Proper Thermography Inspection of Control Panels to Assure Reliable Operation

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Abstract

This paper will discuss the importance of reliable control panel in power distribution system. Several examples of on-line infrared scans for number of control panels. The Scanning has been used a Condition Based Maintenance tool in determining potential problems with panels while in service & IR thermography is based on the thermal sensors that able to measure the thermal energy radiating from the elements of control panels with high sensitivity and accuracy

Keywords: *Condition Based Maintenance(CBM), Gas Plant, Infrared Thermography, Reliability, Control Panel, Thermal Images.*

1. Introduction

Infrared Thermography is one of the most valuable diagnostic tools for Condition Based Maintenance. It is a cost-effective Solution available in varying capabilities, depending on how many technological options on can afford. With an infrared camera PM65, it only takes minutes to look at systems and equipment to evaluate their current condition based on thermal patterns. IR Thermography can identity problems such as overheated components, poor connections, overloading, unbalanced loads and overheating breakers, which if left unattended could lead to major breakdowns. Based on infrared inspection data we have collected on electrical control panel of pumps & Gas turbines in gas plant. We have found that poor or loose connection are the most frequently findings we detect. monitoring including in the first instance: Infrared Thermographic Diagnostics, locates temperature differences and can identify problems before they become problems on; Electrical control panels, Power equipment, and Production processes. Condition Based Maintenance, using these condition monitoring techniques, assesses, on a continuous or periodic basis, the electrical condition of control panels. Condition Based Monitoring can significantly reduce the costs of maintenance by detecting potentially catastrophic faults which could be extremely expensive to repair. A well implemented CBM program is an on-going monitoring process that can almost eliminate the chance of an unexpected breakdown, whilst at the same time improve plant reliability and decrease plant downtime.

2. Field Experience at Gas Plant

Like many Production facilities in the process industries, the plant continuously looks for new technologies to improve process reliability, while reducing operating costs. Condition Based Maintenance (CBM) techniques are frequently used as a means of identifying potential failure points that could be addressed during scheduled outages. One CBM tool used very extensively in the facility is infrared thermography. For the past 10 years the plants has retained a full-time in-house technician that “sweeps” the entire facility every 6 months, checking for thermal signatures that may require attention. Thermal imaging has proven a very effective tool across a wide array of applications including areas such as measuring the impact of corrosion, detecting liquid levels in process tanks, final product conformity and of course, electrical. Thermal imaging is primarily conducted within motor control panels. IR scans are conducted while the circuit is energized.

Inspection Equipment

Temperature – CBM currently uses a FLIR Systems PM65 infrared camera and dedicated analysis and reporting software. The inspection is supported in the Field by a fully equipped mobile workshop ensuring that equipment can be readily accessed and secured after inspection.

Method

Images were taken as following procedures:

- Review equipment construction and operating theory.
- Operating conditions.
- Set up desired emissivity, distance, and temperature.

The CBM process begins with regularly scheduled inspections at the selected locations. The technical specialists of thermography, perform the station equipment inspections and determine the condition of each findings, assigning a severity level to each detected abnormality.

3. **Follow -up Results of Thermal Images**

From following thermal image surveys, engineers collected a larger sample of panels. Note from this thermal image that the observed elevated temperatures resided near the line terminals at the top of the panel and down the left side. The line terminal connections were checked for tightness, but the temperature issue persisted. Although it was difficult to determine the source of elevated temperatures for the image, with known good terminations the test technician elected to remove the failed part. The severity levels are defined as follows:

i. Condition level 1 – Acceptable – Routine follow up
ii. Condition level 2 – Minor fault – Monitor and follow up.
iii. Condition level 3 – Intermediate – Inspection required
iv. Condition level 4 – Serious – Intervention required

Priority levels on IR Thermography depends on temperature rise over a predetermined reference temperature

Level1	Serious
Level2	Intermediate
Level3	Minor

Summary

The initial inspection of Gas Plant equipment took place between 10th September and 28th November 2014. The following table shows a summary of the findings and shows that a high percentage of the equipment inspected requires immediate attention or is giving warning of potential problems that may cause equipment failure. This level of faults should not be taken as a reflection of the performance of the maintenance staff because these faults are immediately apparent with routine maintenance procedures and can only be found by utilising the procedures of the Condition Based Maintenance.

