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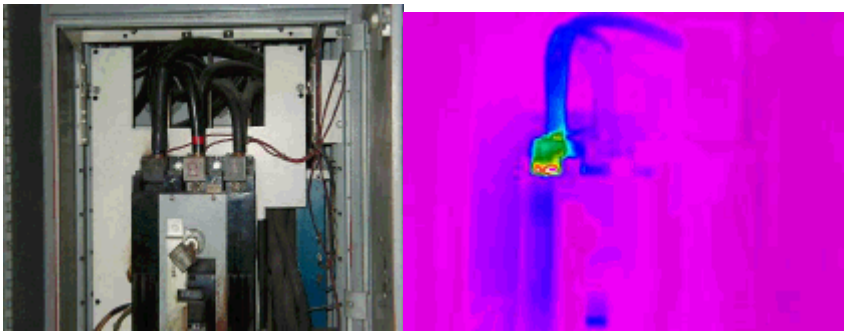
INTRODUCTION

Most electrical equipment failures go through a stage where they give off heat before the actual physical failure takes place (changes in temperature) and they are problems that are invisible to the naked eye in the early stages.

Since infrared radiation is actually the "heat" that is invisible to the human eye, Infrared thermography is introduced. It is specifically an Infrared Scanner that performs a non-intrusive inspection of the analyzed object to locate and detect abnormalities before they become defective or hazardous.



By measuring the temperature profiles of the equipment, infrared imaging produces thermal maps that reveal electrical problems that otherwise would be undetectable.

Infrared thermal scanning is an inspection technique that uses an infrared camera to conduct analysis for various applications such as:

- Electrical Inspection and Troubleshooting
- Mechanical Inspection and Troubleshooting
- Building Inspection
- Facilities Maintenance
- Process Monitoring and Quality Assurance
- Research and Development
- Other areas, such as medical, etc…

The report will introduce what “infrared thermography is all about and it’s application towards electrical components. In order to have a better understanding of this advancement in the market, a brief introduction will be covered on the performance of a thermal imager “Raytek ThermoView Ti30” and its use in some case studies with reports for various electrical applications.

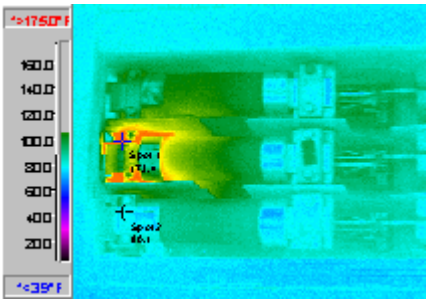
INFRARED THERMOGRAPHY

How Infrared Technology Works

Depending on its specific use, infrared technology works by utilizing one or two basic characteristics of the infrared spectrum:

- Light
- Heat

All objects with a temperature above absolute zero emit some degree of infrared heat. Heat based infrared technology assigns different, often vivid colours to specific ranges of temperatures, usually assigning warm colours like yellow, orange, and red to hotter temperatures and cool colours like green, blue, and purple to cooler temperatures.

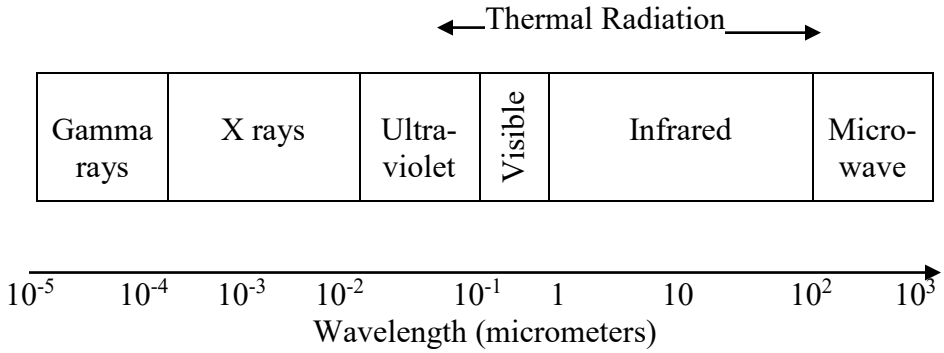


The representative light of the infrared heat source is able to captured on film (as with infrared still photography), or is rendered using computer programs (as in medical thermography and night vision). These programs can range from the simple motion sensing programs used in outdoor lights to the complex digital infrared thermal imaging used in human medical and veterinary scans.

