Generator Management

Application Brief

Generators are often the primary backup solution for failed commercial power but can also be used as the primary power source - commonly found in remote or hard-to-reach locations. Because generators are critical to maintaining site availability remote monitoring, management, and control is no longer optional but critical to network quality.

There are numerous challenges associated with generator management:

- Monitoring generator performance (idle and running)
- Monitoring and understanding the significance of detailed generator alarms
- Understanding fuel tank levels of all generators in the network
- Creating preventative maintenance schedules
- Reducing truck rolls and maximizing technician efficiency

The generator management application, part of the Westell power management solution, manages the health and monitors the status for both fixed and portable generators. Proactive alarms are available for items such as maintenance timers, generator performance, and low fuel levels. This application can remotely start and stop compatible generator systems and perform routine maintenance cycles as part of a preventative maintenance plan. It can determine the amount of time the site is operating on different power sources (such as commercial and generator power) and provides a historical measure (important fir future equipment planning.)

Additionally, the generator management application will allow customers to meet regulatory or government requirements for required reports on the accurate measurement of generator runtime.

The generator management application contains a set of network elements (NEs), dashboards, alarms, measurements, reports, and controls within the Westell Remote suite of products. These are managed by Westell Optima management system to provide accurate and current information.

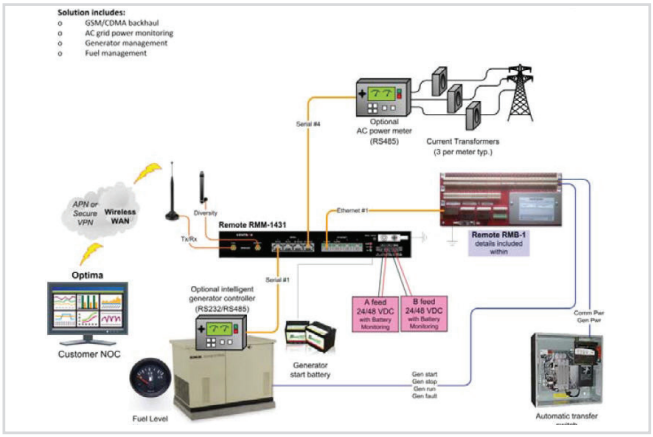

Figure 1: Power management solution example

Solution Design

Figure 1 shows a power management solution design example including the Westell generator management application. In this example, the Westell solution is monitoring AC power generator health, and the state of the Automatic Transfer Switch (ATS).

Monitor, Manage, and Control Generator Power

Westell uses the Optima management system and Remote suite of products to monitor the status of a generator from virtually anywhere. Live View, a unique feature within Optima, is a specialized screen that provides a near real-time view of an entire site including generator operation. Live View can be used by Network Operations Center (NOC) operators and operations technicians to determine what problems may exist with the generator or other site devices and what actions are required to repair them.

Generator Management

Application Brief

Figure 2 shows the Live View display specifically for generator status. If a monitored generator subsystem is not operating appropriately, the health indicator will be first indication that a problem exists.

The key areas of information provided in Live View for generator management include the following:

- Health: operating normally or an issue that could potentially impact the generator's performance has been detected
- State: is the generator idle or running?
- Testing: is the generator in test mode, maintenance mode, or manual mode?
- Fuel percentage: fuel remaining based on the total tank capacity (assuming a fuel sensor is installed)
- Fuel level: indicates volume of fuel available (in liters or gallons - assuming a fuel sensor is installed)
- Fuel capacity: total fuel tank capacity (in liters or gallons - assuming a fuel sensor is installed)

The Westell solution offers cut-through access to intelligent controllers that typically require a site visit to connect. Using Optima's cut-through capability, users can obtain single-click access to vendor-specific software suites that utilize local PC COM port access or provide access to web browser interfaces supported on IP enabled equipment at a remote site. This feature also provides access to devices that utilize private or non-routable IPs, saving company IP addresses for other uses.

The generator management application provides the ability to manage both legacy and new generators by interfacing to intelligent generator controllers. Intelligent generator controllers provide a method of fault and performance data retrieval using either a proprietary or industry standard communications protocol (i.e. Modbus) over a serial communications interface (RS232 or RS485).

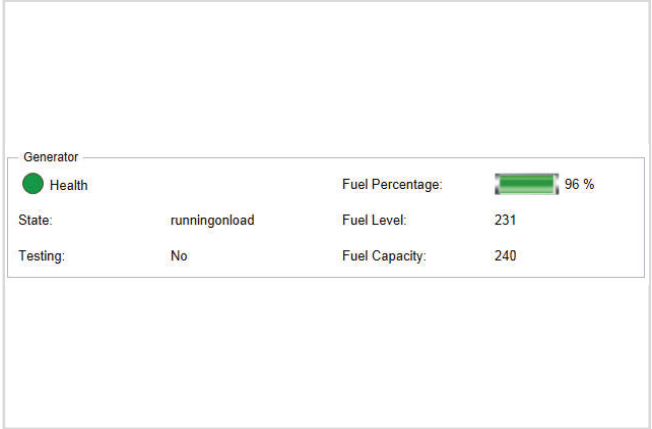

Figure 2: Live view showing near real-time generator status

Reports, Alarms, and Measurements

The Westell generator management application provides standard reports, alarms, and measurements. The near real-time and historical information available can help service providers and operators prioritize which sites need to be addressed in emergency situations. The application helps with planning by determining when generator maintenance is needed as well as future equipment repair/replacement scheduling.

