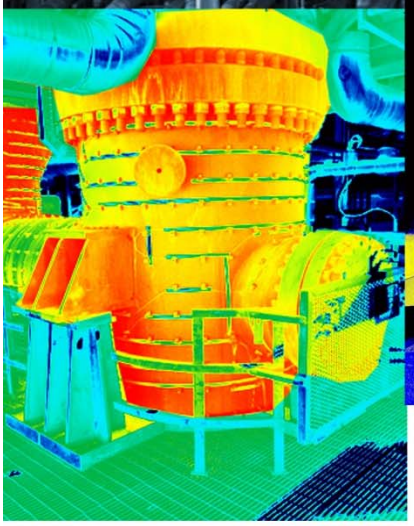
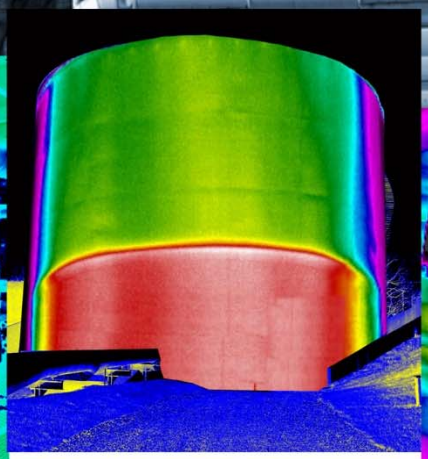
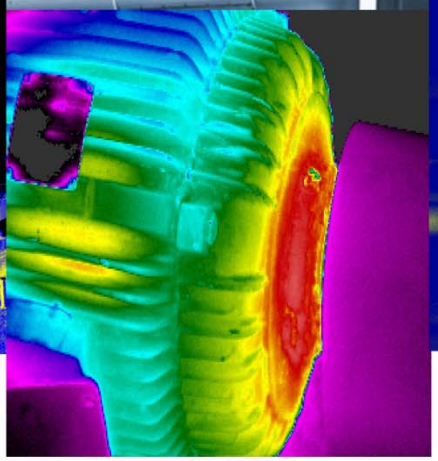
Industrial Thermal Management System



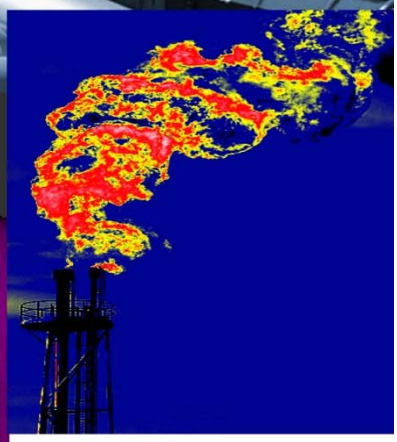
Gasification Reactor Monitoring



Tank Level Monitoring



Critical Equipment Monitoring



Flare Monitoring

Technical Explanation

ICI
Infrared Cameras Inc

Introduction

Welcome

Infrared Cameras Inc. is proud to introduce the Industrial Thermal Management System. This system is made up of specific hardware and software that is designed to explicitly monitor Gasification Reactors for “Hot Spots” due to a breakdown in the underlining refractory. Since its inception, this system has additionally been utilized to monitor, in real time, electrical connections, critical equipment, flares, flare pilots and tank levels. This has provided many industrial systems the unique opportunity to automate responses through real time thermal monitoring.

Terms

1. ITMS Industrial Thermal Management System
2. POE Power Over Ethernet
3. NOC Network Operations Center
4. PAN Plant Area Network
5. LAN Local Area Network
6. DCS Distributed Control System
7. PLC Programmable Logic Controller
8. UI User Interface
9. NIC Network Interface Card
10. P&ID Process and Instrument Diagram
11. AOI Area of Interest

