A Healthy Dose of Electrical Reliability

Major metropolitan hospital uses infrared technology to improve to electrical system reliability.

By: Sheila Kennedy and Forrest Pardue

The facilities management department of a large hospital in the Eastern U.S. is charged with ensuring that all campus facilities are continuously and safely operational. Its electricians manage more than 5,000 electrical panels containing breakers, VFD controls, motor control centers, starters and disconnects, several hundred variable frequency drives, nearly 100 automatic transfer switches, and ten generator plants that provide backup power in the event of an outage. Some very critical circuits are at stake, including those that run to air handling equipment, operating rooms, patient and procedure rooms, medical research laboratories, and elevators.

As part of a wide-ranging infrastructure upgrade, the hospital's manager of electrical systems chose to take a proactive approach to maintenance and prevent equipment failures. He instituted annual infrared (IR) scanning of all electrical panels in the facility, and implemented a centralized reliability information system with equipment bar coding. Due to the successful outcome, the he is looking to expand the footprint of these initiatives into other areas of the hospital.

Improved facilities require new processes

Because there was so much equipment and information to track, it had been a challenge to maintain and keep up a database of all equipment records. With floor plans changing due to construction, the need for a centralized reliability information system to facilitate version control was even greater.

In the past, electricians who detected a problem in the facility would go to the office, upload the information, email it to management, and sometimes a day would pass before the problem was given proper attention. For urgent conditions, a phone call would be placed to management, which introduced the risk of misinformation regarding the problem, the location, or the affected equipment.

Recordkeeping had been done using clipboards, forms, and binders to manually document and store inspection findings and outcomes. The hospital was required to comply with Joint Commission standards, including stringent recordkeeping and inspection requirements. Hence, with each thermographic test, a PDF file was produced and a hard copy report was printed. The reports were archived to help the facility track problems and repairs from year to year.

Parallel binders of maintenance records were kept for each hospital building – one in the shop and the other in the back office. Each sheet of paper in the binder contained an image of the equipment, a description of the maintenance problem, and how it was resolved. When third parties such as insurance inspectors visited the facilities, they reviewed these hard-bound records.

In addition, while annual IR scanning was feasible, the cost to monitor circuit breaker panels and other electrical equipment more frequently was prohibitive.
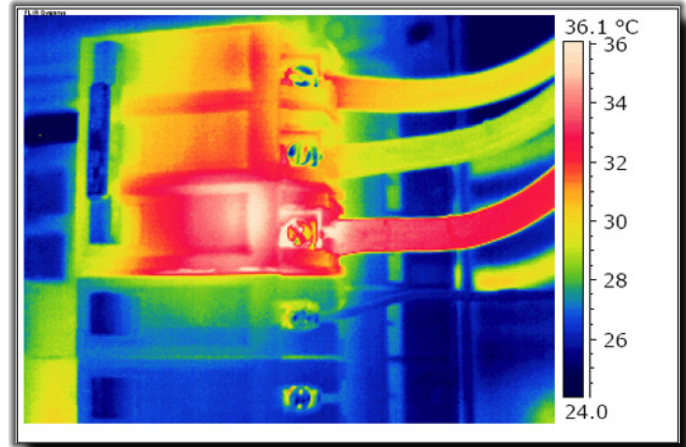
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Figure 1 - Thermo Scan

faster and more reliable method to log rounds and communicate equipment problems was needed. Introducing equipment bar coding would further streamline the process and potentially reduce labor costs. The hospital also wanted to increase its reliance on thermal imaging, which has been a part of its maintenance routine for at least 25 years. IR scans have been performed annually under a thermography service contract with ThermoTesT, a thermographic testing and inspection service provider who manages the data collection, problem analysis, problem reporting, and validates corrections performed by hospital technicians.

"Our prior system was good and our spreadsheets worked fine, but we preferred to have an electronic system that prompts our electricians to complete each step in sequence," says the manager of electrical systems. "We wanted an electronic device to guide them through what gets tested and how, and to have information such as current, voltage, kilowatts, and condition of the room entered into the device, rather than using a clipboard. This would be particularly helpful for our newer employees because it would shorten their learning curve."

