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Temperature Based Condition Monitoring of Rail and Structural Mill

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Abstract— today in this competitive market it is necessary to reduce shutdowns and to increase our production rate. For this purpose we apply Condition Monitoring Methods. SAIL is the world's largest producer of rails with an installed capacity to produce 500 000 tons of rails and 250 000 tons of structural's. Bhilai is also the sole supplier of the country's longest rail tracks of 260 meters. Infrared Thermography is the latest Condition Monitoring technique that is adopted in Bhilai Steel Plant. Predictive Maintenance schemes are being practiced in Bhilai Steel Plant to monitor the health of the equipment and identify potential problems well in advance and plan remedial measures, thereby avoiding unwanted failures.

Keywords: Predictive Maintenance, Thermo vision camera, Thermo graphic image viewer software, Rail and Structural Mill, Temperature Based Condition Monitoring, Thermo graphic images

I. INTRODUCTION

Rail and Structural Mill in Bhilai Steel Plant produces mainly rails and heavy structural's and is equipped with many complex electrical drives. So, it is necessary to do proper health monitoring of equipments. For this purpose we apply predictive maintenance tool. In addition regular maintenance practices, Thermography, a condition monitoring technique is also applied to evaluate the condition of related electrical equipments and cables, reactor, DC Circuit breaker, cable joints etc., to prevent any unforeseen breakdowns. The main reason behind to do Thermography, it is a non invasive non contact method for even far away locations with higher accuracy.

II. METHOD

Firstly we take thermal images of a particular region or surface, and then we apply analytical approach with the help of Thermo graphic image viewer software, if there found any higher temperature on any point then we mark them as hot spots. With the help of hot spots we are able to find out higher side temperature range on a particular point. It is a modern approach to find out hot spots in our shorter time. Through this technique we can generate hot spots on different points on a single surface. Accuracy level may be vary depends on software user.

The Major Profiles Produced in the RSM Mill are

1. Rails

a) IRS 52 Kg/m
b) Thick Web Asymmetric Rail

2. Heavy Beams

a) 600 * 210 * 12 mm
b) 500 * 180 * 10.2 mm
c) 450 * 150 * 9.4 mm
d) 400 * 140 * 8.9 mm
e) 350 * 140 * 7.5 mm
f) 50 * 125 * 6.9 mm

3. Channels

a) 400 * 100 * 8.8 mm
b) 300 * 90 * 7.6 mm
c) 250 * 82 * 7.6 mm

4. Angles

a) 200 * 200 * 20/16 mm
b) 150 * 150 * 20/16 mm

5.) Crane Rails

a) CR 120
b) CR 100
c) CR 80

6.) Crossing Sleepers

a) It depends as per requirement 80kg/mm², 100 kg/mm², 120 kg/mm².

Introduction of Power Supply Units

For 1 D motor:

- Power capacity: 4 MW ,
- Speed : 70 rpm
- Current carrying capacity : 4940 amp
- Supply : 865 V

For 2D motor:

- Power capacity: 7.1 MW
- Speed : 90 rpm
- Current carrying capacity : 6190 amp
- Supply : 8040 V

Transformer: 11KV and 6.6 kV, capacity to step down 11000V, 6600V into 850V supply.

Different components used in power transmission unit for RSM

a) Copper cables 150 square mm.
b) Normal nut bolt joints.
c) Circuit Breaker, Load bearing capacity up to 8KA.
d) Reactors, to filter current into pure D.C. Supply.
e) Thyristors, to convert AC supply into DC supply.
f) D.C. motor, to supply rectified power in different Sections.

III. PURPOSE TO DO THERMOGRAPHY

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In Bhilai Steel Plant, Rail and Structural Mill Shop Machine works on very high temperature to produce temperature up to 1300°c. So proper temperature monitoring is essential to reduce hazards. To reduce hazards of failure we apply Thermography. Thermo graphic Images of Different Power Units at Rail & Structural Mill (RSM) Shop, Sail BSP.

(Before Repair) (After Repair)

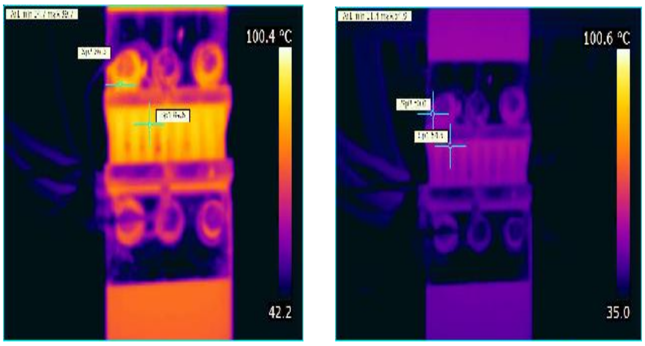


Fig.1 Description RSM Busbar of 1DDCCB2 (At shunt)

