SUCCESS STORIES

Small, Safe, Effective Option

for infrared inspections of medium-voltage switchgear

Inspectors at Alcoa's Warrick Power Plant in Indiana can conduct inspections of medium-voltage switchgears through the cabinet door. The infrared camera connects directly to the lens, which presents a wide-field view and provides temperature measurements accurate to ±3°C. It is able to focus on something as close as 2 in. and provides great depth of field, ideal for situations where components are crowded or near the door.

Unplanned downtime is always a problem and for the Warrick Power Plant feeding electricity to Alcoa's smelter and rolling mill complex in southern Indiana, it's a particular concern. Electricity is the lifeblood of primary aluminum production, and service interruptions can have an impact that's far more consequential than loss of production.

Like most global manufacturing organizations, Alcoa is working to improve its profitability with an aggressive reliability program aimed at eliminating unplanned downtime. But, it's hard to eliminate unplanned downtime without thermographic surveys of medium-voltage switchgear in a generating station where the newest unit dates to 1970.

The Warrick Power Plant is a four-unit, 742-megawatt, coal-fired, steam-electric generating facility. Each of its first three units are rated at 144 MW, and all are owned by Alcoa. The fourth unit is rated at 300 MW, and it is jointly owned by Alcoa and Vectren, an Indiana gas and electric utility. All of the units were placed in service between 1960 and 1970. Of the Alcoa-owned generating capacity, nearly all of the power is provided to the Warrick smelter and fabricating operations, which produces flat-rolled aluminum for a variety of applications, including beverage and food can ends and tabs.

Originally, thermographic surveys of the switchgears were conducted through open-door panels on the cabinets, but that practice ended when Alcoa adopted the Electrical High-Voltage Safety Standard 32.60, which is even more stringent than NFPA 70E. To continue with the surveys, senior power reliability engineer Brent Welz identified an inexpensive and clever alternative.

The Viewport, available from Mikron Infrared (www.mikroninfrared.com), is a simple, 0.50-in. opening that's UL approved and uses no IR-transparent window. Like a keyhole, a Viewport allows a thermographer to use Mikron's SpyGlass lens to conduct infrared scans with the doors closed, eliminating the need for "NASA suit" personal protection. At $50 the port is significantly less expensive than transparent panel windows (estimated at $300-600 per unit), which are the only available alternative for closed-door inspections. "With 60 ports installed, we've saved more than $20,000 over the cost of IR windows," says Welz.

Welz explains that the Alcoa safety standards offer two options for open-door inspections of the medium-voltage switchgear: wear 100-calorie protective gear, i.e., the NASA suit, or operate the infrared camera remotely from a safe distance. "The suit imposes physical limits on what a thermographer can do and see while using the IR camera, not to mention that it can be intolerably hot inside that suit" says Welz.

Client: Mikron Infrared
Application article in *Metal Producing & Processing*
Ad Space Value: $8,940

MAINTENANCE LOG

14-Camera Infrared System Monitors Critical Vessels

By Gary Strahan, Texas Infrared

Operators of high-temperature pressure vessels now can see in vivid color the advantages of new wireless radiometric imaging technology for safety monitoring of shell temperatures. The largest such system, using 14 Mikron infrared cameras and MikroSpec R/T software, has been online for more than a year monitoring a Chevron-Texaco-designed gas separation system in Texas.

The 14 infrared cameras are located at distances of 10-40 ft from the gas separation unit. They are mounted in totally sealed environmental enclosures with IR transparent windows and continuous purging and cooling by instrument air from a UL-certified air purge system. Real-time radiometric temperature data is transmitted by wireless Ethernet from each camera to a control room 1100 ft away.

Developed by Mikron Infrared Inc., Hancock, MI, as a turnkey installation, the system provides continuous real-time tracking with computer-generated alarms for possible burn-through and temperature excursions, while storing trend data for analysis and process improvement. In addition, the imaging data gives plant operators a color-coded graphic representation of conditions inside the vessel, enabling them to make inferences about the overall quality and uniformity of the process. This is the second gas separation monitoring system in the Oil Patch, and the technology is applicable to any refractory-lined equipment, as well as reactors, regenerators, boilers, and furnace tubes.