Preferred solution came recommended

The facilities management organization evaluated a range of software solutions to improve its inspection processes. "There are a lot of good IR software packages, but most are really standalone electronic versions of the binder," says the electrical systems manager. One solution had good information and graphics but it was not web-based and it had to be loaded on the computer. That method works well for small organizations with one building, but not for growing organizations with multiple buildings.

In the end, the hospital chose Tango Reliability Information Management by 24/7 Systems for IR rounds logging. Implementation of the reliability information management system was a joint effort involving the hospital, ThermoTesT, and 24/7 Systems personnel. It took approximately six months to build the "location tree" that depicts the hospital's electrical infrastructure and another six months to populate the equipment data.

Now, when you click on the tree within the Tango user interface, the various buildings are revealed. Another click opens up the floors, and you can drill down further to the closets, corridor panels, and equipment room. A work order interface connects the reliability information system with the hospital's computerized maintenance management system (CMMS).

The software implementation coincided with the linear bar coding of all circuit breakers, electrical closets and panels, and the deployment of handheld personal digital assistants (PDAs) to capture the inspection readings. The full system went live in 2010 with all electrical panels in the hospital campus, and since then new buildings and additional equipment details have been added.

Recently, the hospital switched from linear bar codes to quick response (QR) bar codes, which allow greater amounts of information to be stored. It also switched from PDAs that cost $2,500 each to Galaxy tablets, iPad tablets and some smartphones, which cost a few hundred dollars each and are supported by the hospital's IT telecommunications department, so there is less concern if the device breaks or disappears.

"Implementing this software was a quantum leap for us. Keeping it up to date with all the growth and changes the hospital has been undertaking is an ongoing process," the electrical systems manager.

Unified system increases visibility and productivity

The hospital's facilities maintenance team as well as personnel from ThermoTesT and 24/7 Systems now have web-based access to the electronic equipment records. With all records under one umbrella, users can click on the tree and see everything in a single, centralized database.

The reliability information management system is used in the hospital's annual IR inspections to assist with information integration, communication, and accountability. All the electrical panels for the hospital campus are now in Tango, contributing 6,000 points to the database. IR scanning is currently being used on the hospital's circuit breaker panels, distribution boards, transformers, and motor control circuits. Next year, the hospital intends to add more data points to the IR program, including motor terminations and splice boxes.

As the current readings at the hospital are scanned, all data and imagery is uploaded directly into the online database. The equipment's history can be pulled up during the inspection rounds and notes can be added on the spot. IR scanning reveals the breakers and connections that are going bad, among other problem conditions. Some are fixed on site, while others are scheduled for maintenance by hospital personnel.

Figure 2 - Quick Response (QR) Codes used to start routes within this Mechanical Room

The hospital's electrical maintenance staff picks up the problem records and images from Tango, corrects the breaker problems, and records the repairs in the system. ThermoTesT personnel then validate each repair, remove the equipment from the active problems list, and take a normal profile infrared picture that is also uploaded to the system.

In addition to the thermal inspections, to meet federal and state requirements for health care facilities, the maintenance team performs monthly generator tests under load as well as weekly no-load exercises and daily shift inspections. Maintenance personnel also perform visual inspection patrols at least once a week. They'll get into closets to make sure they are clean, the lights work, and the covers are properly secured. During the generator tests and visual walkarounds, operating parameters such as voltage, current, water flows, temperature and more are read into the new reliability information system.

Figure 3 - Employee using a smart device to scan a QR code on a breaker panel.

Win-win results

Tango provides centralized access to historical data that extends well beyond thermal condition information. It simplifies inspection and maintenance tracking and gives more people access to the information. It allows changes to circuit breaker directories to be performed electronically, ensuring version control.

Most important, the annual thermal imaging program is helping to prevent burnout. "We love the new system and everyone in the hospital really welcomes our IR scanning program because we can't afford to be down. Without power, vulnerable patients are at increased risk," explains the manager of electrical systems.