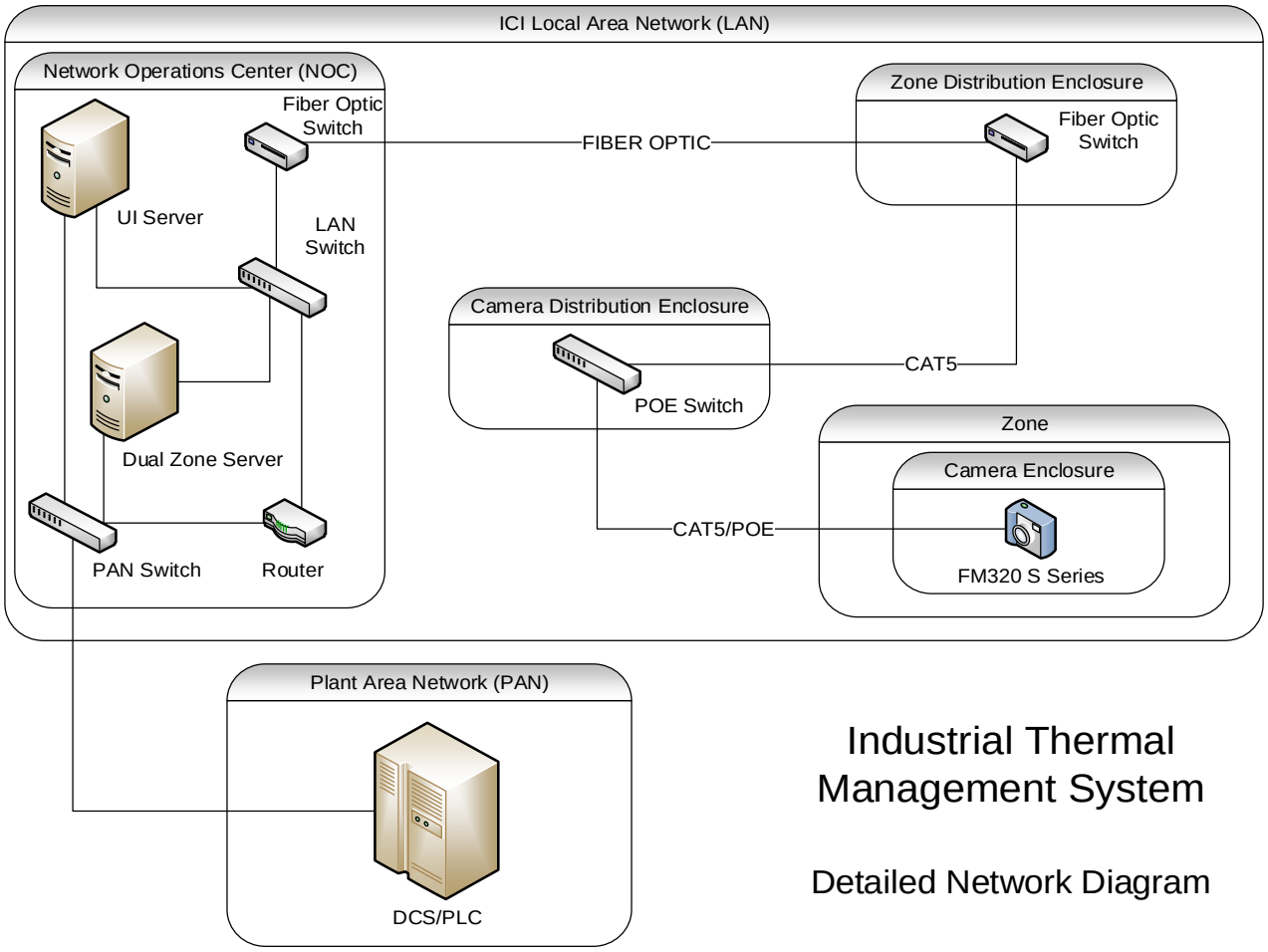
System Overview

At the heart of the Industrial Thermal Management System (ITMS) are the infrared cameras that monitor the exterior temperature of critical vessels and equipment. A set of these cameras monitor a specific area defined as a Zone. All of the cameras within the Zone connect to a Camera Distribution Enclosure. A Power over Ethernet (POE) Switch, in this enclosure, provides network and power connectivity via a single CAT5 cable to each Camera. The Camera Distribution Enclosure is connected to an intermediate point defined as the Zone Distribution Enclosure. This enclosure contains a switch to provide network connectivity between the Network Operations Center (NOC) and all of the Camera Distribution Enclosures in that area. This connection maybe facilitated via CAT5 unless the distance is over one hundred meters, in which case, a Fiber Optic connection is required.

At the NOC, a set of servers manage the temperature data, of each pixel, from every camera in the field. This information is relayed to the Plant Area Network (PAN) where ultimately the

Distributed Control System and/or the Programmable Logic Controller (DCS/PLC) can collect and manage that data. Additionally, remote access to the UI Server and Dual Zone Servers provides full data collection, monitoring and management of the system from anywhere in the PAN.

Network Diagram



Considerations

Network Traffic

To isolate network traffic created by the cameras, the entire ITMS resides on its own Local Area Network (LAN). The Dual Zone Servers and the UI Server will cross connect to the PAN where the DCS/PLC resides. The software, not the cameras, facilitate the Modbus TCP-IP connection with the DCS/PLC, relaying temperature data and the status of established alarms via standard Modbus TCP-IP registers.

Camera Locations

Each camera enclosure mount will attach to the surrounding support structure of the vessel or equipment. From experience, we can typically identify the number of cameras each zone will likely need to provide proper coverage. Several factors play a role in making this determination, including target distance, camera optics, vessel diameter, support structure and obstructions. Also, careful consideration must be taken, if a portion of the sky is in the scene, and whether or not that portion of the sky will ever have the sun travel through it during the course of an entire year. The sun cannot be allowed to enter the scene as it can damage the camera.

