information is reviewed annually, and any required changes are implemented. SCWA has 116 standby generators, consisting of two natural gas, six propane, and 108 diesel engines that range in size from small four-cylinder units generating less than 100 kW to 16-cylinder units that generate more than 1,000 kW. With this many units in service, it was necessary for the utility to develop a comprehensive specification, maintenance, testing, and tracking process for its standby power units.

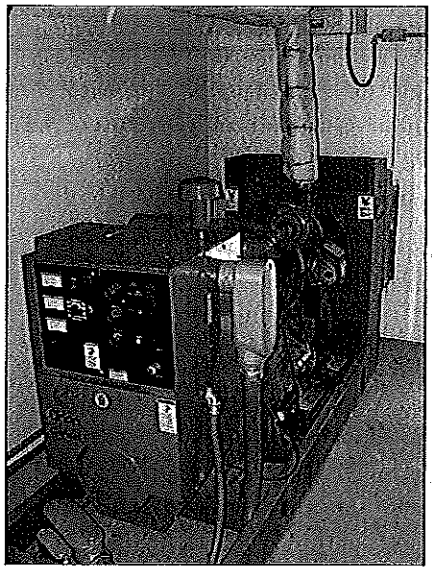
Considerations in generator choice. To select the right generator, consider a unit that is easily serviced by either company mechanics or a local dealer/service center. Purchasing a generator that cannot be serviced locally will ultimately present problems—routine maintenance will be more costly, and emergency service may not be available at all when it is most needed. Plan on having basic maintenance supplies on hand, such as coolant, belts, oil, air, and fuel filters for each unit in the field. Having these types of supplies on hand can get a unit back in service quickly during an emergency if there is a breakdown. If installing multiple units, try to select from one manufacturer, because this will make servicing the units easier (even if the units are different sizes, they will probably use common filters). If the generator is to be mounted in an external enclosure, specify an enclosure large enough to allow easy access to the radiator; fuel, air, and oil filters; and charging system.

CONSIDERING BACKUP OPTIONS

Compliance. An additional consideration when selecting a standby unit is its emissions compliance. In 2010, the US Environmental Protection Agency (USEPA) released the National Emission Standards for Hazardous Air Pollutants for Reciprocating Internal Combustion Engines (40 CFR Part 63; EPA-HQ-OAR-2008-0708). This standard imposes emissions regulations for stationary engines producing greater than 10 tons annually of any single hazardous air pollutant or 25 tons of any combination of hazardous air pollutants. Compliance with these regulations should be confirmed with the engine's manufacturer before purchasing the unit. Although exemptions are available for residential, commercial, and industrial users, any utility that operates its standby unit for more than 15 hours annually is not eligible for an exemption. The same exclusion applies to utilities that participate in peak-shaving or load-shedding operations. AWWA has submitted a letter to the USEPA asking them to reconsider this regulation for water and wastewater utilities, but thus far has not received a response. This standard would impose a hardship on utilities of all sizes because the costs associated with bringing units into compliance would be prohibitive. Utilities may be forced to decide between compliance and reducing or eliminating their standby power–generating capacity.

Location. Generator locations should be carefully considered. Standby units can be mounted on a trailer as a mobile unit, inside a pump station building, or outside either in the open or in an enclosure. Smaller units mounted outside should have removable side panels, whereas larger units mounted in an enclosure will have catwalks on either side of the generator to facilitate maintenance and repair. If a generator is being installed in an area that is prone to flooding or storm surge, provisions should be made to install the generator in an elevated location or enclosure. Specifying that the air intake and exhaust be vented through the roof will offer an added degree of protection if the water levels get high enough.

Fuel. Fuel type should also be carefully considered when buying a standby power unit. Diesel is the most common fuel, followed by natural gas, and then propane and gasoline. One downside to diesel, propane, or gasoline is the need to replenish fuel tanks either during or after a power outage. Natural gas generators are filled from a pipeline connection to the local supplier. This option provides an uninterrupted fuel supply, provided the gas lines are not broken, such as during an earthquake. In some cases, the power may be out for weeks or even months. Fuel consumption and fuel storage capacity are important factors to consider to ensure a continued ability to remain on line. Plan on having enough fuel on hand to run generators uninterrupted for at least 24 hours before refueling. In addition, an emergency operations plan should include provisions to refuel and service generators during an extended power outage.



The power generator shown here has 500 gallons of fuel storage and can run at full load for 31 hours. This unit is installed at a booster station and was placed in a separate enclosure away from any of the pumping equipment, which is a method the Suffolk County (N.Y.) Water Authority has been using for 15 years.

Many of SCWA's standby generators were purchased in the 1960s and 70s and thus did not have the proper instrumentation to allow easy monitoring of fuel consumption. Therefore a program to measure fuel usage under a full load was initiated, and this information was added to the SCWA generator database as well as to its supervisory control and data acquisition (SCADA) system. It was calculated that systemwide, consumption was approximately 1,635 gph or 39,240 gpd. Systemwide fuel capacity is 54,500 gallons, which provides an average run time of 33 hours using only the fuel on hand. SCWA's standard fuel storage is 550 gallons for units mounted inside pump station buildings, using two 275-gallon home heating oil storage tanks. Generators installed after the late 1980s were installed outside of the pump stations in separate enclosures. Their internal fuel tanks contain from 500 to 2,000 gallons and are the double-wall construction type with spill and leak alarms. A few sites still have 1,000-gallon fiberglass tanks that are buried on site. Utilities should consult the local health department to verify requirements for fuel storage because regulations vary from state to state.

