PowerQuality Specialists

Delivering Client Solutions & Satisfaction

SOLUTION CASE STUDY

IMPULSES – BEFORE & AFTER

This case study was completed in 2003, but it is even more relevant today than it was then. The conditions identified herein are found at computer & communications facilities, hospitals, office buildings, military facilities, colleges & schools, manufacturing plants, oil & gas wells, truck stops, convenience stores, motels & hotels, malls, etc. – i.e., wherever electronic equipment is installed.

This case study was performed on a hospital laboratory that was experiencing recurring power problems. Laboratory technicians identified problematic conditions that compromised their ability to provide essential services; which also presented life-safety concerns in this particular environment:

- Intermittent Equipment Disruption – Process Restart or "Do Over" Required
- Random Equipment Lockup – System Reboot and Recalibration Required
- Equipment Lockup Every Time Electrical Supply Transferred Between Utility and Backup Generator-Set – System Reboot and Recalibration Required
- Intermittent Image Problems with Monitors, Including Changing Colors and Distortion – System Reboot and Recalibration Required
- Intermittent Data Errors, Data Contamination, or Data Loss – Process "Do Over" Required
- Random Equipment Component Failure – Downtime Caused Process Backlog
- Premature Equipment Failure – Downtime Caused Backlog and Placed Mission At Risk

The graphs shown on page 2 provide a "before and after" comparison of power events. Events are voltage excursions outside standard utility parameters. Impulses are relatively high frequency voltage excursions of short duration. When of significant magnitude and duration, these disturbances can cause malfunction of sensitive electronic equipment and damage both components and insulation.

The graphs shown on page 3 provide a "before and after" comparison of current distortion. While most of the power quality standards only consider the effects on the voltage, current distortion shows how equipment, inadequate wiring, and lack of surge suppression (all at the load-end of the electrical distribution system) can be the problem source, as it was in this hospital laboratory case.

Data was captured at the laboratory branch circuit panelboard for 24-hour periods:

BEFORE Data was collected from 05/13/02 11:00:00 through 05/14/02 11:00:00
AFTER Data was collected from 03/06/03 14:00:00 through 03/07/03 14:00:00

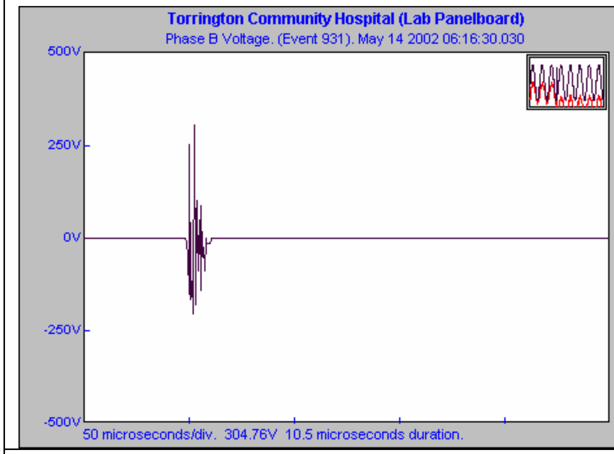
These "before and after" graphs clearly demonstrate how application of the appropriate mitigation solution dramatically improved power quality, thereby completely eliminating or significantly reducing the adverse affects described above. The hospital laboratory mitigation solution included: (1) upgrading branch circuit wiring, (2) replacing several line-interactive uninterruptible power supply units with true-online, double-conversion UPS units, and (3) installing high-quality transient-voltage surge suppression device, equipped with very good filtering, on the branch circuit panelboard supplying laboratory equipment.

I am available to discuss this document or any aspect of power quality.