One hundred percent coverage is very difficult to achieve, as the support structure often can partially obstruct the view of the vessel in question. However, with an understanding of conduction, we feel that the system actually offers very close to complete coverage. For instance, let's assume hypothetically that one camera has a partial obstruction due to a handrail in the scene. Even though we cannot see the vessel where the handrail is blocking the radiation emitted, if the refractory was to breakdown exactly in this area, the increased heat at this location will conduct, very quickly, to the surrounding vessel skin triggering the alarm is it dissipates to an area that is in the scene. Properties of conduction insure that areas of higher heat will dissipate to areas of lower heat.

ICI reserves the right to adjust the number and locations of the infrared cameras installed to insure proper coverage.

Enclosure Temperature Management

Camera and distribution enclosures can be outfitted with internal heaters, to manage the temperature, when it is expected to fall below the operating conditions of the equipment. An additional 120 VDC must be dropped at each enclosure location to enable this option.

The enclosures may also be equipped with vortex coolers if temperatures are expected to exceed that of the specified operating conditions. An additional 120 VDC line and compressed air must be dropped at each location to enable this option.

Enclosure Purging Options

If area classification calls for Non-Hazardous enhancement to any of the enclosures, purging system may be required. To enable this option, Z-Purging units will be required, at each enclosure location, along with nitrogen/instrument air drops. 120 VAC is also required if purging pressures are to be monitored and alarmed. This system will provide enough cooling and heating to maintain the operating conditions of all the internal equipment. Therefore, if the purging system is applied, there is no need for temperature management.

Fiber or CAT5

When distances between the NOC and the Zone Distribution Enclosure exceed 100 meters, Fiber Optic Cables must be used to facilitate the connection. When required, Fiber Optic Switches are utilized at the NOC and all Zone Distribution Enclosures.

Data Management (DCS/PLC or ITMS)

It is the experience of ICI that data management and long term trending are typically better managed at the DCS/PLC level. We, of course, do not provide this solution, but our system easily integrates to provide this data to your system. As a secondary resource, our UI Server will provide similar abilities. The method you choose is completely up to you.

Hardware Specifications

Typical Rack Mount Configuration Diagram

The hardware represented in this configuration would provide the ability to manage 14 Zones with up to 126 infrared cameras. It is pictured with a 48" open rack, 2 UPS Systems, 7 Dual Zone Servers, 1 UI Server, 1 LAN Switch, 1 PAN Switch and 1 Router. A local connection to this system is possible through a KVM switch and necessary interface hardware such as a keyboard, mouse and monitor.

ICI builds and provides the entire system including the field items not shown, such as the switches, power supplies, switch enclosures, infrared cameras, and camera enclosures. Additionally, all the hardware to make the necessary connections is provided. The purchaser is required to provide the necessary VAC, CAT5 Cable, Fiber Optic Cable, Conduit, Nitrogen/Instrument Air, Compressed Air and Tubing. ICI will not be responsible for the installation of any of these systems or additional cost associated with the installation from access equipment such as scaffolding. Camera mounting brackets will be supplied by ICI and welded onto the existing surrounding structure per our specifications. ICI will install cameras and provide final cable connections. Initial setup of the system and consulting for integration with DCS/PLC is typically included with our quote.

Network Router

The Network Router provides the TCP-IP structure for the LAN where the cameras, switches and servers reside.

PAN Switch

The Pan Switch takes a single CAT5 or Fiber Optic connection from the PAN and distributes the connection to the secondary Network Interface Cards (NIC's) installed on each of the servers. This provides a clear separation between the PAN and the LAN to minimize the effect of network traffic from the many infrared cameras. The interface from your PAN is only established via Modbus TCP-IP and/or Remote Access Server.

LAN Switch

The LAN Switch connects all the equipment in the field to the servers. If the distance between the NOC and the Zone Distribution Switch is less than 100 meters, this switch can manage that connection. If the distances greater than 100 meters, an addition Fiber Enabled Switch must be added at the NOC.

User Interface Server

The UI Server is the front end for the ITMS. It provides the User Interface and offers the ability to collect, manage and store data from each and every camera in the system.

The UI Server is a 4U rack mountable system running an I7 processor with 8 Gigs of Ram. Windows 7 Professional along with ICI's Industrial Thermal Management Software is pre-installed on (5) SSD hard drives in a Raid Configuration with 5TB of data storage. Hard Drives are swappable without data loss. Dual power supplies and adequate cooling are provided. Dual Network Interface Cards provide LAN and PAN connections.

Dual Zone Server

Dual Zones Servers are exactly what their name indicates. They provide the interface for two zones and up to 18 cameras.

A 2U rack mount case houses each Dual Zone Server. They are configured with an Intel I5 processor with 8 gigs of ram. Windows 7 Professional along with ICI's Industrial Thermal Management

Software is pre-installed on (3) SSD hard drives in a RAID configuration. Dual Power Supplies and adequate cooling are provided. Dual Network Interface Cards provide LAN and PAN connections.

