THERMOGRAPHY AS A TOOL TO IMPROVE RELIABILITY


V Nagarajan


K Praveen Kumar


S Vigneshwar


V Madhusudan

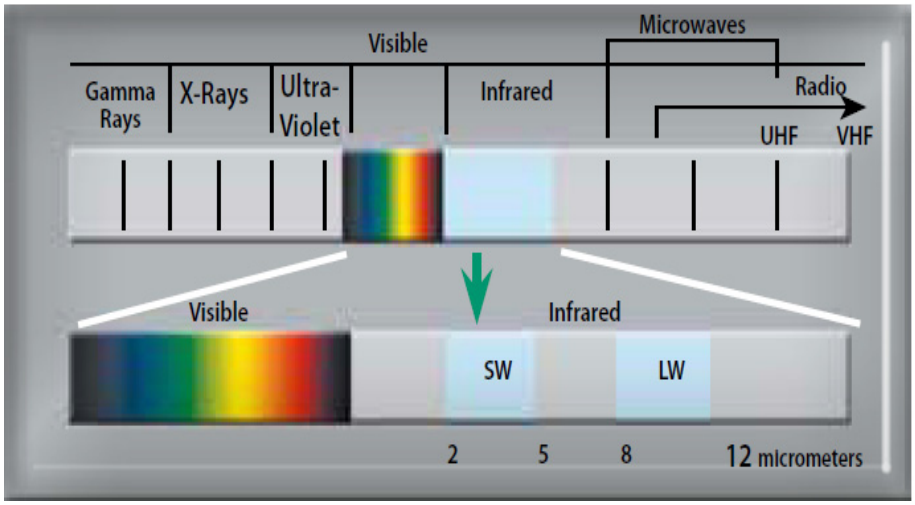
INTRODUCTION

- Since then thermal imaging technology has evolved. Thermal imaging cameras have become compact systems that look just like a digital video camera or digital photo camera. They are easy to use and generate crisp real-time high-resolution images.
- Thermal imaging technology has become one of the most valuable diagnostic tools for industrial applications. By detecting abnormalities that are usually invisible to the naked eye, thermal imaging allows corrective action to be taken before costlysystem failures occur.
- Thermal imaging cameras are a unique tool to determine when and where maintenance is needed, for electrical and mechanical installations tend to get hot before they fail. By discovering these hot-spots with a thermal imaging camera, preventive action can be taken. This can avoid costly production breakdowns or even worse, fire.
- A thermal imaging camera is a reliable non contact instrument which is able to scan and visualize the temperature distribution of entire surfaces of machinery and electrical equipment quickly and accurately. Thermography programs have contributed to substantial cost savings for our customers around the world.

The following picture depicts the control system of DIP Tower control.

WORKING PRINCIPLE

Infrared radiation lies between the visible and microwave portions of the electromagnetic spectrum. The primary source of infrared radiation is heat or thermal radiation. Any object that has a temperature above absolute zero (-273.15 degrees Celsius or 0 Kelvin) emits radiation in the infrared region. Even objects that we think of as being very cold, such as ice cubes, emit infrared radiation.



Why use thermal imaging?

- Producing faster, better, more efficiently and at a lower cost. In order to reach these goals, industrial plants need to be running continuously: 24 hours a day, 365 days a year.
- Unfortunately the worst problems remain hidden until it is too late.
- Thermal imaging cameras are the perfect tool for predicting failures because they make the invisible visible. On a thermal image problems seem to jump right out at you.
- To keep plants operational at all times many industries have combined their predictive maintenance programs with the most valuable diagnostic tools for industrial applications on the market: thermal imaging cameras.

THERMOGRAPHY

All electrical panels are checked for high temperature periodically to avoid breakdown. We at SPB having one infrared thermal imager. Following problems can be indentified and rectified using infrared thermography testing, which may prevent possible future breakdowns that would be very costly.

- Fuse blocks
- Control circuits
- Loose or corroded electrical connections
- Transformer bushings
- Faulty connections
- Inspecting steam systems

HIGH VOLTAGE INSTALLATIONS

- Heat is an important factor in high voltage installations. When electrical current passes through a resistive element, it generates heat. An increased resistance results in an increase in heat
- Over time the resistance of electrical connections will increase, due to loosening and corrosion for instance. The corresponding rise in temperature can cause components to fail, resulting in unplanned outages and even injuries. In addition, the energy spent on generating heat causes unnecessary energy losses. If left unchecked, the heat can even rise to the point where connections melt and break down; as a result, fires may break out.