Some of SCWA's sites can run as long as 100 hours without refueling, whereas others are limited to less than 24 hours. These numbers are based on a full fuel tank. Pump station operators are instructed to submit an order for fuel if the level goes below three quarters of the tank's capacity. If there is advance warning of a storm, such as a hurricane, all fuel tanks are filled to capacity regardless of level before the storm arrives.

DEVELOPING A MAINTENANCE PLAN

A comprehensive maintenance plan should be drafted for every generator installed. At SCWA, generators are typically serviced once per year. This service includes

changing air, fuel, and oil filters; changing the engine oil; and sending the oil out to be tested for the presence of metals that would indicate internal engine wear. Engine coolant is also tested at this time to ensure that it is still within the manufacturer's specifications. Because of the large number of units, SCWA uses outside vendors to service and repair its generators. The service area is broken up into two zones, and service contracts are awarded for each zone. This is done to ensure that SCWA is not committed to a single vendor over the course of a contract period. In addition, there are personnel on staff capable of performing repairs in the event a contractor cannot respond in a timely manner to an emergency situation. After a unit is repaired or a service is performed, every unit is tested under a load. This is done for several reasons. First, it is essential to always verify that the generator can produce stable voltage after a service cycle. A generator that does not produce stable power of the correct voltage can damage any electrical device attached to it, and if the automatic transfer switch (ATS) does not detect the proper voltage, it will not accept that power source. Second, running a generator without an electrical load on the unit will result in a condition known as "wet stacking," which occurs when excess fuel collects in the exhaust system, creating quantities of black smoke.

As part of his or her normal pump station operator duties, every operator at SCWA checks the generator fluids once per week. Fuel, oil, and coolant levels are recorded on a monthly log sheet, as are the generator batteries' water levels. In addition, every generator at SCWA is tested at least once per month under a load. Manual start/transfer units are run for at least an hour by the operator while he or she is at the station. At least one well is run at that time to provide a load. Remote-start generators are run once per month for two hours and are controlled from SCWA's control center via SCADA. At least one well is run at this time to provide a load. Wells are run during the 8:00 a.m.-to-4:00 p.m. shift, so if there are any problems, mechanics and electricians are available to investigate and repair any issues. In addition, generators are run quarterly with the full load that they are expected to carry. Although a unit may appear fine during normal testing with only one well, problems may present themselves when it is placed under a full load.

All remote-start generators are controlled by our SCADA system, with local controls onsite as a backup. When the ATS detects a no-voltage condition in any of the three phases or detects an undervoltage or overvoltage condition, the generator is started and power is switched to the emergency supply by the ATS. A generator-run alarm is sent to the control center at this time. The operator monitoring the SCADA system will investigate the reason the generator is running, either by contacting the local power company or by sending a pump station operator to check first hand. The control center can monitor generator run time, transfer time, percentage of fuel remaining, and the approximate run hours remaining. Normal and emergency power status can also be monitored. If the generator shuts down because of low oil pressure, high coolant temperature, low fuel pressure, or an engine running over speed, an alarm is generated in the SCADA system. An alarm is also generated if the unit fails to start, at which point an operator is dispatched to investigate and repair if necessary.

Every generator supplied to SCWA is required to include operator, repair, and electrical manuals, which are stored at the office to ensure they will be available when needed. Service and operator manuals are reviewed before placing a unit in service, and all service intervals are noted. It is important to follow the manufacturer's recommended service intervals. Not doing so can result in the generator failing when it is most needed. All maintenance records for generator service and repair are tracked in SCWA's database. It is recommended that paper records be kept in a separate location from the generator because generator rooms can be hot and humid. These records should be maintained for the life of the unit and will help provide a clear picture of its performance and operating costs.

A section should be included in an emergency operations plan to address a failure of primary generators or fuel supply. Consider onsite portable units that are either owned or rented, an emergency contract with a local supplier, or using your state's Water/Wastewater Agency Response Network (http://apps.awwa.org/ebusmain/warn.aspx). Investigate alternate fuel sources in the event that the primary supply is not available.

Properly specifying, maintaining, and testing backup power supplies—and including backup power in an emergency operations plan—allows water utilities to concentrate on maintaining or restoring service to customers after a disaster instead of waiting for the power company to restore service to the water utility.

—Phil Thompson has worked for the Suffolk County Water Authority for eight years, and has been the mechanical supervisor for two years. He provides mechanical maintenance and repairs for 245 pump stations with 603 wells and more than 750 chemical dosing pumps, and a high number of standby generators, water storage tanks, iron removal plants, ion exchange plants, and standalone booster stations. He is working toward a master's degree in emergency management. Thompson is a committee member on AWWA's Emergency Preparedness Security Committee and the Standards Committee on Emergency Preparedness Practices. He can be reached at pthompson@scwa.com.

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