Uninterrupted Power Supply

Depending on the number of servers and switches provided at the NOC, ICI provides a sufficient number of Uninterrupted Power Supplies (UPS) to maintain and condition the power provided to the system.

Zone Distribution Switch

The zone distribution switch resides in the field and is the first point of connection from the NOC. Multiple Zone Distribution Switches may reside at different location within industrial complex.

Zone Distribution Enclosure

The Zone Distribution Enclosure is a NEMA 4X rated IP66 enclosure which houses the Zone Distribution Switch and 12 VDC Power Supply. 120 VAC and all I/O cabling enter through the bottom of the enclosure secured with wire glands. All components mount inside the enclosure using standard DIN/Rail mounts for easy replacement in the event of a failure. Room for additional switches can be added to provide future expandability.

Camera Distribution Switch

The Camera Distribution Switch resides near the Zone the cameras will be monitoring. It is normally configured to inject Power over Ethernet (POE) onto the CAT5 Cabling eliminating the need for power drops at each camera location.

Camera Distribution Enclosure

The Camera Distribution Enclosure is a NEMA 4X rated IP66 enclosure which houses the Camera Distribution Switch and 48 VDC Power Supply. 120 VAC and all I/O cabling enter through the bottom of the enclosure secured with wire glands. All components mount inside the enclosure using standard DIN/Rail mounts for easy replacement in the event of a failure. Camera Distribution Enclosures may only connect with up to 9 cameras, which also represents the maximum number of cameras per Zone.

Infrared Camera

ICI utilizes our FM320 Series Infrared Cameras when quantitative radiometric data is required. It has a 320x240 array and is available in 60Hz and 9Hz configurations making it available for export to most countries. When only qualitative data is required, ICI utilizes the Centurion Pro 320 Series. Applications such as Tank Level Monitoring can be achieved with this model. Both Models have a wide assortment of lens configurations and both are available in a 640x480 configuration if and when higher resolution is required.

Camera Enclosure

The cameras are housed in an IP67+ enclosure with a diamond coated germanium window for resistance to extreme environmental conditions. The enclosure can be outfitted with a temperature control system or purging capabilities. The enclosures mount to the existing support structure best suited to provide the proper field of view for thermal monitoring of the vessel and/or the equipment in question.