Example:

- Oxidation of high voltage switches
- Overheated connections
- Insulator defects

LOW VOLTAGE INSTALLATIONS

Besides loose connections, electrical systems suffer from load imbalances, corrosion, and increases in impedance to current. Thermal inspections can quickly locate hot spots, determine the severity of the problem, and help establish the time frame in which the equipment should be repaired.

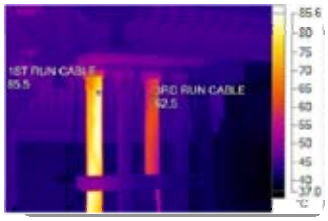
Example:

- High resistance connections
- Corroded connections
- Internal fuse damage
- Internal circuit breaker faults
- Poor connections and internal damage

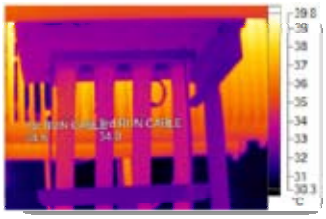
OBSERVATION - 1

5MVA-III TRANSFORMER

Before



After

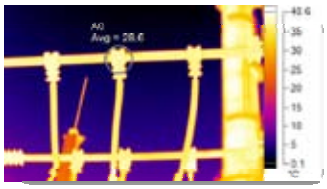


- Observed High Temp on Transformer Secondary Cable Termination
- Cable Reluged And Termination Tightness Checked.
- Work Attened And Found Normal

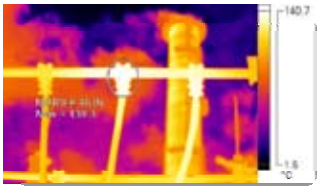
OBSERVATION - 2

110KV YARD

Before



After

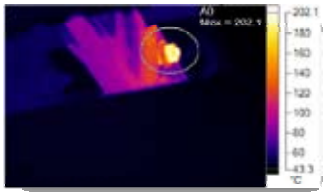


- Observed High Temp On 22kv Middle Run Cable Gland
- Check And Found Crack In Gland
- After Gland Changed Found Normal

OBSERVATION - 3

MF-III PANEL 502 BREAKER

Before



After

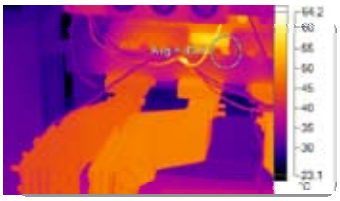
- Observed High Temp On Breaker Incoming B-Phase Isolating Termination
- Termination Tightness Checked
- After Work Attened And Found Normal

OBSERVATION - 4

PAPER MACHINE - SS-15 BREAKER

Before

After



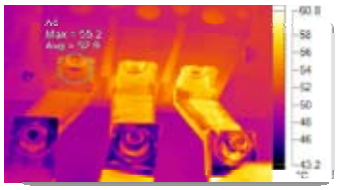
- Observed High Temp On Breaker Incoming Y- Phase Cluster
- Check And Found Misaligned
- After Work Attended Found Normal

OBSERVATION - 5

NEW PULP MILL - MILL WATER PUMP - 2

Before

After



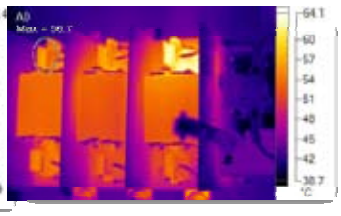
- Observed High Temp On Switch O/G R-Phase Jumper
- Jumper Cleaned And Bolt Nut Tightness Checked.
- After Work Attened And Found Normal

OBSERVATION - 6

PAPER MACHINE - SECONDARY HEAD BOX SCREEN

Before

After

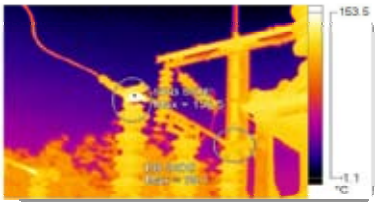


- Observed High Temp On R-Phase Fuse Limb
- Limb Cleaned And Repluged
- After Work Attened And Found Normal

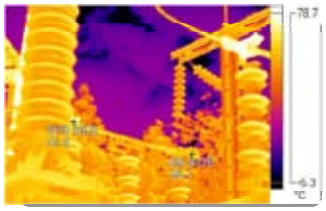
OBSERVATION - 7

110KV YARD EB SIDE AB SWITCH

Before



After

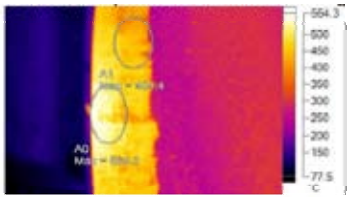


- Observed High Temperature On Y-Phase Clamp.
- Checked Clamp Tension Condition, Clean And Gel Applied.
- Found Ok .

