



# Power Quality Monitoring and Analysis: Evaluating Power Quality at Medical Center

**S&C Featured Solution:** S&C's Power Systems Solutions Division

**Location:** Southern United States

## Customer Challenge

A large medical center in the southern United States experienced nuisance tripping of their equipment due to unexplained events on their electrical system. Realizing that nuisance tripping could be the result of any of a number of root causes, the facility contracted with S&C's Power Systems Solutions Division to perform a complete power quality evaluation of their electrical system. The facility was also considering converting their existing "conventional" medium voltage source-transfer scheme to a high-speed source-transfer system.

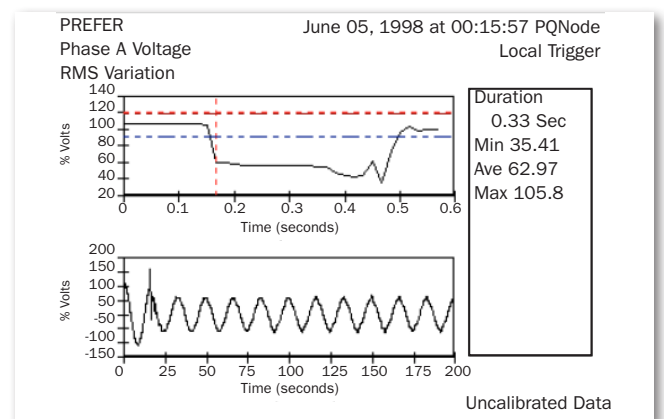
The facility is served through a common-bus preferred-alternate scheme via two incoming 13.8-kV feeders. In the event of a voltage sag or outage on the preferred feeder the conventional source-transfer equipment is designed to transfer between preferred and alternate feeders in approximately 0.3 to 3 seconds. Unfortunately, contactors in voltage-sensitive equipment, as well as adjustable-speed drives, could still be affected under such a transfer scheme, resulting in nuisance tripping of this equipment.

Furthermore, in the event of short-duration sags due to faults in the utility system, the conventional source-transfer scheme will not even attempt to transfer. Thus, the equipment will be subjected to the voltage sags even though a healthy alternative feeder may be available. On the other hand, a STS will minimize the impact of any sags or outages on the facility's electrical equipment. The STS accomplishes source transfer in response to voltage sags and outages typically 100 to 250 times faster than the conventional scheme, eliminating any impact of these kinds of disturbances on electrical equipment.

## S&C Solution

A review of the serving utility's and facility's electrical systems were conducted during an on-site power quality evaluation. Records of disturbance events and their impact on electrical equipment in the facility were also reviewed. The specific condition of the equipment in the facility's electrical system and operation of electrical equipment was carefully examined during this on-site visit. Specific equipment problems were identified and the undervoltage ride-through characteristics were obtained from equipment manufacturers.

During the second phase of the evaluation, continuous monitoring of the phase voltages on the two incoming medium voltage feeders at the service entrance to the facility was conducted over a period of three months. In addition, continuous monitoring of phase voltages and currents was also conducted at the terminals of a 4160-volt chiller and a 480-volt fan drive over an approximate two-month period. These units had been identified as the equipment most sensitive to voltage sags. Since monitoring was being done during the storm season, a large number of voltage sags related to faults on the utility's transmission





and distribution systems were recorded. A smaller number of these disturbances resulted in the actual tripping of the facility's electrical equipment. The measured ride-through performance of the chiller and fan units was compared to the CBEMA curve. Results of the comparison indicated that the facility's equipment generally had a slightly higher tolerance to disturbances than equipment covered by the CBEMA curve.

Comparison of the two feeder voltages during disturbances indicated that no significant disturbances occurred simultaneously on both feeders. Thus, at any given time there was at least one healthy feeder available to serve the facility. Occasionally slight voltage sags (more than 80% of nominal voltage) affected both feeders. These sags were not severe enough to cause the equipment to trip. More severe voltage sags (less than 80% of nominal voltage) appeared mostly as a result of faults on the distribution system on separate occasions on each of the two feeders.

## Results

In cases where the facility's equipment tripped due to a voltage sag, the associated fault duration was on the order of 0.3 seconds. In such cases, the most sensitive drive was found to ride through at least 0.03 seconds (i.e., 3 to 10 times longer than the time it would take the STS to transfer). These statistics, combined with the results of a voltage regulation study, indicated that a STS can be effectively applied to significantly reduce the occurrences of nuisance tripping of the facility's electrical equipment.