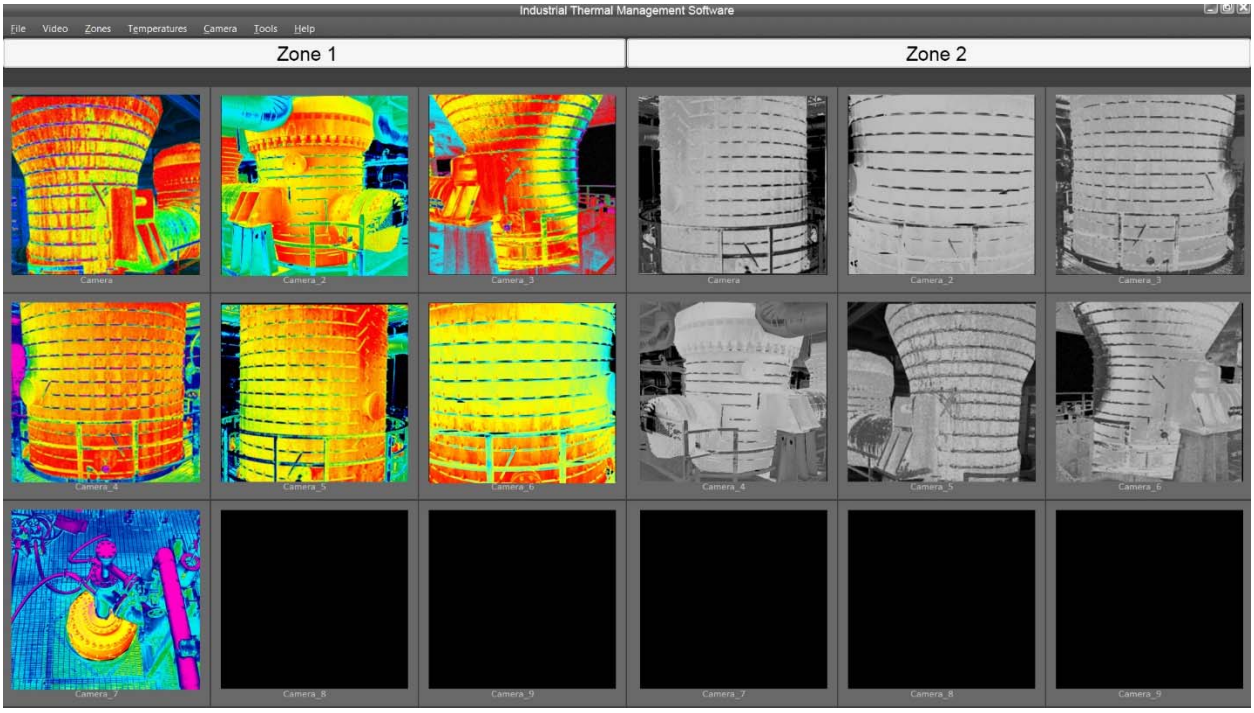
Software Specifications

Dual Zone Server

Each Dual Zone Server runs the Industrial Thermal Management Software providing an interface with (2) zones and up to (18) cameras. This is the first point of data management and configuration options are available under settings and tools for each camera individually. Zone Labels can be renamed be simply selecting them from this screen.

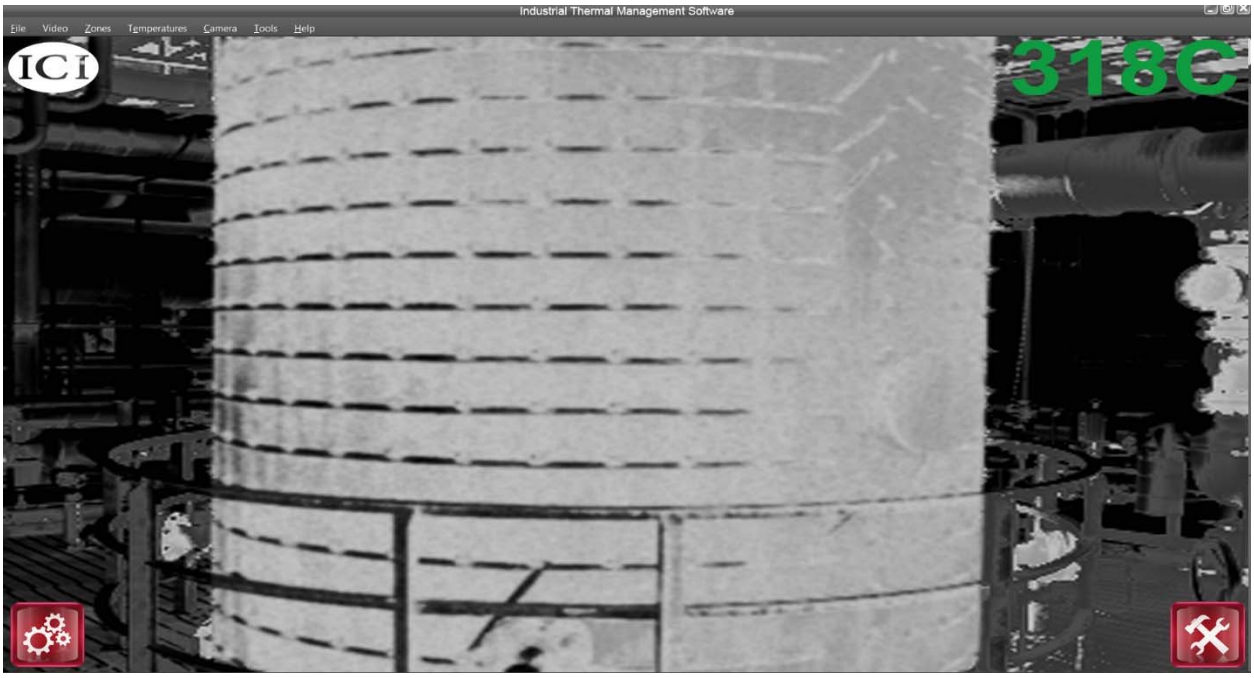
Multi-Camera View

The image below shows the primary interface you can expect when establishing an interface with a Dual Zone Server. By selecting any of the camera windows with a mouse, or touch enabled screen, you will enlarge the view of that camera and have access to the settings and tools for that camera. Notice that the images in Zone 1 are using a color palette, while the images in Zone 2 are using a gray scale palette. Each camera can be customized to have a unique Camera Identification, Color Palette, Level and Span. Additionally, two scene thresholds can be established to identify if the camera is seeing a “Warning Temperature” or an “Emergency Temperature”. Visible and Audible alarms can be mapped to these settings. Isotherms can be established to identify where in the scene the thresholds have been breached.