(Before Repair) (After Repair)

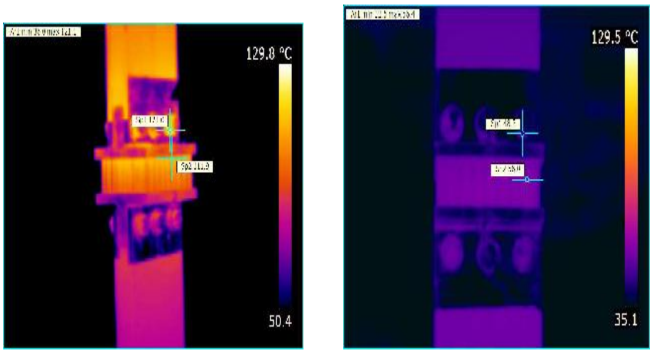


Fig.2 Description RSM Busbar of 1DDCCB1 (At Shunt)

(Before Repair) (After Repair)

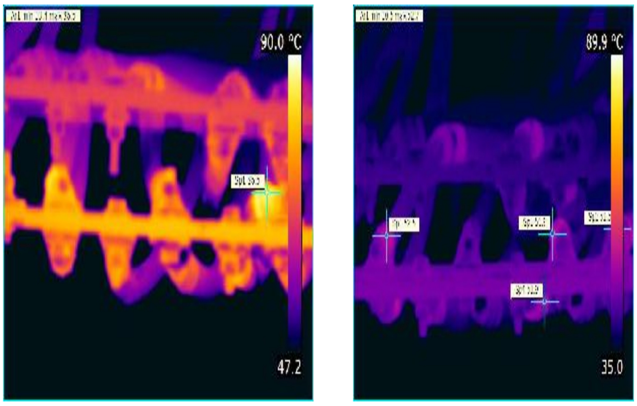


Fig.3 Description: RSM Bus bar of 1D DCCB

(Before Repair) (After Repair)

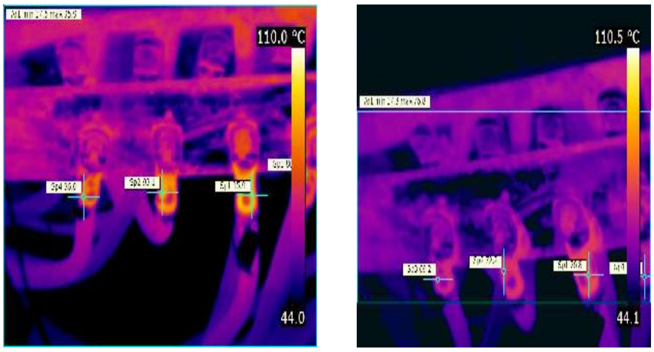


Fig.4 Description: RSM 2D DCCB1 Reactor bottom

(Before Repair) (After Repair)

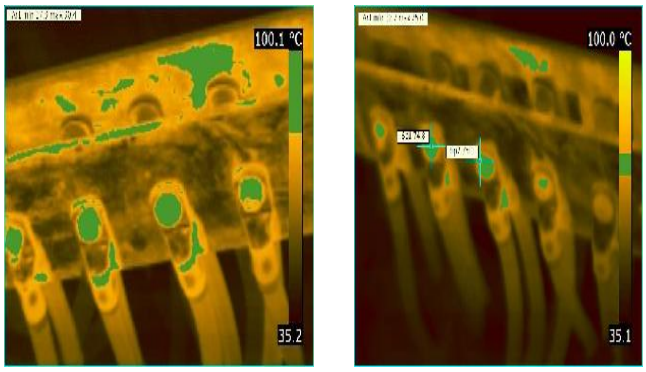


Fig.5 Description: RSM 2D DCCB2 Reactor

(Before Repair) (After Repair)