Radiation at discrete wavelengths in the infrared range is characteristic of many molecules. The temperature of a distinct object can also be determined by analysis of the infrared radiation from the object.

Infrared radiation lies between the visible and microwave sections of the electromagnetic spectrum. Infrared waves have frequencies which are lower than visible light and higher than microwaves. They have wavelengths longer than visible light and shorter than microwaves.

Electromagnetic radiation having a wavelength in the range from c.75 x c.10^{-6} cm to c.100, 000 x 10^{-6} cm (0.000075-0.1 cm). Infrared rays thus occupy that part of the electromagnetic spectrum with a frequency less than that of visible light and greater than that of most radio waves, although there is some overlap. The name infrared means “below the red”, i.e. beyond the red, or lower frequency (longer wavelength), end of the visible spectrum.



Radiometers operating in the infrared range serve as the basis for many instruments, including heat-seeking devices in missiles and devices for spotting and photographing persons and objects in the dark or in fog.

Thermongraphy has also been used in industry and other applications. Some lasers produce infrared radiation. A recent development has been the expansion of research in infrared astronomy; infrared sensors are sent aloft in balloons, rockets and satellites to study the infrared radiation reaching the earth from other parts of the solar system and beyond.

Temperature Measurement Techniques

The measurement techniques used by infrared thermal imager to quantify or measure the temperature are complex:

a) Qualitative also called Thermal Viewer – with the ability to capture quality thermal image
b) Quantitative also called imaging radiometer – with the ability to perform detailed temperature study

Measurement method and Instrumentation selection depends on following issues

- What is the temperature range of the target?
- What is the ambient operating temperature?
- Are the ambient conditions contaminated by dust, smoke, steam?
- What are the target material and its emissivity?
- What is the size of the target (Spatial Resolution)?
- How close to the target is from the instrument (Field of View)?
- How fast is the target or process moving (Frame –recording)?
- Will discrete objects or a continuous process be measured?

Key parameters are:

- Total Field of View: the image size, in terms of measurement distance and angle
- Instantaneous Field of View: angular projection of the IR detection element and it is also mean measurement spatial resolution indicating target spot size on which accurate temperature study
- Minimum Resolvable Temperature: the minimum black body equivalent target temperature difference can be observed and also frame record rate

Infrared Thermograhpy Camera

Infrared thermography can be divided into two approaches, the passive approach and the active approach. The passive approach test materials and structures which are naturally at different (often higher) temperature than ambient while in the case of the active approach, an external stimulus is necessary to induce relevant thermal differences.

In many industrial processes temperature is an essential parameter to assess proper operation and passive thermography aims at such measurement. Important applications of the passive approach are in production, predictive maintenance, medical, fire forest detection, building thermal efficiency programs, road traffic monitoring, agriculture and biology, medicine, detection of gas (by mean of absorbing tracer gas) and in non-destructive testing (NDT).

In all these applications, abnormal temperature profiles indicate a potential problem to take care of. Interestingly for some applications, knowledge of the work piece fabrication and operation combined with proper thermal modeling opens the door to quantitative extraction of information.

INFRARED THERMOGRAPHY INSPECTION ON ELECTRICAL COMPONENTS

Predictive & Proactive Maintenance Diagnostic Approach

Predictive and proactive maintenance practices are the appropriate maintenance strategies for any organization.

Maintenance professionals with their right diagnostic skills and understanding of the principles of machines, instruments, controls, operation capabilities are able to trouble shoot faults in advance to avoid any catastrophic failures.