Condition Level	***Thermographic***
Level 1 : Acceptable – Routine follow up	*Not noted*
Level 2 : Minor fault – Monitor and follow up	*70 items*
Level 3 : Intermediate – Inspection required	*17 items*
Level 4 Serious – Intervention required	*9 items*

4. **Conclusion**

Electrical Control Panels operate reliably in countless industrial settings, and when properly applied these devices are designed to safely protect distribution systems for many years. In some cases, previous accounting of performance and reliability of components has been inaccurate, at times resulting in confusion for the engineer attempting to apply these devices properly. Like any electrical component, ongoing maintenance of panel components is an important element in assuring these devices will perform as designed, protecting distribution systems when called upon to do so. An element of the initial inspection has been dedicated to the set up of the equipment database that whilst not complete will not need to be repeated if the program is extended.A continued Condition Based Maintenance Program with thermal scanning will bring the following positive results: (i) Reduced equipment downtime. (ii) Reduced overhaul costs.(iii) Possibility to reduce spare parts inventory. (iv) Improved personnel safety & equipment reliability. (v) Improved Mean Time Between Failure of equipment.

5. **References**

[1]. Cornelius Scheffer, Paresh Girdher Machinery Vibration Analysis & Predictive Maintenance 2004.

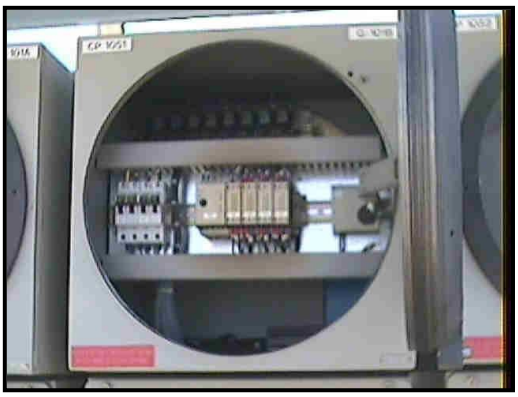
[2]. Infrared Training Centre (ITC) Imaging guidebook for Industrial Applications 2011

Examples of Findings Using IR Thermogreaphy

We currently using an infrared camera model PM65 and we inspect a wide verity of control panels on many locations.
The following illustrations of some of the abnormalities detected.

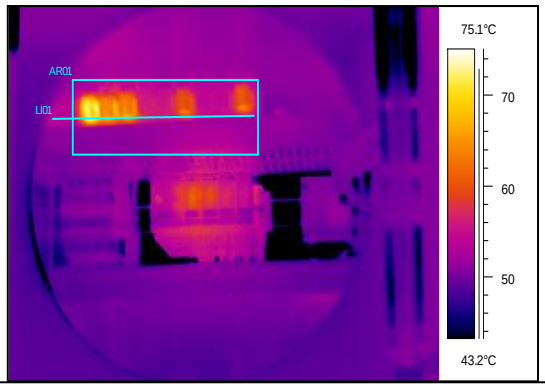
i. Hot connections on control panel, a hot connections detected on a control panel of Transferring pump as illustrated below. Excessive temperature rise required attention at monthly schedule.

Identification



Section	*GOSP A*
Equipment	*Control panel for G-101 B T.pump*
Additional information	*Connections*
Date	
Time	