Single Camera View

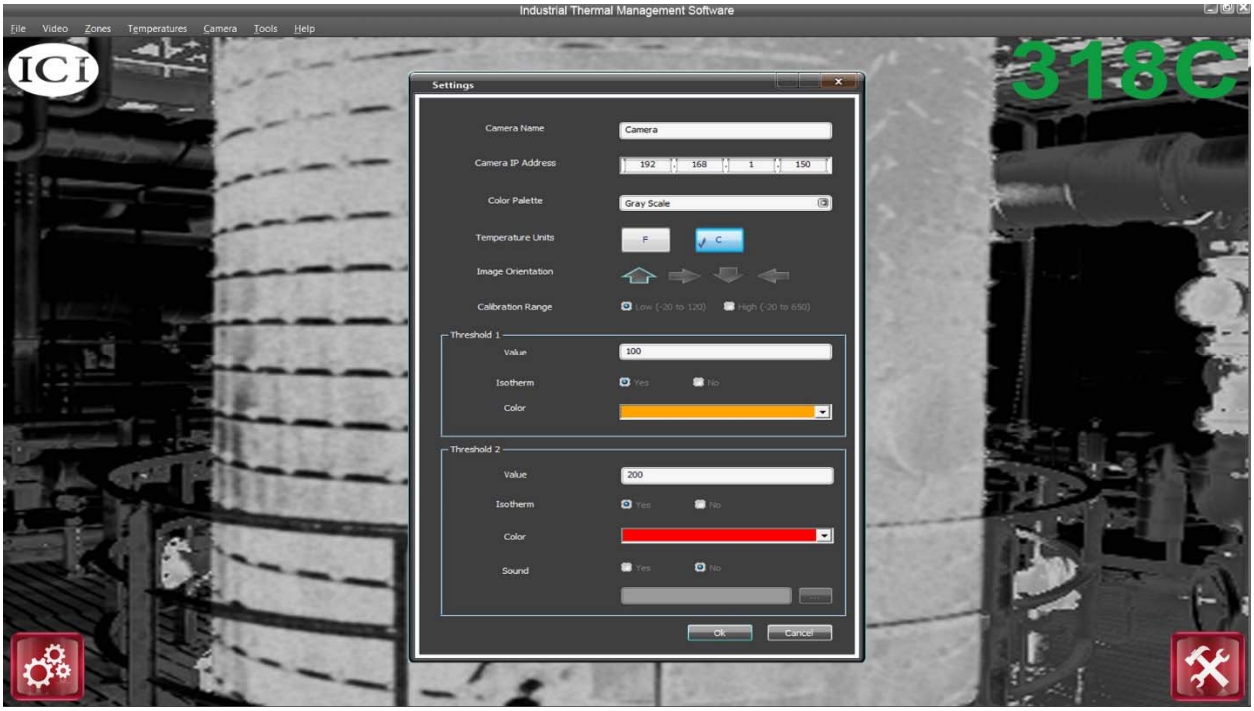
When a single camera is selected, the software leaves the multi-camera view and brings that camera to full screen. From here you will see, in the four corners of the scene, an ICI Logo, a Settings Icon, a Tools Icon, and the current hottest temperature in scene. By selecting Zone 2, Camera, 1 from the image above, we see the following.



Settings

By selecting the settings icon, a dialog box will appear in the middle of the screen. From here the camera can be given a custom name and the IP Address of the camera can be selected. This allows you to place the cameras, in a particular zone, in any order you wish, within the software. Palette, Level and Span settings are also set within this dialog box. We recommend the Auto Level and Span function to be enabled to allow for the best contract within the scene at all times.

Two threshold levels can be assigned to the entire scene based on temperature. Each threshold, the “warning threshold” and the “emergency threshold”, can be assigned an audible alarm, a visible alarm, and an isotherm. Custom activities can be assigned, when these thresholds are breached. For instance, you may want start recording images or exporting data to a log file.



Tools

The tools options allows for individual Areas of Interest (AOI) to be established in each scene. Area boxes, circles, lines and even custom polygons can be created to monitor items individually within a scene. This allows for more advanced alarming functions. Alarms can be triggered when a temperature goes below, above, or matches a preset value or range of values. The minimum, maximum, and average temperature, along with the standard deviation of each AOI, can be placed in a Modbus register. Custom area boxes for monitoring tank levels can be established which place the level of the tank, as a percentage of full, in the Modbus register.

