CASE STUDY

Johns Hopkins University
School of Medicine
The Koch Cancer Research Building
Baltimore, MD

Facility Description

Johns Hopkins Medicine, headquartered in Baltimore, Maryland, is an $8 billion integrated global health enterprise and one of the leading health care systems in the United States. Johns Hopkins Medicine unites physicians and scientists of the Johns Hopkins University School of Medicine with the organization's health professionals and the facilities of The Johns Hopkins Hospital and Health System.

- 267,000 square foot building
- Five floors of laboratories
- 10 stories of office space
- 250-seat, high tech auditorium connects this research tower to its twin, the Bunting Blaustein Cancer Research Building
- Mission-Critical Facility
- Completed in 2006

Existing Electrical Distribution System Conditions

- 24 low voltage, dry-type distribution transformers
- 7 year old transformers had pre-NEMA TP-1 efficiencies
- Extremely light electrical loading
- Average load factor was 11.7% of system capacity
- Load-generated harmonic profiles were in a range between K-4 & K-9

Challenge

Significant 'penalty losses'[1] were present in the low voltage distribution system due to oversized distribution transformers. Transformer oversizing is the usual outcome when meeting the requirements of the National Electrical Code. In addition to the higher capital cost of oversizing, the higher operating costs of lightly loaded transformers are significant. 'Penalty losses' were also present in the circuitry because of load-generated harmonic currents. The system's harmonic impedances created significant voltage distortion at the loads.

Over a seven-year period, electronic loads were added to a distribution system that was never designed to supply nonlinear electronic loads.

Solution

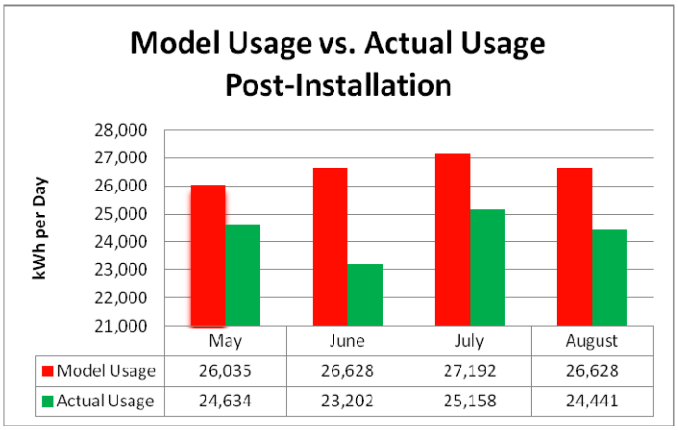
PQI was contracted by the Johns Hopkins' Energy Engineer to develop a distribution system solution that would reduce 'penalty losses', increase overall power quality and efficiency, and ensure system-load compatibility.

After confirming each transformer's maximum and average load factors, and harmonic current load profile, PQI's engineers optimized the system by replacing the twenty-four oversized, inefficient transformers with rightsized, ultra-efficient harmonic mitigating transformers. The transformer downsizing was made in accordance with CSA C802.4 and national**grid**® guidelines.

To maximize payback and return-on-investment we were limited in downsizing to one standard kVA rating. This limitation, which was far less than recommended by CSA or national**grid**® guidelines, was necessary to avoid the need to change the protective circuit breakers and cabling.

Impact

- **894,977 kWh** annual power savings
- **$89,498** total annual utility savings
- **$43,382** calculated energy savings due to transformer replacements
- **$46,116** calculated energy savings due to harmonic current reduction in the circuitry, but mainly due to voltage distortion improvement at the loads
- **9.4%** reduction in annual energy costs
- **2.1 years** project payback



[1] *'Penalty losses' are defined as consumed power that does not contribute directly to the intended work. Circuit and transformer losses at 60Hz are excluded.*

Distribution system 'penalty losses' include losses due to reactive load currents, unbalanced load currents and nonlinear load-generated harmonic currents. 'Penalty losses' also include excessive excitation [no-load] losses in oversized power and distribution transformers and elevated impedance [load] losses due to nonlinear load-generated harmonic currents.

Load 'penalty losses' include losses due to distortion of the supply voltages' sinusoidal waveforms. Load 'penalty losses' also include losses due to low voltage, when the loads are electronic.