

## HOT SPOT DETECTION

Real time fault detection and monitoring for critical vessels



*Figure 1: Critical Vessel View*



*Figure 2: ThermalSpection CVM system*

Accurately measuring temperature has always been one of the most important and difficult things to do when monitoring the safety of critical vessels in refining and other industrial plants. Extreme temperatures and non-uniform temperature gradients make it nearly impossible for traditional temperature-measurement methods to monitor every critical point or to obtain complete temperature data.

The lack of accurate and early detection of temperature changes increases the likelihood of failure-related problems, which create safety and reliability issues. The consequences of undetected failures can be very serious and pose extreme safety risks if a vessel isn't properly monitored. A rupture in chemical reactors, storage tanks, and piping systems can all lead to catastrophic loss of life, product, and capacity. These all require sophisticated monitoring techniques to spot irregular temperatures and trends that precede unsafe and costly problems.

For many years, thermocouple systems and fiber optic sensors have been viewed as the traditional solution for temperature measurement in critical vessel monitoring applications. Yet, these sensors can be both unreliable and cost prohibitive to install and operate. They typically utilize wired or fiber optic networks and employ point sensors which only monitor the temperature of discrete points on the outside of a vessel. This can result in inaccurate measurements due to skin temperature gradients. In addition, failures of thermocouples leave dangerous holes in overall monitoring schemes until replacement or repair can be made. Of course, missing points in the monitoring scheme put the critical vessel, plant, and staff at risk when unexpected hot spots arise.

Innovative thermal imaging systems, however, have demonstrated how radio-metric thermography has evolved into a mature and cost-competitive alternative. The non-contact nature of infrared thermal imaging is more robust, more reliable, and easier to maintain. It is also more modern with technological advantages such as graphical visual displays, historical archiving and trending, and easy integration to plant SCADA systems.

### "Seeing" Is Believing

One of the emerging trends making inroads in the chemical, power, and refining sectors is the proliferation of thermal imaging cameras for critical vessel monitoring. These devices allow operators of high-temperature and high pressure vessels to see, in color, real-time thermal behaviors of equipment. This insight is unavailable with fiber optic systems, giving infrared thermal imaging an edge when it comes to early detection of possible failures.

Thermal imaging systems go further by providing a more complete look at the temperature profile of the vessel; highlighting where potential dangers lie. With a system of infrared cameras constantly monitoring the environment as a whole, it is far less likely that a potential problem will be missed.

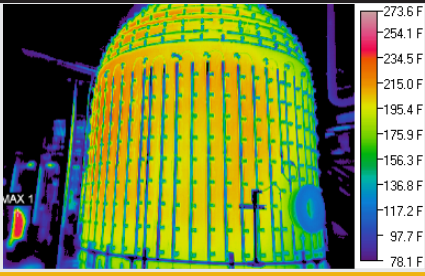


Figure 3 : Thermal Image Gasifier Skin

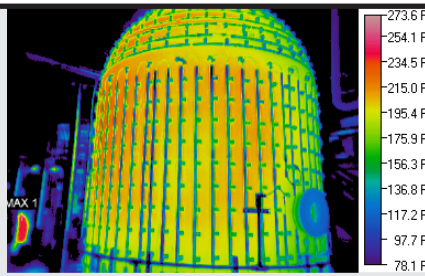


Figure 4 : Installed ThermalSpection CVM system

## Critical Vessel Monitoring in Action

A large system utilizing 14 infrared cameras for a single gasifier has been online for over eight years, monitoring a Chevron-Texaco-designed gas separations system for a major specialty gas producer. According to maintenance personnel, their original thermocouple-grid system started to degrade from the day it was installed because it was in direct contact with the vessel shell. Over time, the internal elements began to react at different temperatures and operators lost confidence in the data. The old system gave only a general idea of where a potential problem might be developing, constraining the ability of operators to proactively respond. Furthermore, it had to be removed and reinstalled whenever work had to be done on the vessel internals, which is a considerable amount of extra labor and time.

Implementing the infrared imaging system, the operators quickly realized several benefits. The most convenient was the ability to connect directly with a plant's DCS and data historian system. With the installation of a thermal imaging system, they were no longer forced to merely react to problems as they occur. Instead, they are able to document the temperature "personality" of the gas separation system and catalog its behaviors to properly assess, predict, and respond to potential problems.

Further, they can now store weekly thermographs of their vessel to benchmark normal patterns and compare changes over time. After rebricking their unit with a new refractory, they can establish where the hot zones really are and can look for changes over time. This helps to understand the degradation of the refractory, particularly when zones get progressively hotter, which could indicate some substrata refractory problem.

Operators also receive alarms much further in advance, which gives ample warning to help make informed decisions on how to respond to potential dangers. Having a high level of confidence in knowing where safe limits are, operators know when to ride out an event or when to shut down. During start up of the unit, for example, the plant operators thought they had a hot spot developing on a nozzle connection, which would not have been detected with a thermocouple-based system. However, the thermal imaging system allowed them to continue monitoring the area and the situation never progressed to an alarm. The infrared imaging system allowed them to make an informed assessment of the risk in plenty of time and determine that it was prudent to go forward while monitoring.

## Results

Better alarm response time, enhanced predictive abilities, and improved information availability are the three key benefits that make thermal imaging the preferred method for critical vessel monitoring. Continuous, real-time information showing exactly how a vessel is behaving allows operators to identify potential problem areas before they even arise. This prevents emergencies and mitigates unplanned downtime in plant areas where sufficient insight was difficult, or impossible, to obtain.



For international contact information, visit [advancedenergy.com](http://advancedenergy.com).

[sales.support@aei.com](mailto:sales.support@aei.com)  
+1 970 221 0108

PRECISION | POWER | PERFORMANCE

Specifications are subject to change without notice. Not responsible for errors or omissions. ©2019 Advanced Energy Industries, Inc. All rights reserved. Advanced Energy® and AE® are U.S. trademarks of Advanced Energy Industries, Inc.