The gasification unit consists of two vessels operating at about 1100 psi with internal firing at approximately 2600 F and exterior shell temperatures ranging from 200-500 F. A lining of AA22 castable refractory insulation 6-8 in. thick protects the integrity of the 1 in. thick carbon-steel shells, which have a melting temperature around 1700 F. Loss or breach of insulation in a monitored area is immediately visible as a temperature spike on the infrared system's monitor graphics, while the system computer generates an alarm.

Replaces grid system

The wireless visual system replaces a 12-in.-square, thermocouple-grid monitoring system fixed directly to the shell's exterior surface. Failures of thermocouples or problems with fiberoptic connecting cables left holes in the monitoring scheme until replacement or repair could be made—always under difficult conditions. Grid problems put both the gasification unit and maintenance personnel at risk.

The critical vessel monitoring system was developed to enable remote monitoring by multiple cameras with simultaneous wireless transmission of images in real time to a single PC. At the Texas installation, the 14 cameras are located at distances of 10-40 ft from the gas sep-

Client: Mikron Infrared
Technical article in *Maintenance Technology*
Ad Space Value: $15,400

FIELD NOTES

SECTION EDITOR: TERESA HANSEN, ASSOCIATE EDITOR
STEVE BLANKINSHIP, ASSOCIATE EDITOR

INFRARED CAMERA PERFORMS DOUBLE DUTY

SHIELDED WITH PROTECTIVE visors, operators at Westar Energy's three 800 MW generating units at St. Marys, Kan., attempted to inspect the plant's boiler tubes for signs of slag by looking through the boilers' hot flames.

"That's typical practice in the utility industry, and we make multiple inspections per day," says Carl Schultz, Westar's senior predictive maintenance (PdM) analyst for thermography. "We thought there should be a better way and began exploring the use of an infrared camera to capture what was happening with slag inside the boiler."

Westar began its search for a better slag monitoring method by researching cameras specifically designed to

Operators perform thermal inspections by inserting the camera lens into an inspection door in the furnace wall. Photo courtesy of Mikron Infrared.

operate in the 3.9 micrometer (μm) band, a mid-wavelength that allows the camera to look through flames. During the search, operators learned about a broadband (8 to 14 μm) bolometer camera that uses filtering to operate in through-flame mode. The camera's broadband capability allows it to be used as a general purpose infrared camera for typical thermal inspections when it isn't being used in the through-flame mode.

"This gave us the potential for double-duty service from our camera investment," says Schultz. "We could use it for varied thermal inspections as well as for monitoring what was happening with slag inside the boiler."

Westar bought the camera, a MikroScan 7400, from Mikron Infrared. The uncooled, microbolometer (a specific type of bolometer used as a detector in a thermal camera) camera offers three selectable temperature ranges, including a high-temperature range (400 C to 1,600 C) needed for infrared imaging inside the boilers where combustion temperatures can exceed 1,100 C.

Infrared filtering on the MikroScan 7400 allows the dual spectral band operation—8.0 to 14 μm long-wave mode or mid-wave with 3.9 μm microfilter for through-flame imaging. According to Jon Chynoweth, Mikron Infrared marketing director, the camera is suited for typical PdM applications because it is unaffected by sunlight or smoke in a plant.

Mikron's infrared technology enables the bolometer camera to image narrow spectral bands at high temperatures, Chynoweth says. "In this case, we can deliver 3.9 μm through-flame capability along with general purpose 8 to 14 μm utility."

Mikron calls this technology "spectral tuning." It allows operators to use the camera for more tasks, such as predictive maintenance monitoring in the long-wave band on motors, bearings and electrical cabinets from ambient temperature to 400 F, says Schultz. "Then we can switch to the 3.9 μm band and high-temperature range to image the boiler tubes for slag condition."

Along with specialized infrared filtering capabilities, the MikroScan 7400 is also available with a radiation shield and protective window to allow temperature measurement inside a furnace without interference from combustion flames.