Standard Reports

The following reports are available for the generator management application and can be customized to fit specific customer deployments:

- Generator runtime
- Generator runtime until empty (if fuel sensor installed
- Generator testing runtime
- Generator troubles (start failures)
- Generator troubles (stop failures)
- Ranking: generator runtime
- Ranking: generator scheduled maintenance
- Ranking: generator testing runtime

Generator Management

Application Brief

Alarms Available

There are numerous alarms available for the generator management application. Alarms provide fault data if something isn't operating as intended. The following is a list of standard alarms currently available:

- Alternator
- Communication
- Emergency stop
- Engine temperature
- Failed to start
- Failed to stop
- Generator failed
- Frequency
- Generator breaker failure
- Health of the generator
- In maintenance mode
- Oil pressure
- Overload RPM
- Radiator level
- Remote access
- Short circuit
- Running
- System error
- Testing active
- Unexpected stop

Important note: the alarms are dependent on the generator and generator controller being used. Contact Westell for a complete list of available alarms for a particular model of generator.

Measurements Available

The following is a list of standard measurements available in the generator management application. This data is gathered every 15 minutes.

- Total runtime
- Count: failed to start
- Count: failed to stop
- Runtime until scheduled maintenance Running duration in hours
- Running duration in minutes
- Running duration in seconds
- Testing duration in hours
- Testing duration in minutes
- Testing duration in seconds
- Failure duration in hours
- Failure duration in minutes
- Failure duration in seconds

Important note: the measurements are dependent on the generator and generator controller being used. Contact Westell for a complete list of available measurements for a particular model of generator.

Generator Management Examples

Using the Westell generator management application provides many benefits for cost and maintenance savings and improved network availability. Below are two examples of information that is provided by Optima to understand site power status.

Example 1: Power Failure and Generator is Running

Live view in Figure 3 is indicating that site power is currently available and running on generator power. This is determined by viewing the 'Site Power' Health alarm indicator showing an alarm (orange) due to commercial power being unavailable (shown in 'Commercial Power' with the alarm indicator in red). The generator is operating normally ('Generator" Health alarm indicator is green). Table 1 provides additional information on the scenario from Figure 3 (Note: In this example, commercial power is available through dry contacts).

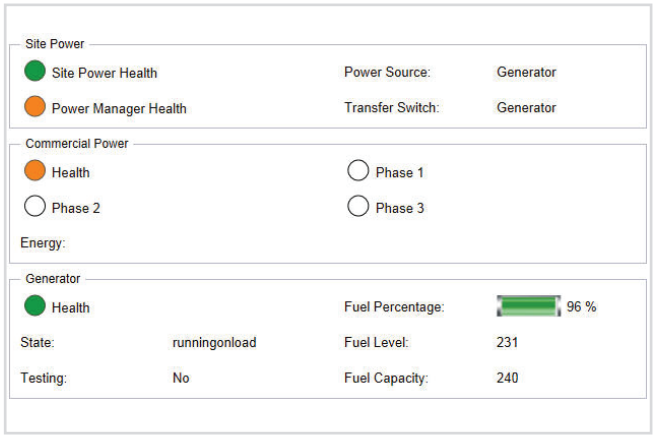

Figure 3: Live view indicating commercial power was lost and the generator assumed the site load

Example 2: Commercial Power Returned but Generator Failed to Stop

Live view in Figure 4 shows that site power is currently available and being supplied by commercial AC power. The generator continues to run and is unhealthy ('Generator' Health alarm indicator is orange) because the generator should not be running. Possible causes may include that the generator is portable and being operated manually by maintenance personnel, the transfer switch has malfunctioned, or the generator is in cool down. Table 2 provides descriptions of this scenario.