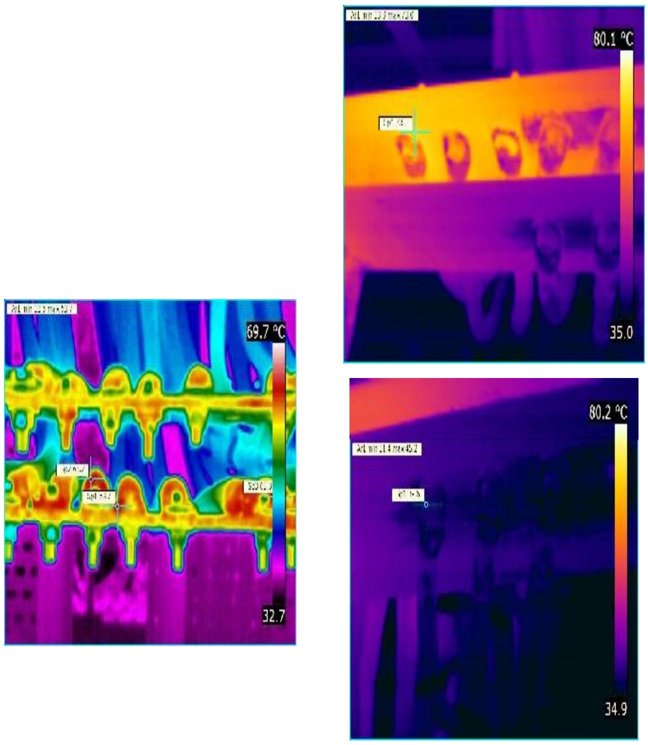


Fig.6 Description: RSM 1D/2 Reactors

(Before Repair) (After Repair)

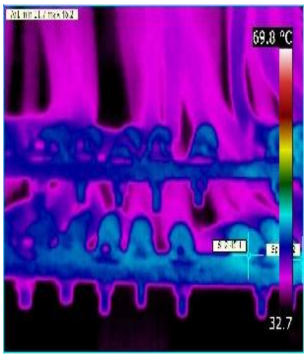
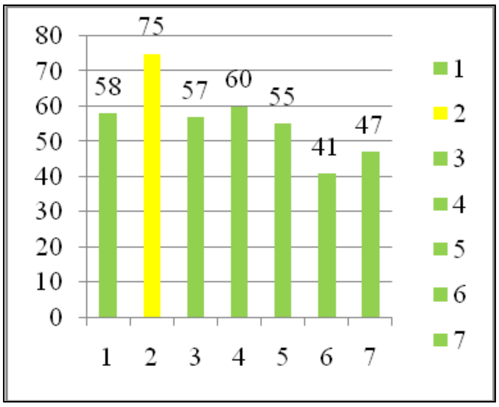


Fig.7 Description: RSM 2D DCCB outgoing

IV. RESULT AND DISCUSSIONS

Graph1.)



Temp◦c ↑

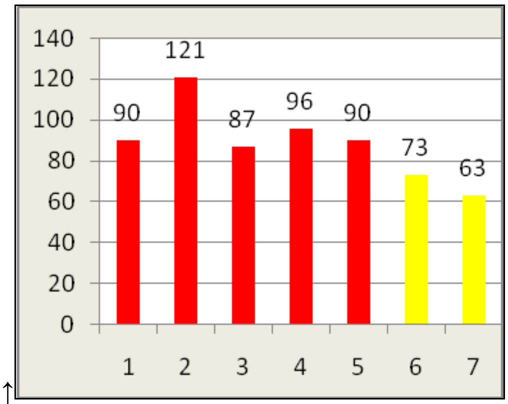
Readings on 15/02/2010→

Where, 1 = Temperature at bus bar of 1D DCCB2.
2 = Temperature at bus bar of 1D DCCB2.
3 = Temperature at outgoing bus bar of 1DDCCB Bottom.
4 = Temperature at 2D DCCB1 reactor.
5 = Temperature at 2D DCCB2 reactor.
6 = Temperature at 1D/2 reactor.
7 = Temperature at 2D DCCB outgoing.

Discussions

Above graph shows reading taken on 15/02/2010 at different power supply units of Rail & Structural Mill Shop, BSP. With the help of graph we can easily find out temperature range for different power units represented by 1,2,3,4,5,6,7. In this graph 1, 3, 4,5,6,7 having temperature of normal range but at 2 temperatures are more than normal range which marked as in caution range. Generally represented by yellow color.

Graph2.)



Temp◦c ↑

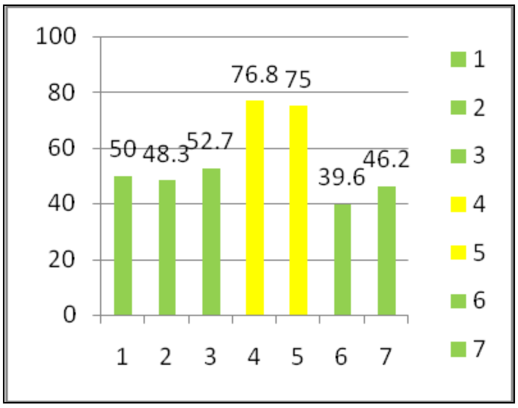
Readings on 15/03/2010→

Discussions

Above graph shows that readings taken on 15/03/2010 having higher side temperature readings, when we compared it with previous readings at 1,2,3,4,5 it shows temperature more than caution range then we mark it as in alarm range generally represented by red color. But at 6, 7 temperatures is in caution range generally represented by yellow color. To reduce temperature at different units firstly check for looseness of joints and cables, if fault not found then we cut a loop of cable for testing purpose. It is generally cut where temperature range is in alarm range. After testing if there problem exist

insulation then we change cable for that particular area. But in this case, temperature increasing due to looseness of joints. After tightening of joints temperature come into its normal range.