Knowledge is also necessary to equip them to provide analysis problem in a proactive manner i.e. beyond the immediate faults identifies and plans and perhaps explore solution to the root cause of trouble and not just the symptoms.

Cutting Edge Technology

Infrared thermography is an ideal inspection technique for scanning electrical equipment for defective components. Normal wear, corrosion, chemical contamination, fatigue and faulty assembly or installation may lower the conductivity and raise the resistance level of the component which will increase the amount of power dissipated in the form of heat. This in turn will cause an increase in the temperature of the component.

This excessive heat, evidenced by the increased surface temperature of the component, can be readily noted and the temperature rise measured by the infrared system. The increased temperature indicates a potential trouble spot (hotspot) and possible future failure of the component.

With a hand held Infrared digital camera which shows us a scene in Infrared heat, we can see the hot spots literally jump out of the scene. The speed of spotting and recording faults allow us to investigate many switchboards and mechanical items in a day this then makes the work of fault finding very inexpensive in comparison with the old method of physically checking every component.

The infrared inspection is carried out while the electrical system is under load, and there is no physical contact with the system. Thus making it an excellent preventive maintenance tool, which cause no disruption to the normal operating routine of a facility.

At the plant or building level, all major electrical equipment such as sub-stations, motor control centers, switchgear, circuit breaker panels, electrical motors, etc…can be readily checked for component parts which are excessive temperatures, thus indicating potential problems.

In power generating transmission and distribution systems, electrical energy is transferred from one facility to the next through a series of mechanical interfaces associated with the connectors, insulators, switches, brushing, buses, etc. Each such interface represents appoint where conductivity may be reduced with a resultant temperature rise, again pointing out a potential problem.

Routine infrared scanning of electrical components is thus a valuable preventive maintenance tool whereby early corrective action may be taken preventing costly breakdowns and / or plant hazards.

Interpreting Thermograms

It is worth noting that the most important element of this inspection - the thermogram analysis - is not simply a matter of looking for the "white" area. A variety of factors must be considered to determine whether or not a particular thermogram is indicating a severe problem, a slight problem, or no problem at all.

A thermogram is a heat picture of an object. Unlike ordinary photographic equipment that responds to visible light, the infrared image produced on the display unit resembles the object in black and white shades of gray. The lighter the object the hotter its temperature, conversely, the darker the cooler.

Who should use Thermal Scanning?

Thermal scanning is designed for any business or company needing to verify its electrical equipment's, operational safety and reliability, and/or required to have thermography performed on a regular basis for fire/safety reasons by its insurance company.

Together, the user will be benefited with a well planned maintenance schedules, e.g.:

- Helps to prevent unscheduled shutdowns
- Provides improvements in production efficiency
- Reduces energy bills
- Reduces insurance premium costs
- Maximizes equipment availability
- Allows repairs to be made at a convenient time
- Provides confidence in plant equipment
- Reveals latent design faults in products
- Monitors high risk production processes

Advantages of Infrared Thermography for Plant Diagnostic and Predictive Maintenance

Money

- Infrared thermography is being used in facility maintenance. Through the proper use of infrared, unplanned shutdowns are avoided and organized timing and planning of scheduled repairs are put into effect. Fiscal responsibility is enhanced through the cost-cutting benefits of this technology, which includes saving energy, protecting capital equipment investment, reducing insurance premiums, speeding inspection and diagnosis, and in verifying repair work

- Test method reveals the approach of problems well in advance of failure, maintenance priorities may be set according to the seriousness of different problems - thereby controlling and reducing scheduled shutdown time (lost production & costly downtime) for maintenance

- Locating potential failures before they occur can be factored into reducing insurance costs by preventing damage to property and personal injuries

- Reduction of unexpected failures and unnecessary repairs

- Preventing costly repairs and reduced maintenance costs

Time

- Ability to plan and schedule repairs and reduce repair time

- Reduce man-hours spent on preventive maintenance by pinpointing areas that need preventive maintenance and critical problems are identified

