Case Study: **Utility**

Salt River Project head office, Phoenix, Arizona

Salt River Project Expands Its Power Quality Program

Salt River Project (SRP) is a nearly $2.0 billion water and electric utility serving over 800,000 customers in Phoenix, Arizona. As competition in its area increases, SRP is always on the lookout for ways to offer customers better service and better power quality (PQ). While the company has had a power quality program in place for years, it is continually striving to excel in this arena.

Recently, SRP decided to expand upon the common utility practice of documenting outage frequency and duration to also include a system to measure voltage sags. Utilities generally focus their efforts heavily on system reliability, but pay less attention to power quality issues like voltage sags because these events don't cause widespread outages and only affect customers who are sensitive to voltage fluctuations.

Application:
Power quality monitoring

System:
ION Enterprise®
ION® 7700 meters

Benefits:

- Power quality assurance
- Reduced system disturbances

Rapid Response

Industry-standard reliability indices don't accurately capture the impact of power quality events because these indices generally don't apply to outages that last less than one minute (or in some cases, even five minutes!). Because a typical voltage sag lasts for only 1 to 10 cycles, a mere fraction of a second, and usually doesn't involve a complete loss of voltage, traditional reliability indices can't accommodate these events.

Although voltage sags don't usually have as severe of an impact on an end-use customer as momentary or extended outages, they can still cause customer equipment to drop off-line, diminish product quality, and decrease productivity. And although their impact on an event-by-event basis may not be as severe as an extended outage, voltage sags tend to occur much more frequently than outages, so the total impact of multiple voltage sags over a given timeframe may actually be significantly greater than an outage. In fact, for some customers, power quality is a much more serious issue than reliability.

Relating Quality & Customer Satisfaction

When their reliability indices couldn't explain certain customer satisfaction findings, SRP realized that power quality and power reliability are unique, and must be dealt with differently. They wanted to implement a system that would better meet the needs of their PQ-sensitive customers.

They recognized that without accurate data to track the impact of voltage sag events, system improvements cannot be justified, customer damage claims cannot be substantiated, and the trending of power quality levels over time cannot be accomplished.

To solve this issue, SRP created a new program to measure voltage sag indices at key sites, with the goal of obtaining system-wide PQ monitoring coverage and producing a set of system-wide voltage sag indices that could be used to effectively measure their PQ performance.

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Creating a Power Quality Monitoring Base

In order to produce a set of system-wide voltage sag indices, a power quality monitoring base was needed. SRP had to collect enough statistical data on events within their system to understand what sag events were happening within its system, as well as their location, frequency, duration and severity.

Four key indices were created to measure and quantify sags:

The Sag Energy Index (SEI) provides a measure of the total severity of a collection of sag events, where the collection could be based on a period of time or a particular location. This index takes into account voltage sag depth and duration on all phases.

The Sag Count Index (SCI) measures how often sags occur within a given time period.

The Sag Severity Index (SSI) measures the average severity of a collection of sag events.

The Severe Sag Count Index (SSCI) is similar to the Sag Count Index (SCI), but only measures sags with a Sag Energy (SE) greater than a specific, user-defined threshold.

The data is also filtered and normalized to prevent unintentional miscalculation or bias in the results and to allow for easy comparison from site to site and year to year.

Key Locations for PQ Monitoring

Power quality monitors serve as a data collection system that "watches" for voltage sag events that may impact customers. Determining the location of PQ monitors for the establishment of voltage sag indices was critical, balancing the cost of additional monitors versus the amount of coverage that a given monitor location can provide.

On SRP's electric system, the 12kV distribution bus (which normally connects to four 12kV feeders) is the optimal location for PQ monitoring, offering a more affordable solution than monitoring each feeder independently, but providing adequate detail to measure and assess voltage sag events. A single PQ monitor located at the 12kV distribution bus captures both sags due to higher voltage class faults, as well as sags due to downstream feeder faults.

SRP already had a number of PQ monitors located in its substations because of ongoing power quality program requirements. However, to create a system capable of comprehensive monitoring, SRP installed additional devices at substations on sub-transmission loops throughout its electric system. In total, the system now has sixty-six ION® 7700 meters from Power Measurement functioning as power quality monitors at thirty-seven substations, including some in substations dedicated to large industrial customers. The ION® meters were chosen because they can be easily customized to meet SRP's specific requirements, and offer insurance against obsolescence through firmware upgrades.

Currently, about two-thirds of the meters are connected to a central workstation via Ethernet. Some original sites are connecting using modems over dedicated leased lines, but SRP is actively working to upgrade all sites to Ethernet by installing its own fiber optic backbone to all substations.

Kevin Kittredge, Associate Power Quality Engineer, Salt River Project, using ION Enterprise to check on PQ system conditions.

Building on PQ Data

The power quality information collected by the meters is gathered and aggregated using ION Enterprise™ 4.5 software from Power Measurement. The software resides on a pair of Compaq servers located in SRP's Power Quality Lab. The information is shared with other departments (including Operations, System Planning, and System Protection) using both the "Vista" client application and the "WebReach" web access feature in ION Enterprise™.

ION 7700 meter installed at a Salt River Project facility

The ION® system also provides automatic email/pager notification to key SRP personnel as well as a summary "PQ Alert" that is sent out if a certain number of PQ monitors report events within a given timeframe.

SRP plans to expand its PQ monitoring system, prioritizing new sites by a number of criteria, including area coverage, the number of large and sensitive customers fed from that substation, ease of installation, new substation transformer bay additions, and communications availability. As the system expands, SRP's power quality indices will become increasingly accurate, as more data will improve its statistical validity (with an ultimate goal of 90% confidence level, 10% confidence interval).

Ensuring High-Quality Power

Already, other indicators of the system's benefits are clear. The new system's data correlates closely with SRP large industrial customer satisfaction measurements and helps to explain PQ-sensitive customer feedback. SRP is using this data to identify and repair conditions within its network that have a negative impact on power quality, improving its service levels to key customers and raising its customer satisfaction levels. And even though many customers may not see a clear distinction between power quality and reliability, with SRP's innovative approach to monitoring and managing both, customers are receiving some of the best power quality available on the market today.

POWER MEASUREMENT

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