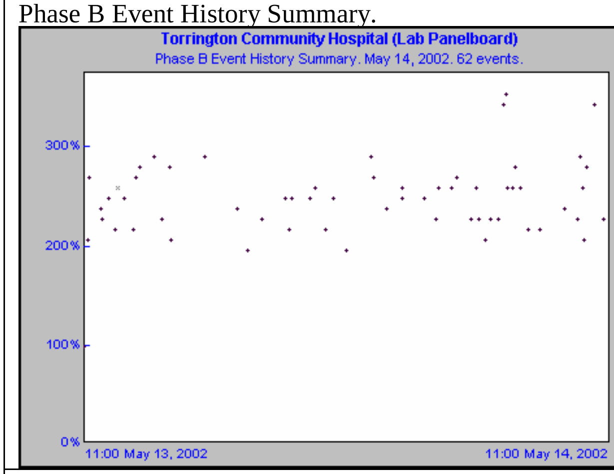
Glen Coffman

P.O. Box 20221 (82003) ▪ 6316 Moccasin Avenue (82009) ▪ Cheyenne, WY
Tel: 307-638-6911 ▪ Fax: 307-638-6893 ▪ powerquality@bresnan.net

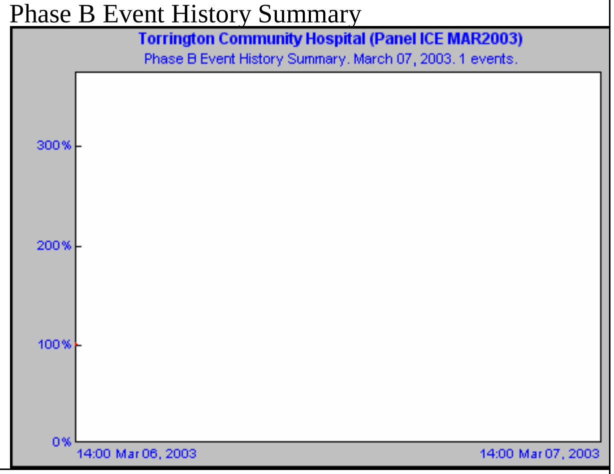
BEFORE MITIGATION	**AFTER MITIGATION**
During the BEFORE monitoring period 151 impulses occurred on the power conductors at the monitoring location. Event 931, the largest impulse (304.7 volts) is shown below.	**No impulses occurred during the AFTER monitoring period.**



Phase B Event History Summary.



Phase B Event History Summary



Phase B Event Tolerance Summary.

Torrington Community Hospital (Lab Panelboard) (CBEMA)
Phase B Event Tolerance Summary. May 14, 2002. 62 events.

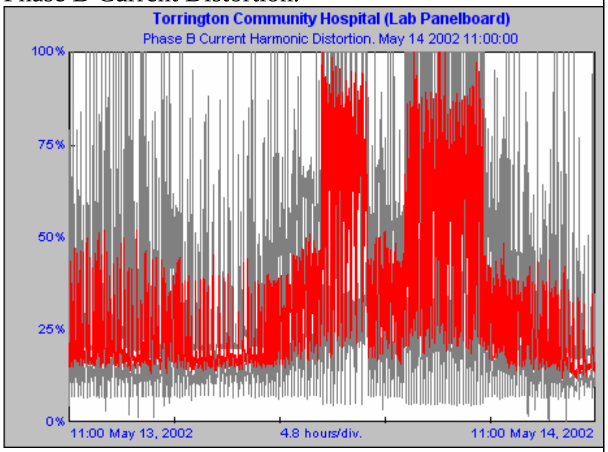
	Type I	Type II	Type III
Start Duration	1 us	8.333 ms	2 sec
End Duration	8.333 ms	2 sec	1 day
Total Events	61	0	0
Total Faults	0	0	0
	Event No.	Amplitude	Duration
Longest Type I Event	1131	190.4V	48.5 us
Largest Type I Event	931	304.7V	10.5 us
Longest Type II Event	N/A		
Largest Type II Event	N/A		
Longest Type III Event	N/A		
Largest Type III Event	N/A		

