Why is my medical equipment *failing*?

Chronic repair spending is a known symptom of power quality issues.

"Undesired operation" may sound nicer than "failure," but in the healthcare industry, nobody's looking to spare the equipment's feelings. The cost of equipment failure is counted in multiple columns: the risk of diagnostic error, scheduling issues, lost billing, overtime, lost productivity, employee stress and turnover, and (of course), repair and replacement costs.

The problem with focusing healthcare technology management solely on the equipment is that may miss the real causes of failures. Medical technology is susceptible to power quality issues, and healthcare facilities have complex, variable power draws that can lead to power quality problems.

How Do I Know It's Power Quality?

If the problem is persistent or abnormally frequent, that could mean something external to the equipment is hastening failure. Check the frequency and timing of equipment issues. For instance, matching failures to changing demands on your power system could mean it's a power quality problem.

There's no "one-size-fits-all" troubleshooting method that will uncover power quality issues, and if you suspect them, you should consult immediately with someone qualified to safely asses the system.

It's important to think about the whole system, since it's not just a question of power loads from large equipment like MRI machines and CT scanners. Computers and other equipment throughout your facility create non-linear loads. Those non-linear loads can create disturbances in power systems that affect both your electrical assets and the equipment they supply power to.

Why Are Power Quality Issues Destructive?

The term "power quality" doesn't exactly convey the serious technical problem it describes, so let's take a moment to explore what it means. Most of us think about electricity as just on or off, but there are really three states of operation: transient, steady-state, and decay. Remember "an object at rest tends to stay at rest, and an object in motion tends to stay in motion?" It's the same for electricity.

Whenever anything is energized or de-energized, there's a transient state before the equilibrium you expect – the steady state - is achieved. Sometimes that equilibrium is harder to achieve than it should be. The resulting voltage surges and sags in the system can be more than a device can safely handle or less than it needs to operate reliably. Both situations can damage equipment or cause it to fail, especially after repeated occurrences.

The other common power quality problem is harmonics. Alternating current is like a wave, and just like other kinds of waves, it can experience interference. With so many pieces of powered equipment in a healthcare setting, from medical devices to computers to operational needs like HVAC, each powered piece of equipment can create their own little ripple in that wave. There's a real danger to those ripples adding up and creating enough of a distortion that it can damage equipment or cause failure.

One of the most dangerous causes of power quality issues is improper grounding. Proper grounding is key to the protective mechanisms in place to limit dangerously high voltage and the risk of shock and arc flash from electrical incidents. When power quality problems are ignored, it could mean improper grounding is being ignored – a clear safety risk.

Damages Like This

A hospital experiencing unexpected failures from a medical imaging system asked ABM to investigate. An integral part of the machine, a solid-state card, had been replaced multiple times. That meant multiple failures had been endured, and the cost of parts and labor multiplied.

ABM found that it wasn't really a repair issue with the imaging equipment. The real cause of failure was the excessive harmonics in the electrical system powering the unit. Instead of just replacing the part again, the power quality issue was resolved with improvements to the hospital's high-voltage cabling. That stopped the habitual failure of the imaging system and had the added benefit of alerting the hospital to harmonic problems throughout the facility that could now be addressed before further systemic damage to assets and equipment.

Let's Look at a Case

Here's an example of the interdependency of equipment and power systems in a healthcare setting: the hospital in question was experiencing multiple trip conditions. In this case, variable-frequency drives (VFDs) for the HVAC system were tripping during normal operation. Underperforming ventilation was a concern for the hospital, and disabling the ground fault protection was a non-optimal solution.

The tripping could be caused by maintenance issues with the VFDs themselves, and so an HVAC tech could have been called, but the frequency and persistence of the issue pointed to power quality issues. Focusing just on fixing or replacing the drives might not solve the problem, and letting any underlying power quality issues continue could put other critical equipment in the hospital at risk. For instance, the possibility of higher ground currents in the system could create safety hazards and equipment failure risks.

Two main points about the evaluation should be made before we look at the results. First, the successful analysis depended on measuring real, dynamic load behavior in the facility during a routine operational day, which takes some expertise in testing – including accounting for the control systems of the VFDs. Second, a clear record of the failures the facility experienced helped the investigating power engineers to best pinpoint their testing strategy, so a clear preliminary investigation of the facts is always important, but on no account should unqualified persons ever attempt testing of trip conditions or power equipment.

The Results Are In

Measurements were taken on the load side of the VFD, looking at the ground currents, total harmonic distortion, and the phase-to-phase voltage. By graphing all the data throughout operations and testing while controlling other key variables, a clear cause of the problem was uncovered.

A current unbalance was detected, with a variation over that specified by the VFD manufacturer for power inputs. The study revealed that the rising ground current happened concurrently with the current unbalance. The key to avoiding the ground current problem and the tripping conditions was keeping the current unbalance from happening.

The recommendations for fixing that problem, however, had to take the whole system into account. To avoid increased costs and decreased efficiency, the electrical power distribution system had to have its load balancing verified and checked for small insulation breakdowns that could have been contributing to the high ground leakage currents.

For this system, the VFDs were part of the problem, but they weren't the total solution. To truly fix the problem and mitigate the risk of failure for the hospital as a whole, the issues with the electrical power distribution had to be addressed before they caused damage to diagnostic equipment or otherwise interfere with treatment.

Is It Time for a Second Opinion?

Don't let power quality problems go undiagnosed, causing damage not only to your medical equipment, but to the electrical assets of your facilities themselves. To keep safety hazards from developing and ensure compliance with Joint Commission, NFPA, and OSHA standards for healthcare facilities, it's important to heed the advice healthcare providers give their patients: listen to the warning signs.

When medical devices, computer systems, or other equipment experience failure, it might not just be that equipment. Talk to facility solutions partner with expertise in both the equipment and the power assets your staff and patients rely on.

ABM keeps healthcare facilities safe, clean, and efficient. Learn more about our team's patient experience training and expert technical services at ABM.com/Healthcare.

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