The improvements made over the past year impressed the hospital's arc flash examiner, who noticed the QR codes in panels, electrical closets and some mechanical areas during a casual walkthrough of an arc flash training session. Now, from outside a mechanical equipment room, a bar code scan reveals all the panels and circuit breaker directories before the room is entered.

Maintenance costs and vulnerabilities are on the decline. Incrementally, as more points are scanned and more repairs are made, fewer defects are being found. (Figure 4)
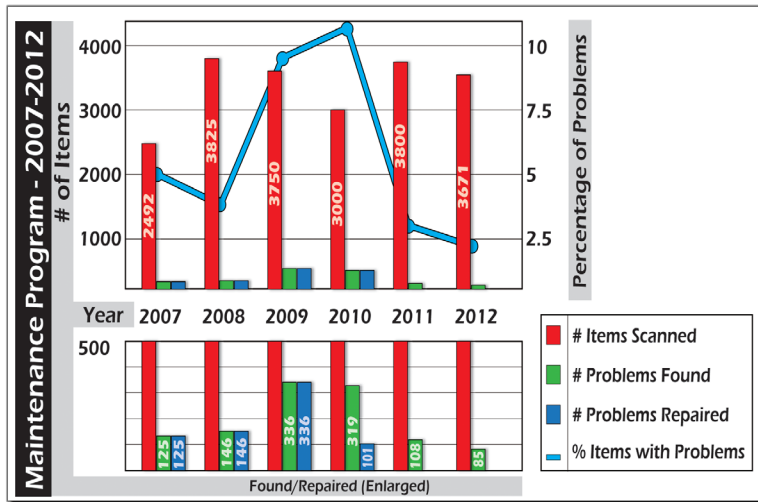

Figure 4 - Problem percentages decrease with reinforced reliability.

The defect rate, currently at two percent, is significant because problems are being found before they escalate. The system pays for itself with the prevention of a single burnout.

The web-based system is more intuitive, according to the electrical system manager. "Each year we are gathering more and more information. For instance, we not only know a fuse's size, but the serial number of the circuit breaker and its manufacturer." Having good history lends itself to much more simple binders. "Sometimes people still want to hold a binder with paper notes, so we still print some sheets when needed."

Because of the success of the reliability information management program, the hospital recently signed a contract with a second service provider to perform quarterly preventive maintenance of the center's variable frequency drives (VFDs). Service personnel will upload field service reports and historical data for every VFD into Tango, including the manufacturer, model,

serial number, current, fuse size, voltage, date installed, types of usage, and other vital information. Designs and manuals will also be centrally accessible.

Tango is a useful tool for managing service contracts. ThermoTesT and the new provider are contractually obligated to monitor equipment on an interval basis, and the hospital's reliability information system verifies that the work has been completed and captures the findings.

Additional Opportunities

Implementing dynamic circuit breaker monitoring and bar code scanning was a huge culture change. The new system provides superior historical data, which lends itself to other purposes. The hospital intends to add additional buildings and data points to the reliability information system, for instance its uninterruptible power supply (UPS) systems. Numerous small and large UPS systems are situated throughout the campus and need to be centrally tracked. Automatic transfer switches are also being added to simplify the monthly, quarterly, and semi-annual inspections on all emergency generators and transfer switches.

NFPA 70E and OSHA code is getting stricter and this system is helping the hospital to focus on safety and compliance. "As we continue to build out Tango and document each piece of equipment and all of its energy sources, we'll be able to employ and edit graphical lockout/tagout procedures," says the electrical system manager.

Another possibility is the use of live circuit directories to diagram all circuit breakers in an interactive database, showing the breaker types, sizes, and what is hooked to a load – for instance an operating room, patient room or specific equipment. A long-term vision is to have the circuit breaker panels meter live data streams into the reliability information system, allowing real-time access to information and more timely decision making.

The facilities management organization has also begun adding a centralized synchronized clock system to the reliability information system. When a battery is low, the technician has access to the clock's location, manual, and URL links from the Tango tree on the smart device.

Each addition to the system will increase its value to the hospital, its service providers, and its employees and customers who depend on the facilities to be continuously and reliably operating.