- Promotes a more efficient preventive maintenance program that reduce unscheduled equipment downtime

Safety

- Safety is improved by using a non-contactable temperature measurement technique with a safe monitoring distance away to uncover latent design or material defect and for assessing high-risk processes as high currents are used in power plants / equipment

- Prevent accidents of personal injury and property damage

- Decrease risk of electrical and mechanical catastrophic failure that may be a resultant to fire

Energy

Increased reliability and efficiency of your systems and equipment for product quality, production capacity and equipment life & availability

- Equipment failures are anticipated and avoided
- Hot spots are identified before they cause irreparable damage
- Improvements are identified in a cost-efficient and effective manner
- Maintenance and repairs are scheduled more efficiently

The table below shows the likely fault nature for some general electrical component:

Electrical Component	Fault Nature
Switches, MCC (Motor control centers), capacitor bank, bus bars, fuses, switches, etc…	Loose or corroded terminal connections, poor contacts, imbalance in loads, overloading, power harmonics, eddy current and other hysteresis
Electrical motor / Generators	Imbalance in loads, shortened or open winding, blockage in cooling system, overheating of brushes, slip rings and commutators
Transmission lines, lighting arrestor, circuit breaker, conductor, compression claps, splices	Loose or corroded terminals connections, and splice, failed capacitor, poor breaker connection, overloading, damaged conductor
Bus duct	Imbalance in loads, high resistance in joints, bus plug-ins and fuse connections
Transformers	Loosed or deteriorated connections, overheated brushings, blocked cooling tubes, low oil level, overloading
Lighting	Poor connections, ballast overheating
Emergency power system-ups etc	Poor or corroded battery terminal connections, defective or weak battery cells

Infrared Inspection Procedures:

Caution

- Exercise caution when working around rotating machinery
- Maintain minimum safe distance from energized electrical circuits
- Observe standard safety precautions when an elevated structures or roofs

Preliminary Check-Instrument

- Charge batteries and backup batteries for infrared camera
- Ensure optical lens are clear
- Prepare image storage devices such as computer disk, etc…
- Inspect imaging system cables and test camera operation. Verify correct date and time (if available) set in the camera
- Notify operators or other local occupant before starting inspection
- Ensure electrical circuits to be inspected are opened and energized to 50% of full load current (check for any imbalance in electrical load and understand the concept of heat energy)

Procedure for a Qualitative Infrared Thermography Inspection

- Become familiar with system construction by review appropriate drawings or blueprints noting insulation materials located on, or within, the subject system and how they might impact findings
- Discuss with the end user the reason for conducting the infrared inspection
- Review any previous reports and operational data to determine history of the subject system including past problems
- Ascertain that the system is under normal operating conditions and how its operation is likely to affect thermal signatures
- Ensure that line-of-sight access is available and that environment conditions and infrared equipment are appropriate for collecting accurate data
- Determine if a similar system is available for reference purpose
- Adjust camera settings such as distant to object, sharp image focus and emissivity
- Perform thermographic inspection looking for hot and cold spots, relative differences in temperature and temperature deviations from the normal or expected range
- Save image of items of interest. Ensure camera is adjusted to show entire temperature range
- Note machine location and operating or environmental conditions for each image saved and immediate actions taken to correct fault
- Repeat procedure for remaining machines/areas on schedule
- Notify operators or other local occupant when inspection is completed
- Notify supervisor of any temperature difference that is greater than 40 degree centigrade
- Upload infrared images to host computer for analysis and reporting. Provide notes/ comments for analyst use

Raytek - ThermoView™ Ti30
Design for Predictive Maintenance Application

ThermoView Ti30 thermal imager offers breakthrough performance for maintenance engineers, managers or anyone who wanted to do thermographic inspections on their own terms. For optimal results and quick payback, professionals use the ThermoView Ti30 not just only in a crisis or for an annual maintenance check, but in every inspection.