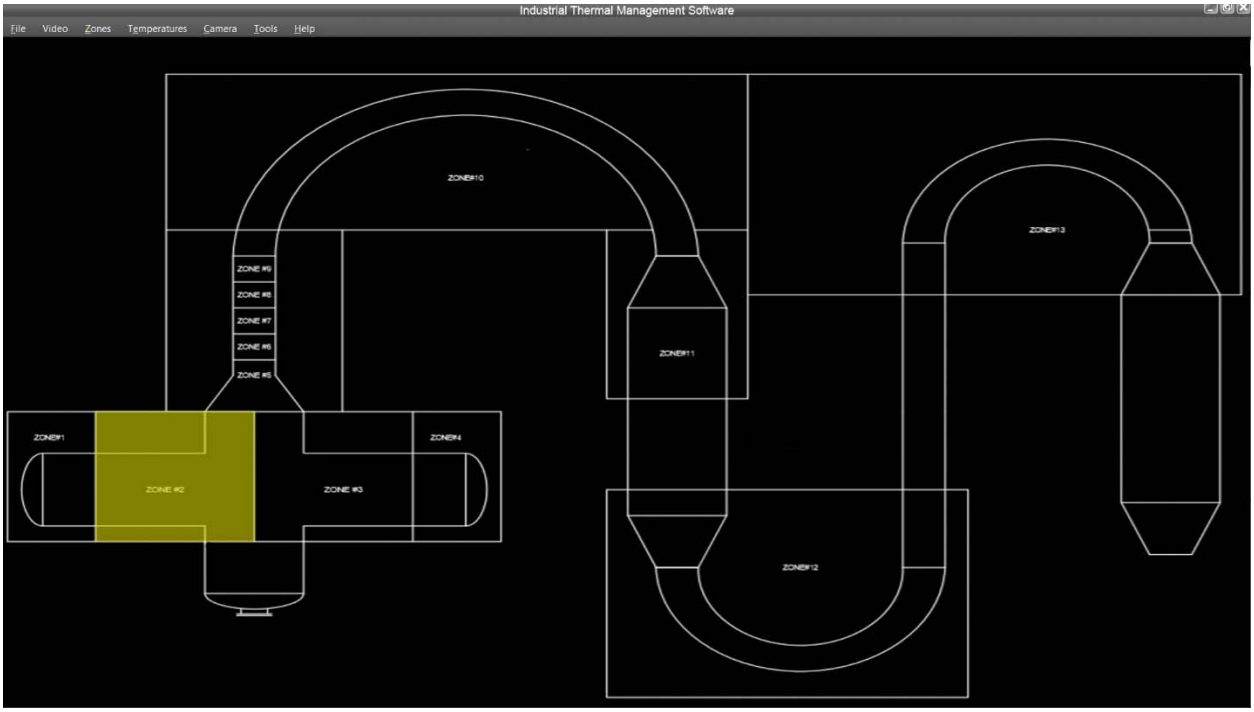
UI Server

The UI Server can be accessed via Remote Access Server from anywhere on the PAN. The Industrial Thermal Management Software installed on UI Server allows for RAS connections to each Dual Zone Server giving the user the ability to drill down to each camera location. Access to every camera is available from this interface. Images, video and data can be collected from any camera in the field to create reports relaying any areas of concern. Additional data storage and trending functions can be accomplished within the software, however, it has been our experience that this mechanism is better served by the DCS/PLC and Historian residing on the PAN.