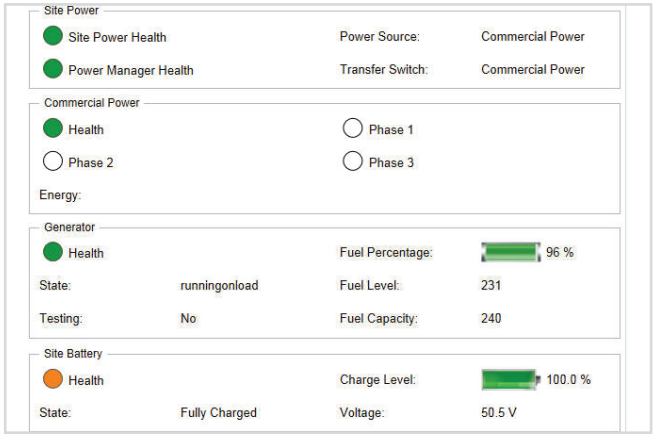

Figure 4: Live view scenario indicating generator has failed to stop

GROUP	DISPLAY NAME	DESCRIPTION
Site Power	Available	AC power is available (from the generator)
	Health	Overall sit power is unhealthy (commercial power has failed)
	Power Source	Indicates generator is running
	Transfer Switch	Specifies the generator is carrying the site load
Commercial Power	Available	Commercial power is not available
	Health	Active when one or more phases has been lost
	Phase 1	Active when phase 1 voltage is out of band
	Phase 2	Active when phase 2 voltage is out of band
	Phase 3	Active when phase 3 voltage is out of band
Generator	Health	Health = OK. Generator = running
	State	Running: generator is active
	Fuel Percentage	Displays percent of fuel remaining in the tank
	Fuel Level	Displays current fuel volume/level presented in gallons/liters
	Fuel Capacity	Displays total tank capacity presented in gallons/liters

Table 1: Description of issues relating to a commercial power outage and using a generator as backup

Generator Supported

The Westell generator management application is currently available for use with the following generators:

- Deep Sea 7320
- Generac H-100
- Generac H-100 with HTS
- InteliLite AMF 25
- Lovato RGK60
- Discrete generator (standard)

Important note: please contact Westell if interested in deploying the generator management application for a generator controller not included on this list.

GROUP	DISPLAY NAME	DESCRIPTION
Site Power	Available	AC power is OK
	Health	Overall sit power is OK (commercial power is in operation)
	Power Source	Indicates commercial power is being used
	Transfer Switch	Commercial power
Commercial Power	Available	Commercial power is OK
	Health	OK
	Phase 1	OK
	Phase 2	OK
	Phase 3	OK
Generator	Health	Unhealthy: generator is running but commercial power active and healthy. Generator should not be operating
	State	Running

Table 2: description of issues relating to generator that failed to stop running

Application Brief

The Benefits of Generator Management

The Westell generator management application reduces operating costs and improves network quality and availability. Monitoring the power status and utilization provides the details necessary for determining what sites are operating with generator power or are running on other backup power types (such as batteries) due to commercial power or generator failures.

Energy consumption is minimized by leveraging backup power sources to reduce unnecessary generator runtime and ensuring the generator is running efficiently and remains property maintained. The automated generator maintenance cycling reduces truck rolls by recording operating times, generator tachometer hours, and creating reports required by government or regulatory authorities.

Remote management also reduces unnecessary site visits by providing control capabilities. When a truck roll is required, the remote access and cut-through capabilities have provided details on the generator status, enabling an intelligent site visit.

Understanding the current condition of generators can significantly reduce capital expenses over time. By monitoring and managing the infrastructure, the useful life of the generator can be extended so replacement costs are minimized. Through occasional review of the network using historical reports, generator vendors can be ranked on performance in a particular situation to optimize equipment based on a site's requirements.

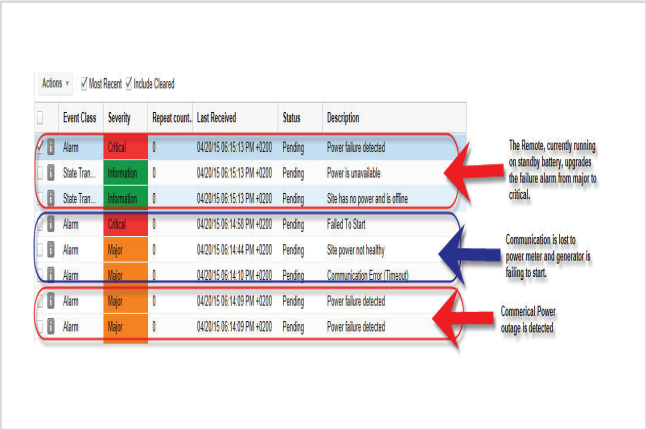

Figure 5: Sample of details from Optima's event view for a power outage

Power Management Solution

The Westell power management solution provides monitoring, management, and control of generators and other power types including commercial, battery, and hybrid power alternatives. The applications in the power management solution work together, providing intelligent information to a service provider. For example, the information obtained from the battery, rectifier, and DC power monitoring applications can result in a comprehensive understanding of a battery's capacity to extend the useful life of the capital investment. The fuel monitoring and generator management applications combine to provide the information required to identify the generator runtime available, facilitate timely refills, and eliminate unnecessary site visits. This reduces operating costs and improves network availability, especially during emergency situations. In addition to power-related applications, Westell also provides comprehensive intelligent site management including security management, environmental management including HVACs, and communications management for microwave and distributed antenna systems.

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