Using the ThermoView imager's structured database, professionals can ensure consistent, repeatable measurements over time. They can efficiently and accurately communicate with co-workers, management, equipment manufacturers and service providers by incorporating thermal images in emails and report. In addition, customers can easily create permanent inspection records indicating temperature behavior before and after repairs, and monitor thermal trends over long periods.

1. **Record image**
2. **Download image and data**
3. **Create and share reports**
4. **Evaluate success of follow-up**

Preventive and predictive maintenance programs can greatly minimize repair and labour costs, reduce inventory of parts, and avoid product variation and production loss. Thermal imaging has emerged as an effective predictive maintenance technology by identifying variations that can lead to equipment failure.

The thermal imager can easily capture 100 thermal images during scanning with a simple 'click' of a trigger. The saved images are then downloaded into a companion InsideIR software for qualitative and quantitative thermal imaging analysis and follow-up reporting.

Download, Analysis, Reporting & Routing – Do it Off-line

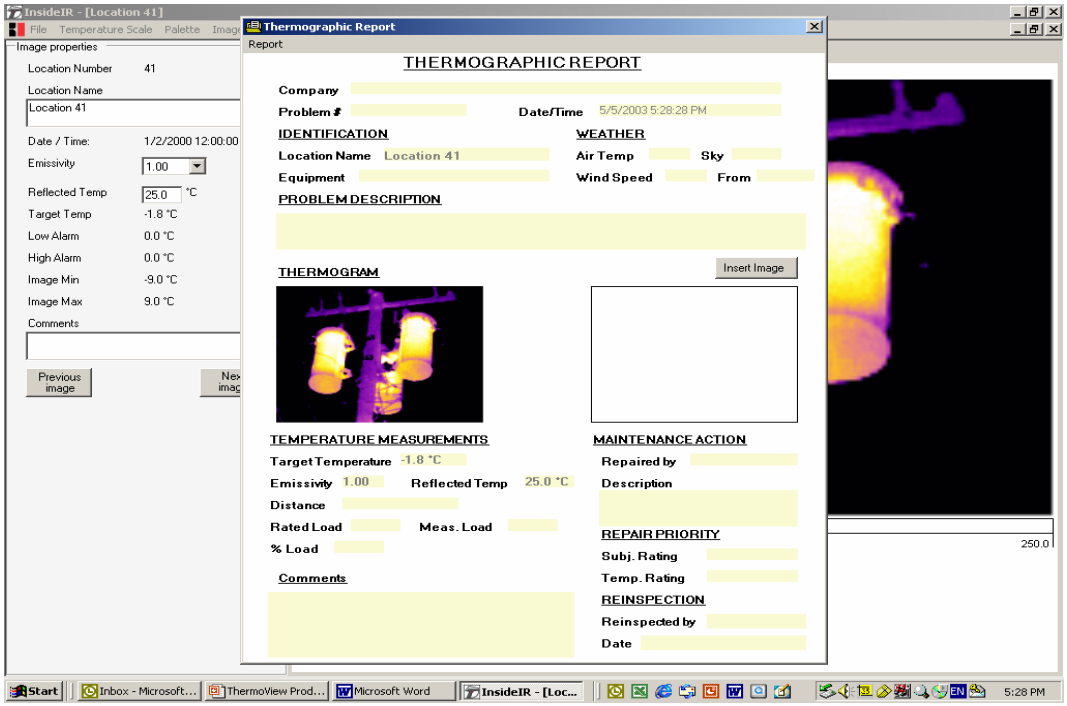
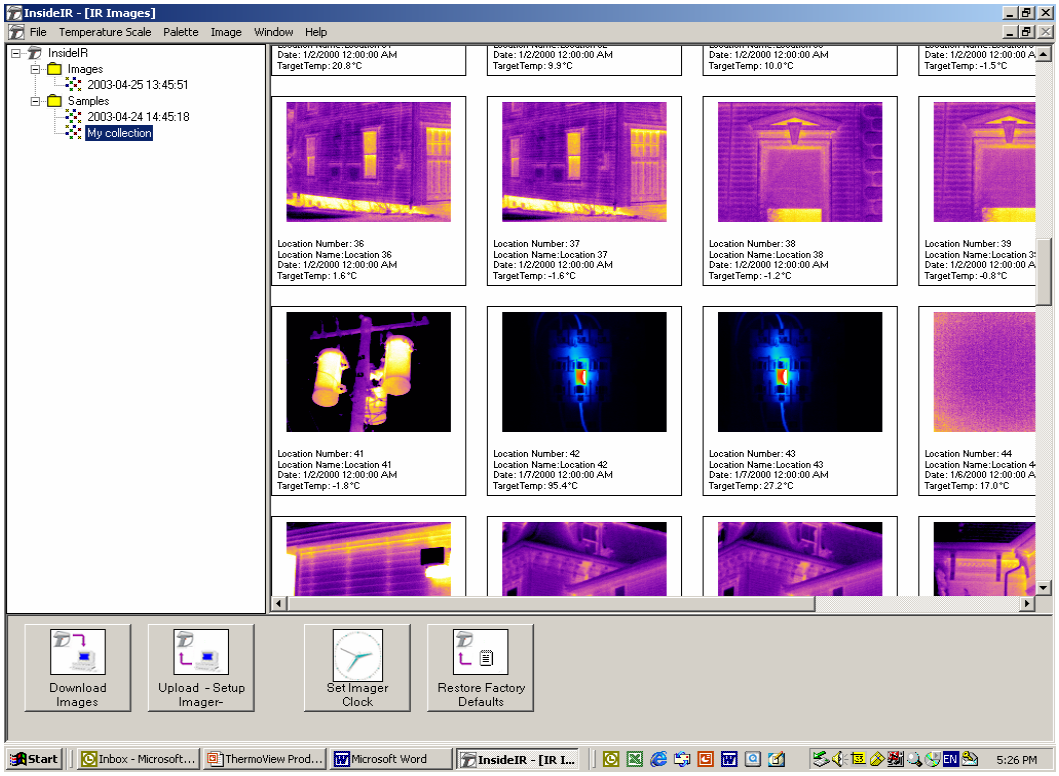