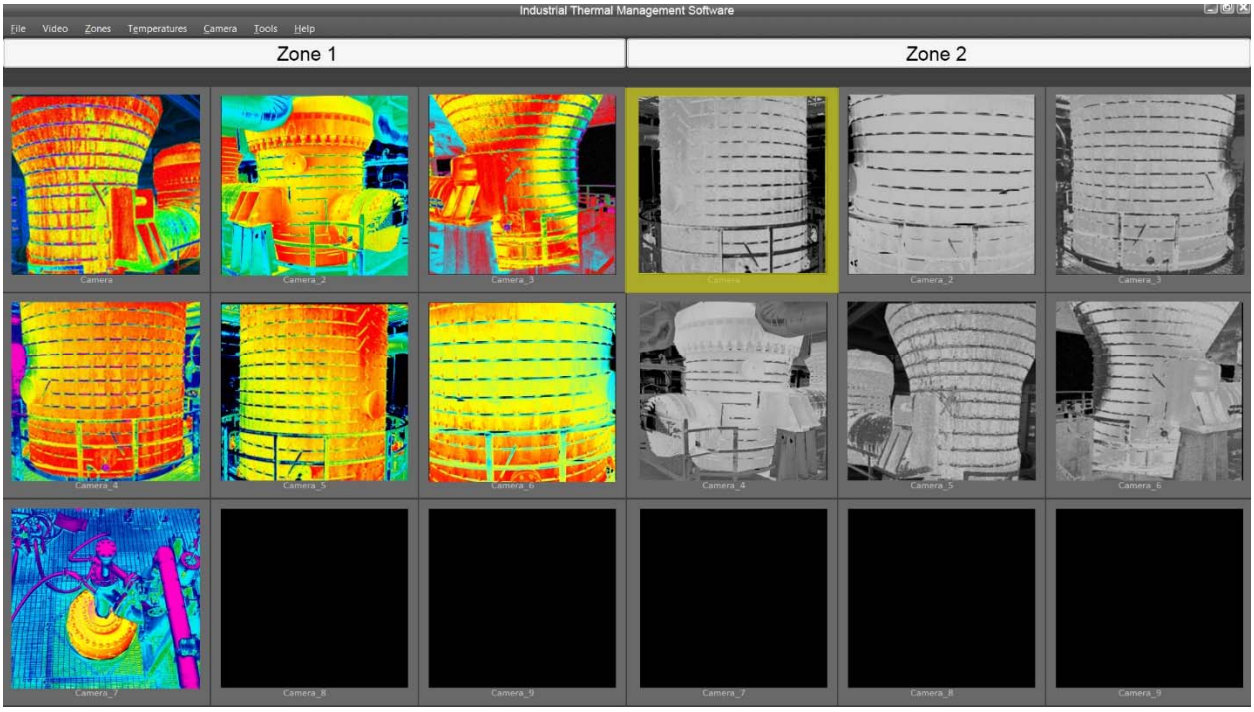
P&ID Interface

A custom P&ID interface, can be programmed to indicate when and where zone alarms are triggering. Selecting this zone will automatically initiate a remote access session with the proper Dual Zone Server to help identify the exact camera triggering the alarm. Finally, with the isotherm function enabled, an exact location causing the alarm can be determined. Three screen shots showing this progression are given below.

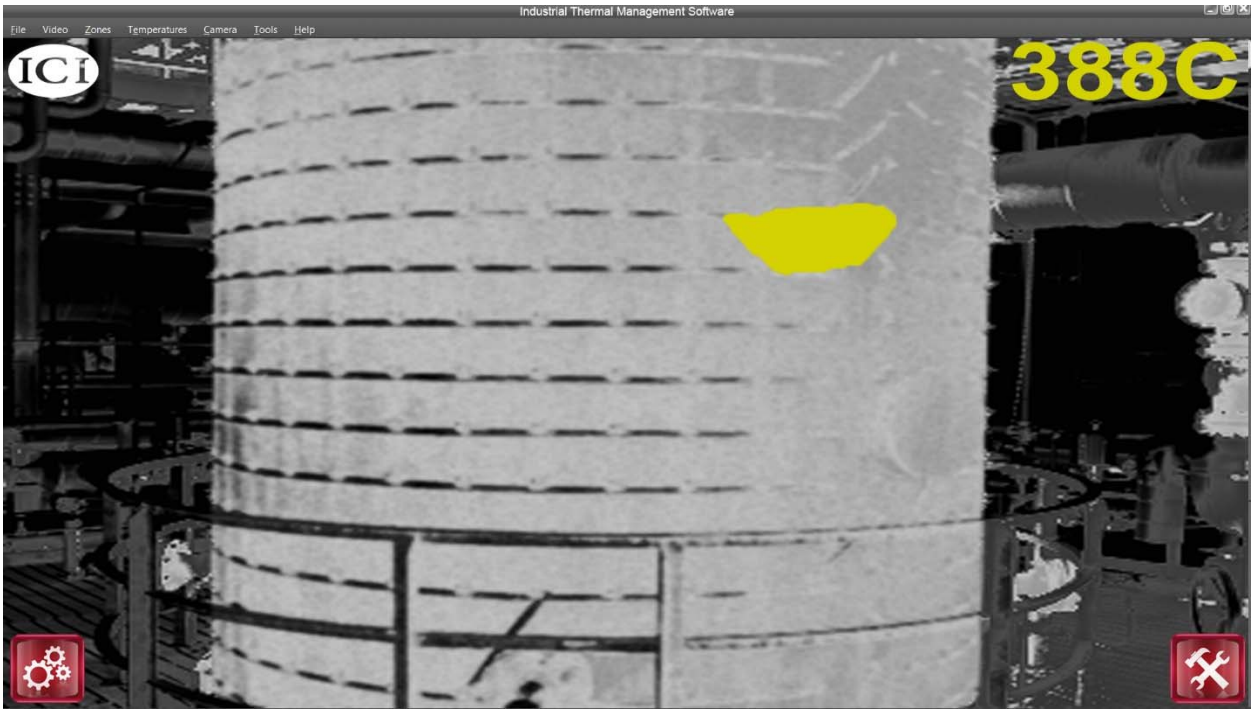
P&ID Interface (Indicating Alarm in Zone 2)



Multi-Camera Interface (Indicating Alarm on Camera 1 in Zone 2)



Single Camera Interface (Isotherm indicates area in scene causing the alarm)



Additional Interfaces.

The UI Server has several interfaces with which to observe the entire system from a single screen. Along with the P&ID interface above, we also provide a Mosaic Interface which shows the multi-camera view from each Dual Zone Server in a single windows. Selecting a particular Dual Zone Server will initiate a remote access session, with that server, giving full access to settings and tools options for modifying the system. Much like the P&ID interface.

There is also a Data Interface showing, in list format, all of the IR cameras and the data they are exporting via Modbus registers.

A Reporting Interface is provided to help in the generation of reports with advanced features to create and note areas of interest and to isotherm certain temperature levels.

Conclusion

We appreciate the opportunity to offer a quote on this project and we hope this technical explanation provides you a thorough understanding of the ITMS. The actual data sheets of each and every component in the system are available upon request. Should you have further questions or require any clarification please feel free to contact us at your convenience.