Graph3.)



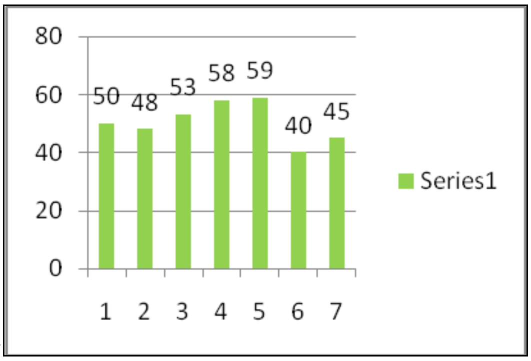
Temp◦c↑

Readings on 20/03/2010→

Discussions:

Above graph shows that readings taken on 20/03/2010 still having higher side temperature at 4, 5, then we marked it as in caution range. Other readings are in normal range. To reduce this excessive temperature, we check looseness of cables and joints if there found any looseness then resolve it by taking proper action. The reason for increasing temperature at 4, 5 is looseness of clamping nut bolts. After repair temperature is minimized**.**

Graph4.)



Temp◦c↑

Readings on 25/03/2010→

Discussions

Above graph shows that all readings are in normal range taken on 25/03/2010.It shows that no maintenance work is needed at this stage. With the help of 'hot spots' we can easily find out excessive temperature at a particular point.

Result

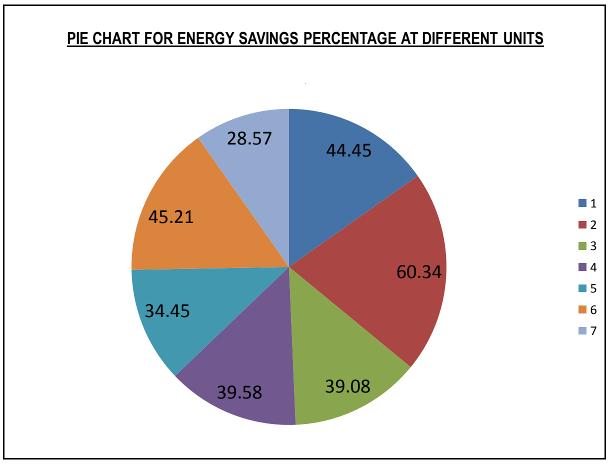
Total energy savings at different units:

- Energy savings at 1 ↔ 44.45%
- Max energy savings at 2 ↔ 60.34%
- Energy savings at 3 ↔ 39.08%
- Energy savings at 4 ↔ 39.58%
- Energy savings at 5 ↔ 34.45%
- Energy savings at 6 ↔ 45.21%
- Energy savings at 7 ↔ 28.57%

Overall savings → (1+2+3+4+5+6+7) / 7 → 41.67%

Formula Used

Energy savings ↔ 100-{(Min Temp/ Max. Temp.) * 100}
Overall savings ↔ ∑ savings at different units /7



IV. CONCLUSION

Through proper condition monitoring with the help of Thermography the improvement achieved in different units of rail & structural mill shop at BSP can be easily observed from above Thermo graphic images. The excessive temperature is minimized up to its normal range within 1 month. These are the benefits which show that Thermography is a very effective predictive tool to reduce catastrophic hazards in our short time. The above mentioned applications clearly indicate the usefulness of Infrared Thermography as an effective condition monitoring tool. Locating the surface 'Hot spots' developed due to internal defects in critical units and loose connections in electrical joints well in advance and taking corrective measures well in time has helped in avoiding many breakdown in Bhilai Steel Plant. Thus Infrared Thermography utilizing Thermo vision camera has become a very powerful resource for Predictive Maintenance in Bhilai Steel Plant.

Remedies

- Installation of highly resistive copper nut bolts.
- Installation of clamping must be done by experts only.
- Regular monitoring of loose parts at different power supply units.
- Installation of good insulated power cables.
- Installation of highly efficient circuit breaker.
- Proper installation of bus bars and cable joints.

Advantages of Thermography

- Quick problem detection without interrupting service.
- Prevention of premature failure and extension of equipment life.
- Identification of potentially dangerous or hazardous equipment.
- Can monitor target in motion and also low visibility target.
- Temperature profile can be recorded and displayed easily.
- Can monitor targets electricity charged. (high voltage equipments)
- Can also monitor small and remote items.

Disadvantages of Thermography

- Cost of instrument is relatively high.
- Unable to detect the inside temperature if the medium is separated by glass/polythene material etc.

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