

APPLICATION NOTE

**Teamwork, tools and techniques:
How one plant brought
thermography in house**

This story is about a BP natural gas operation in Ulysses, Kansas. The Jayhawk plant processes gas from the wells of several different companies, including its own. To get the gas from its wells to the plant, BP uses compressor stations that boost the pipeline pressure of the natural gas after it flows out of the ground. At the plant, several processes strip waste products off the gas, verify the refined natural gas meets proper BTU contents for distribution, and produce helium, nitrogen, and propane by-products. Then, the company delivers the refined natural gas to a pipeline headed east.

One of the plant's contractors, Alltech Instrumentation & Electrical Service, has long performed onsite electrical installation and service work for the main facility and its gas fields. Their daily work ranges from replacing electric motors and running conduit to automation controls, to wiring for AFR (air/fuel ratio) controllers for the compressors and helping field and plant technicians with repairs.

Then, Alltech added thermal imaging to their electrical services. Up until that point, electrical and thermography had been handled as two separate services, but as it turned out, Alltech's knowledge of the plant's equipment, their daily presence and their ability to make electrical repairs created a far more efficient all-in-one service.

Now, according to Len Sisk, Maintenance Team Leader at the BP plant, "We're realizing significant cost savings just by doing more thermal imaging."

The tool

Thermal imaging is ideal for measuring electrical equipment, and this plant has plenty of it—about 115,000 kilowatts coming in. Until recently, the facility had been using a secondary contractor from six and a half hours away to conduct annual thermal imaging surveys of its key electrical equipment.



By using thermal imaging, Alltech determined that insufficient airflow and cooling was causing this pump seal to fail, saving a \$100,000 project from ongoing seal failure.



If you are interested in starting up a similar program, Fluke recommends you research the following Fluke thermal imagers: Fluke Ti480, Ti400 and Fluke Ti300.

This arrangement was problematic. When plant personnel needed a problem assessed, six and a half hours was too long to wait for a thermographer, especially in downtime situations. Then, new thermal imagers came on the market that were more affordable than the traditional models but still powerful enough for facility maintenance and significantly easier to use. So, Alltech purchased a Fluke thermal imager, sent their operations manager, Barry Ungles, to training, and began inspecting plant equipment.

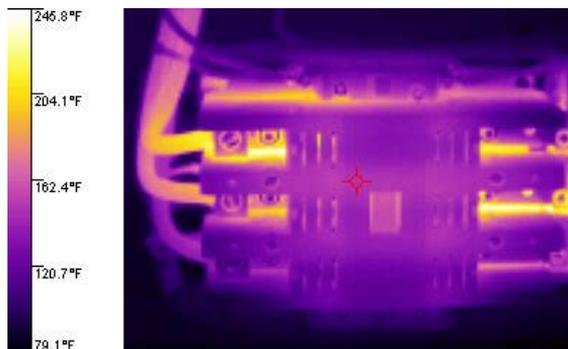
At first, says Sisk, the facility didn't realize the full potential of having an in-house imager. But, within months, Alltech had moved from just on-demand inspections to inspecting switchgear, junction boxes and other high voltage systems, conducting regular inspections of field equipment, and taking over the annual thermal inspection contract. Sisk has already found uses for the imager in vessel, pipe and valve inspections, and plans to use thermography to inspect low-temperature cryogenic processes, as well.

The in-house move made sense. The thermography-only contractors hadn't been authorized to remove panel doors or make other electrical adjustments necessary to get clear thermal images. That meant the facility's electricians had to be involved. As licensed electricians, Alltech now does all of that. They're also able to interpret the electrical significance of the thermal images, and in some cases, proceed immediately to repairs and then verify their success with additional thermal images.

Technique

Every year, Alltech spends about three days scanning the plant for electrical problems. The two power control rooms are divided into sections, or buckets, that contain switchgear and breaker sources for the power supply and distribution. The electricians monitor everything in the buckets, checking all of the operating stations and making thermal images of all the electrical connections—from relays to transformers. Among other things, they use the imager to look for loose connections, because that's where major problems such as meltdowns often occur.

"Because the Fluke thermal imager can measure components to one-quarter of a degree," says Ungles, "we can find wire lugs that are loose but overheating only slightly. That means that we can detect potential problems long before they



Example of a hot connection on panels in the BP Jayhawk Plant power control rooms. Abnormal connection heat can be caused by overly loose or tight connections, corrosion, overloading, unbalance, harmonics and other electrical problems.

become serious problems. In some cases, we can tighten lugs on the spot if it's safe to do that." For more serious problems and for equipment carrying very high voltage, Ungles takes a thermal image and a digital photo of the unit and sends a report to the supervising plant technician.