Image storage and organization



CASE STUDIES REPORT

With the use of Raytek - ThermoView™ Ti30

COMMON PROBLEMS IN ELECTRICAL CIRCUITS AND COMPONENTS

1) Loose Connections (Poor Contact) and Corroded Terminal

Causes:

Poor initial installation / poor maintenance. The difference of the thermal properties between the screws and connection / contact points may be a cause of loose connection.

Effects:

It will cause the equipment to draw excessive current to achieve its normal loading condition, therefore excessive heat will be dissipated and the cable insulation may deteriorate with time.

2) Improper Terminations

Effects:

The electrons in the air around the exposed wire will charge up day by day. It deteriorates the resistance in the air and the air might turn conductive. A flash over might occurs (Partial Discharge).

3) Unbalance Loading

Causes:

Bad load balancing designing (Diversity Factor).

Effects:

It will cause one of the three phases to draw excessive current (due to unbalance loading) and therefore excessive heat will be dissipated causing the cable insulation to deteriorate with time.

4) Harmonics and Eddy Current

Causes:

Usually cause by using large numbers or electronic devices such as computers (work stations), computer network and servers.

Effects:

The distorted current and voltage from the electronics equipments (harmonics effect on the cables) causing heat to be generated in the cable thus deteriorate the insulation.

THERMAL SCANNING REPORT

Project Information

A thermal scanning is carried out in May 2005 at a shopping mall.