OBSERVATION - 8

LIME KILN BURNER AREA

Before



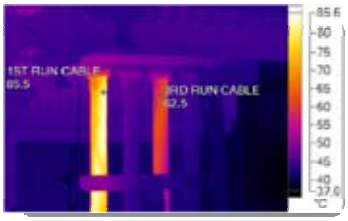
After

- Observed High Temperature (564 °C) On Lime Kiln Burner Area
- Refractory Bricks Got Damaged.
- New Refractory Bricks Has Been Relined.
- After Work Attended Found Normal -218 °C

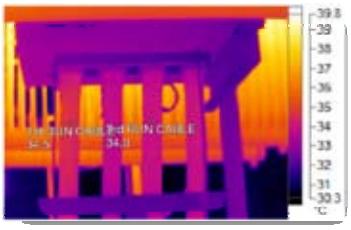
OBSERVATION - 9

CPP - 5MVA-3 TRANSFORMER

Before



After

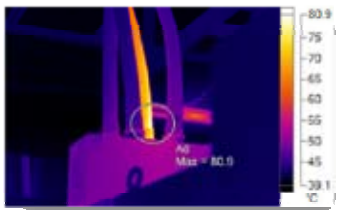


- Observed High Temp on Transformer Secondary Cable Termination
- Cable Reluged And Termination Tightness Checked.
- After Work Attened And Found Normal

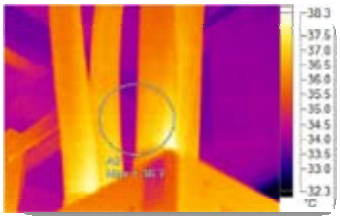
OBSERVATION - 10

CPP

Before



After

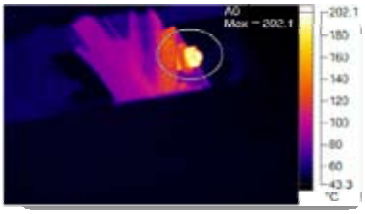


- Observed High Temp on Transformer Secondary Cable Termination
- Cable Reluged And Termination Tightness Checked.
- After Work Attened And Found Normal

OBSERVATION - 11

MF-3 P-502 INCOMER BREAKER

Before



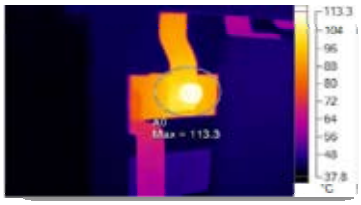
After

- Observed High Temp On Breaker Incoming B-Phase Isolating Termination
- Termination Tightness Checked
- After Work Attened And Found Normal

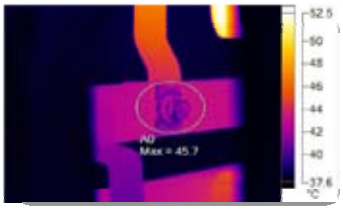
OBSERVATION - 12

PM1-4 MF-2 NEW COUCH VACUUM PUMP

Before



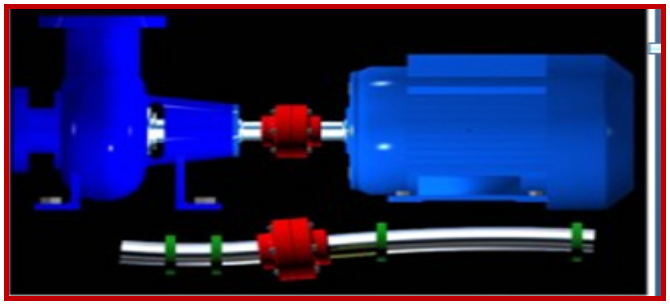
After



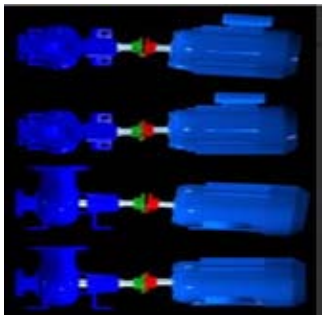
- Observed High Temp On Switch Incoming R-Phase Bus End Termination
- Bolt Nut Replaced
- After Work Attened And Found Normal

LASER ALIGNMENT

- Precision alignment will lead to reduce maintenance, operational cost and to improve product quality.
- Alignment=Less stress on seals,bearings,shaft and couplings.
- "Shaft are misaligned when their rotational centrelines are not collinear when the machine are operating under normal conditions".