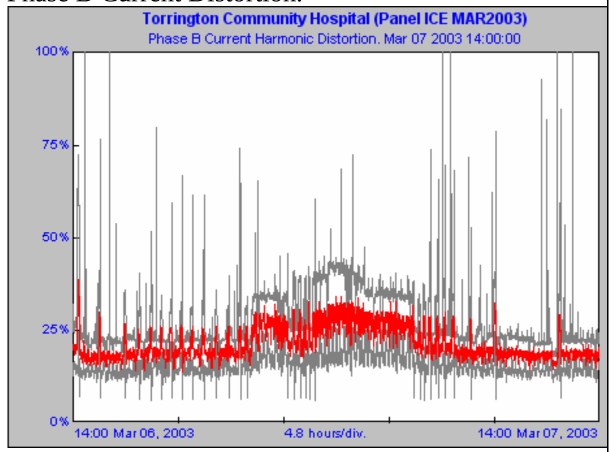
Phase B Event Tolerance Summary.

Torrington Community Hospital (Panel ICE MAR2003) (CBEMA)
Phase B Event Tolerance Summary. March 07, 2003. 1 events.

	Type I	Type II	Type III
Start Duration	1 us	8.333 ms	2 sec
End Duration	8.333 ms	2 sec	1 day
Total Events	0	0	1
Total Faults	0	0	0
	Event No.	Amplitude	Duration
Longest Type I Event	N/A		
Largest Type I Event	N/A		
Longest Type II Event	N/A		
Largest Type II Event	N/A		
Longest Type III Event	1	120.4V	23.999 hr
Largest Type III Event	1	120.4V	23.999 hr

Before Mitigation	**After Mitigation**
Phase B Current Distortion.	Phase B Current Distortion.





Before Mitigation			After Mitigation		
Min.	12.05%	May 14 2002 10:07:00	Min.	13.75%	Mar 06 2003 19:01:00
Avg.	**33.40%**		**Avg.**	**21.92%**	
Max.	113.0%	May 14 2002 03:52:30	Max.	38.92%	Mar 06 2003 14:15:30

The ability to interpret all of the data is not required to comprehend that significant power quality improvements were made. And, while there is no single "silver bullet" for correcting power problems – for each site and set of conditions is unique – the installation of high-quality transient-voltage surge suppression devices, with proper filtering, will "almost always" be one of the solution components. Be aware that there are countless products that bear "TVSS" or "transient-voltage surge suppressor" on their nameplate; however, high-quality devices account for but a very small percentage of these.

Other common solution components include replacing improper & inadequate wiring, improving grounding & bonding, and installing suitable uninterruptible power supplies. After that, the requirements get very site specific and may include such components as upgrading utility service, upgrading generator-sets, modifying electrical system design & installation, replacing & adding distribution equipment (e.g., panelboards, harmonics-canceling transformers, transfer switches).

I frequently advocate a 3-Step power quality approach for clients managing multiple facilities:

- Step 1. Install high-quality transient-voltage surge suppression devices at the service entrance and at all panelboards supplying critical loads – as a minimum. Installation of TVSS devices at all panelboards is a smart business decision, with a ROI payback period of 1-2 years. Experience and studies have shown us that high-quality TVSS application will correct numerous problems and TVSS installations may be accomplished quickly.
- Step 2. Conduct comprehensive power quality site surveys and analysis for each facility to determine subsequent mitigation requirements. The new high-quality TVSS devices, particularly where installed on all panelboards within the facility, have taken care of numerous problems and it is now easier to identify "what's left."
- Step 3. Implement all recommended mitigation solutions. It comes down to action – ROI and improved reliability are achieved only when the solution upgrades are implemented.

The return-on-investment payback period for power quality improvements ranges from 1-3 years for most equipment and services. While we advocate improving energy efficiency, and even sell ultra energy-efficient transformers, the return-on-investment for power quality improvements far exceeds the ROI for energy-efficiency equipment investments. Avoiding premature equipment failure and improving equipment reliability – to minimize downtime and save money – should be the primary focus for facility managers. The addition of energy-efficient equipment is "icing on the cake."