Electrical components are not the only thing Ungles monitors at the plant. One example is the sludge catcher, the big vessel that collects waste from the natural gas. "At one point," says Ungles, "plant personnel weren't sure their level indicators were working correctly, which meant they weren't sure how much sludge was in the vessel. I made thermal images of this unit at the end of a hot day when the vessel had begun to cool. The image revealed the line between the heated sludge and the unrefined natural gas above it in



the vessel, which cooled faster. Thermography proved to be a failsafe backup to the level indicators." A vessel entry to determine the sludge depth would have required a major plant shutdown and an extremely dangerous vessel entry. "With thermal imaging," says Len Fisk, "we were able to determine this depth for a fraction of the cost of conventional methods."

In another case, says Sisk, the plant wanted to determine which valve in a faulty system needed to be replaced. Conventional troubleshooting methods were ineffective due to plant operating constraints and replacing all of the valves would have cost \$15,000. So, the plant used the thermal imager to locate temperature deviations in the system, identified the faulty unit, and replaced just one valve.

The imager also saved a \$100,000 project at risk due to faulty pump seals, when the vendor engineers could not solve the problem. Thermal imaging revealed that the seal failure stemmed from overheating caused by insufficient flow and cooling—not from a faulty unit. If the pump seal had simply been replaced and the real problem left uncorrected, the failure would have led to a spill.

In the gas fields, the Alltech electricians use the Fluke thermal imager to monitor mechanical devices. Thermal images can detect alignment problems in rotating equipment—for example, between a motor and a compressor. With a thermal image, they can quickly discover when a bearing is heating up because of misalignment.

They also use thermography to monitor 24-volt control circuits. On these low-voltage installations, the imager permits them to pinpoint loose connections as potential future problems, tighten them and prevent failures at a later date. Using the Fluke thermal imager, Alltech has found loose 24-volt connections that, because of the rating of the wire, weren't yet problems. Still, if those connections had kept vibrating until the screws came out, the wires might have come out of their sockets and caused shutdowns.

Teamwork

With basic training on thermal imaging and good communication on the plant floor, many different facility teams can benefit from thermal imaging. For example, the plant uses extremely cold processes to remove the unwanted gases from the natural gas. In one case, a nitrogen pump had a persistently leaky seal. It had to be changed out regularly.

The electricians took a thermal image of the pump. An engineer took one look at the image and realized immediately that there was a restriction preventing the seal from receiving enough cooling airflow. As a result, the seal was overheating and melting.

The software included with the imager helps the user set up inspection routes for the regularly scheduled inspections at the plant and in the field, and to adjust measurement parameters such as emissivity, RTC, temperature level and gain for particular locations and pieces of equipment.

Thermography and predictive maintenance (PdM)

Thermal imagers capture images created by the otherwise invisible infrared (IR) radiation emitted from objects. These images show a range of temperatures represented as color or tone variations and allow observers to pick out hot spots (or cold spots) that might signal electrical or mechanical, or process flow problems.

Predictive maintenance (PdM) is a maintenance method that advocates regularly collecting measurements and tracking key indicators over time to predict when key equipment needs to be repaired to avoid failure. Petrochemical and energy companies as well as discrete manufacturing companies invest much capital in production and processing equipment. Delivery schedules and profits can be adversely affected by machine downtime. So, identifying impending equipment failures and preventing them before they happen can result in lower maintenance costs and fewer production losses.

Ungles uses the same software to report his inspection results. "It uploads all of the images I've taken and allows me to add side-by-side digital photographs, so that the technicians can translate the hot spots on thermal images to locations on the digital photos. I add notes and analysis to each image and rate the inspected equipment, designating which should get attention first. For example, if a wire is rated for a maximum temperature of 150 °F and my scan shows that wire fastened into a terminal lug that is more than 200 °F, then I know I am looking at a meltdown fairly soon. "

In general, says Ungles "I use "high," "medium" and "low" designations for scanned equipment with problems. "Low" means it can be addressed sometime. "Medium" means it needs to be taken care of relatively quickly. "High" signifies do something right away. Each year, I put together a book of my findings, and the facility keeps that book on hand to guide its PdM activities." In addition to thermal imaging, the BP plant in Ulysses also uses oil sampling analysis and vibration analysis on its compressors, VOC packing leak detection on valves and pumps, hi-pot insulation resistance testing, and regular switch-gear cleaning and electrical maintenance.

The only warning here is to watch out for snowballs. As this plant found out, once thermal imaging comes in house, applications for it appear everywhere, operation costs start to drop, and efficiency improves. What's a plant manager to do?

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