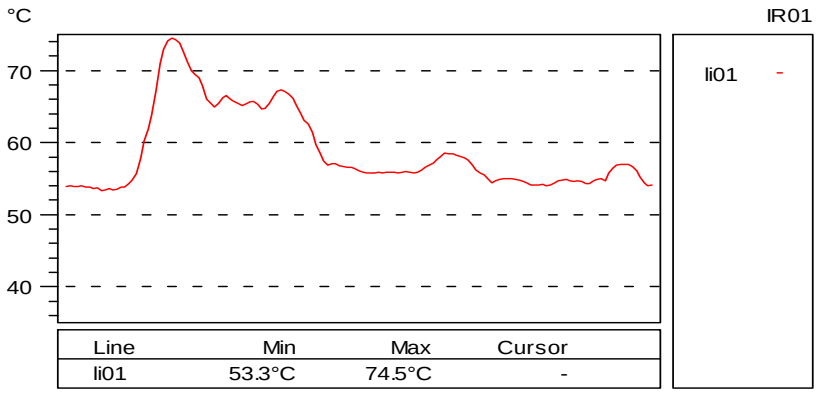
Fault Description



Object parameter	***value***
Emissivity	*0.98*
Object distance	*2.0 m*
Label	*value*
L101: max	*74.5 °C*
AR01: max	*74.5 °C*
Fault	*INTERMEDIATE*

Summary

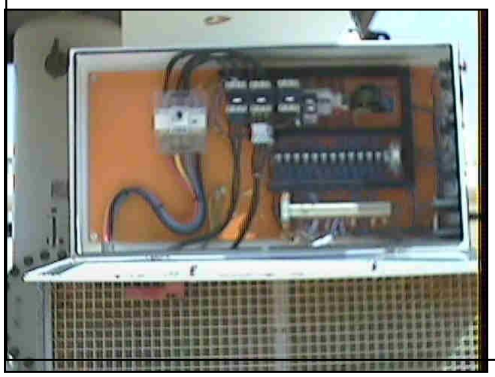
Based on infrared inspection data we have collected on Control panel for G-101B Transfer Pump,we have found



Thermal Profile Shows Intermediate Temperature Rise (74.5C) on Connections

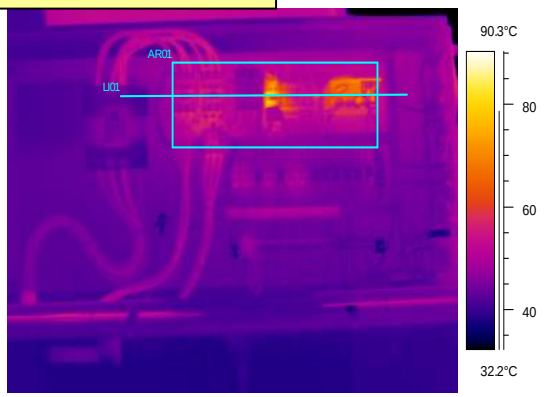
ii. Serious temperature raise at Protection Relays an control panel requires attention as soon as possible.

Identification



Section	*GOSP A*
Equipment	*Control panel for C-154 N.COMP*
Additional information	*Protection Relays*
Date	
Time	

Fault Description

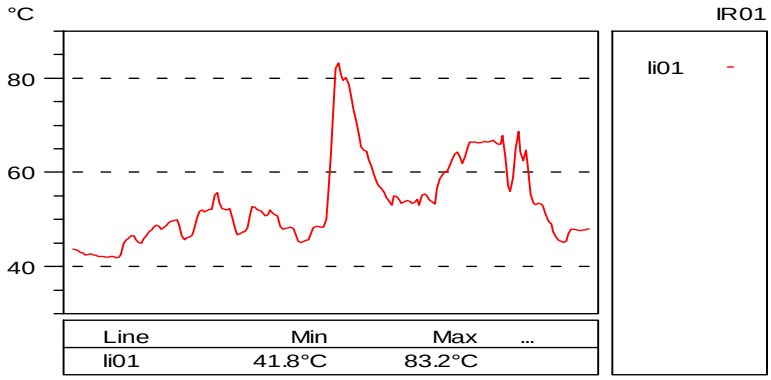


Object parameter	***value***
Emissivity	*0.98*
Object distance	*3.0 m*
Label	*value*
L101: max	*83.2 °C*
AR01: max	*83.2 °C*
Fault	*SERIOUS*

Summary

Based on infrared inspection data we have collected on Control

Panel for C-154 Nitrogen Compressor,we have found that temperature rise are Excessive and we recommend a proper inspection ASAP to ensure the reliability and safety .



Thermal profile shows a Serious temperature rise(83.2 C) on Protection Relays.