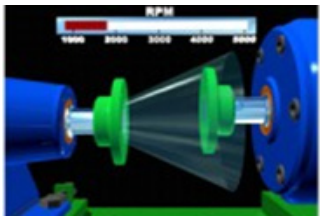


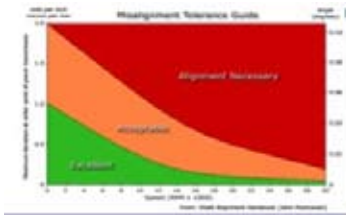
- Unless we take special precautions the shaft will not be collinear.
- There will be angular and offset misalignment.
- The misalignment will exist in the horizontal and vertical direction.



ALIGNMENT TOLERANCE

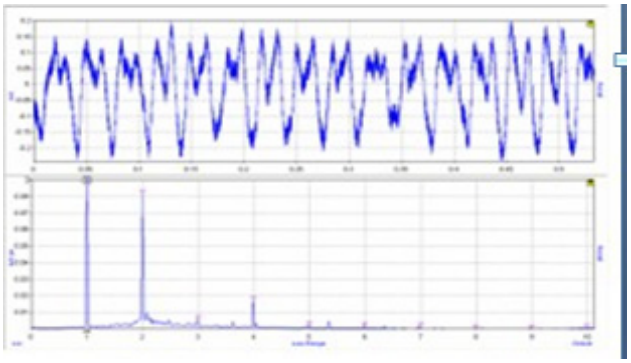
- ⊡ We do not aim for perfect alignment .
- ⊡ A small angle and offset can be tolerated.
- ⊡ Tolerance are based on the speed of the machine, coupling type spacer length, and other factors.



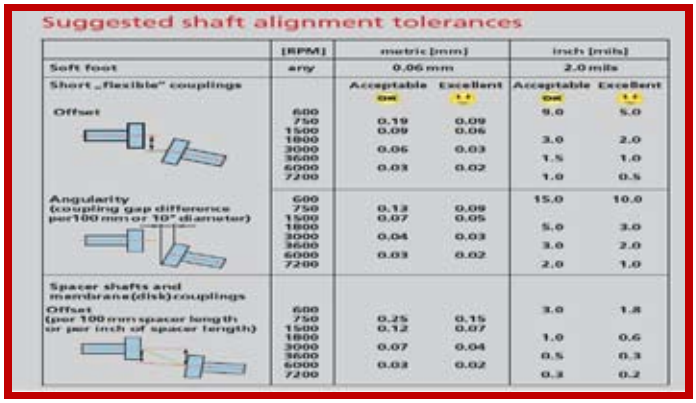


MISALIGNMENT SYMPTOMS

- ⊡ Failed bearings, couplings shafts, and seals, are sure sign of misalignment.
- ⊡ Vibration measurements can be used to detect misalignment.
- ⊡ Time waveforms, phase readings and spectrum can be used.



SHAFT ALIGNMENT TOLERANCES CHART



LASER ALIGNMENT REPORTS

CPP ID FAN-B

POSITIONS	ANGULAR	PARALLEL
VERTICAL	-0.019MM	0.022MM
HORIZONTAL	0.022MM	0.025MM

CPP NEW FD FAN

POSITIONS	ANGULAR	PARALLEL
VERTICAL	0.007 MM	0.012 MM
HORIZONTAL	-0.017MM	-0.016MM

MF-3 REELER MOTOR & GEARBOX

POSITIONS	ANGULAR	PARALLEL
VERTICAL	0.016 MM	0.017 MM
HORIZONTAL	0.023 MM	-0.021 MM

ULTRASONIC LEAK DETECTOR

- ⊡ Ultrasonic leak detector is an instrument meant for assessing online leakages pertaining to steam, air, and vacuum.
- ⊡ Following problems can be identified and rectified using ultrasonic leak detector testing, which may prevent possible future breakdowns that would be very costly.
- ⊡ Vacuum, air leakages identification and online valve passing.
- ⊡ Leak detection & reporting.
- ⊡ Steam trap and valve inspection.
- ⊡ Bearing Monitoring.
- ⊡ Electrical Inspection

Benefits:

Period	Mechanical Downtime Due To Misalignment-%	Electrical Downtime Due To High Spots -%
JAN-16 to July-16	0.94	0.75
Aug-16 to Feb-17	0.93	0.73
March-17 to July-17	0.77	0.47