It is battery-operated and self-contained in a metal case. It includes a digital voice recording device and can simultaneously record high-definition 14-bit thermal images with digital visual images. It comes with built-in image processing software and stores images and data to PCMCIA (Personal Computer Memory Card International Association) standard cards. Images can also be viewed in real time via video output or optional built-in IEEE 1394 (Firewire) interface—a very fast external bus standard that supports data transfer rates of up to 800 megabits per second (Mbps) and is ideal for video and other devices that need to transfer high levels of data in real time.

Chynoweth says that depending on the resolution of the detector array (commonly 320x240 pixels) microbolometer-based cameras may cost $12,000 to $43,000. "Typical mid-wave cameras that would otherwise be needed for this boiler application are based on a cryogenically cooled (approximately -200 C) detector. Such cameras are larger, heavier and less portable. They commonly cost $50,000 to $80,000, consume batteries at a rapid rate, and require costly servicing if the cooling system fails."

The MikroScan 7400's primary role at Westar Energy is imaging the slag buildup on boiler tubes, which reduces heat transfer efficiency and can keep ash from falling to the bottom of the boiler. "In this application, we're not trying to precisely

CONTINUED ON PAGE 94

Client: Mikron Infrared
Application article in *Power Engineering*
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TEMPERATURE SENSING

Safety Monitoring Of Critical Vessels

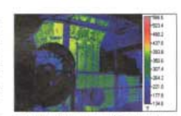
Wireless radiometric camera technology is simple to install and maintain while providing data for loss prevention and process improvement.

BY GARY STRAHAN, TEXAS INFRARED

Operators of high-temperature pressure vessels can now see in vivid color the advantages of wireless radiometric imaging technology for safety monitoring of shell temperatures. The largest such system, utilizing 14 Mikron infrared cameras and MikroSpec R/T software, has been online for more than a year monitoring a Chevron-Texaco-designed gas separation system in Texas.

Developed by Mikron Infrared, Hancock, Mich., as a turnkey installation, the system provides continuous real-time tracking with computer-generated alarms for possible burn-through and temperature excursions, while storing trend data for analysis and process improvement. In addition, the imaging data gives plant operators a color-coded graphic representation of conditions inside the vessel, enabling them to make inferences about the overall quality and uniformity of the process. This is the second gas separation monitoring system in the oil patch. The technology is applicable to any refractory-lined equipment as well as reactors, regenerators, boilers and furnace tubes.

The gasification unit consists of two vessels operating at about 1,100 psi with internal firing at approximately 2,600°F (1,427°C) and exterior shell temperatures ranging from 200 to 500°F (93 to 500°C). A lining of AA22 castable refractory insulation 6 to 8" thick protects the integrity of the 1" thick carbon-steel shells, which have a melting temperature around 1,700°F (927°C). Loss or breach of insulation in a monitored area is immediately visible as a temperature spike on the infrared system's monitor graphics, and the system computer generates an alarm.



Thermal images are displayed in a spectrum of colors from dark blue for the coolest temperatures to red/orange/yellow for the hottest. The colors are keyed to a temperature graph covering the range of temperatures encountered in the particular system.

The gasification plant uses MikroScan 7302 Ethernet-based thermal imaging cameras that provide ±2 percent or ±2°C temperature accuracy, 29° H x 22° V field of view, and 30 cm to infinity focus range. The cameras are mounted in totally sealed environmental enclosures with infrared-transparent windows and continuous purging and cooling by instrument air from a UL-certified air-purge system. Positive pressure inside the enclosure prevents dirt or dust from entering, even in the harshest conditions, and protects against explosion hazard in areas where volatile gases may be present.

At the Texas installation, the 14 infrared cameras are located at distances of 10 to 40' from the gas separation unit. Real-time radiometric temperature data is transmitted by wireless Ethernet from each camera to a control room 1,100' away. Each camera has a built-in wireless Ethernet board. Data from the Ethernet board is carried by Category 5 cable to a router box, then on to the antenna for wireless transmission to the control room. Wireless

The largest radiometric imaging system for safety monitoring of a petrochemical processing vessel uses 14 Mikron infrared cameras and MikroSpec R/T software. It has been on line for more than a year monitoring this Chevron-Texaco-designed gas separation system in Texas.

The infrared cameras are located at distances of 10 to 40' from the gas separation unit.

Client: Mikron Infrared
Technical article in *Process Heating*
Ad Space Value: $11,425