Summary Report

Faults boxed in red are found to have a higher temperature than the normal:

Fault No.	LOCATION	EQUIPMENT NAME	PRIORITY	REMARKS
1	Basement Chiller & Pump Room	Contactor	3	
2	Basement Chiller & Pump Room	Termination of Incoming Feeder	3	Carbonization on cable and cable termination
3	Basement Chiller & Pump Room	Contactor / Relay	2	Discoloured cables, deform cables insulation
4	Basement Chiller & Pump Room	Contactor / Relay	2	Discoloured cables, deform cables insulation
5	Basement Chiller & Pump Room	Contactor / On Delay Timer / Relay	1	Improper termination, burn marks on cables and termination, deform cable insulation
6	Basement Chiller & Pump Room	Capacity Bank	2	Burn marks on R phase, unbalance loading at the load side
7	Roof Top	Relay	2	Carbonization and discolouring of cables
8	LEVEL LG	Circuit Breaker	3	Improper cable termination, melted marks spotted on cables

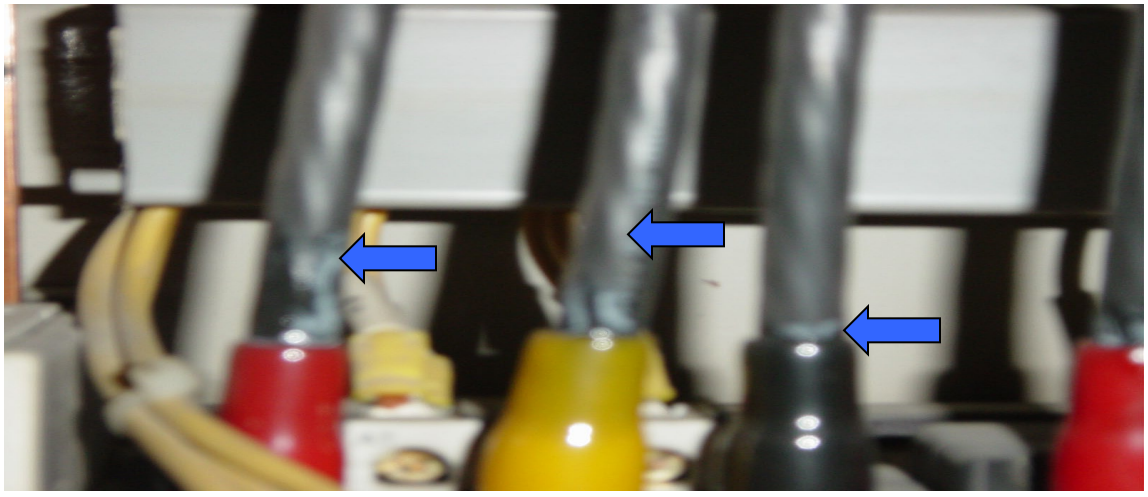
Priority Scale of Repair

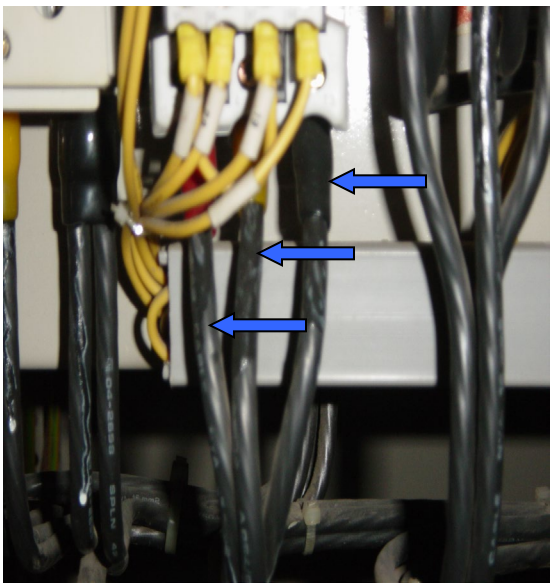
Temperature Difference (°C)	>40	20 - 40	10 - 20	<10
Priority Scale	1	2	3	4
Corrective Measures	Schedule immediately	Rectify during the next opportunity	Check the electrical circuit	No action required

Brief Notes of Some Defect Findings at:

Fault No. 3

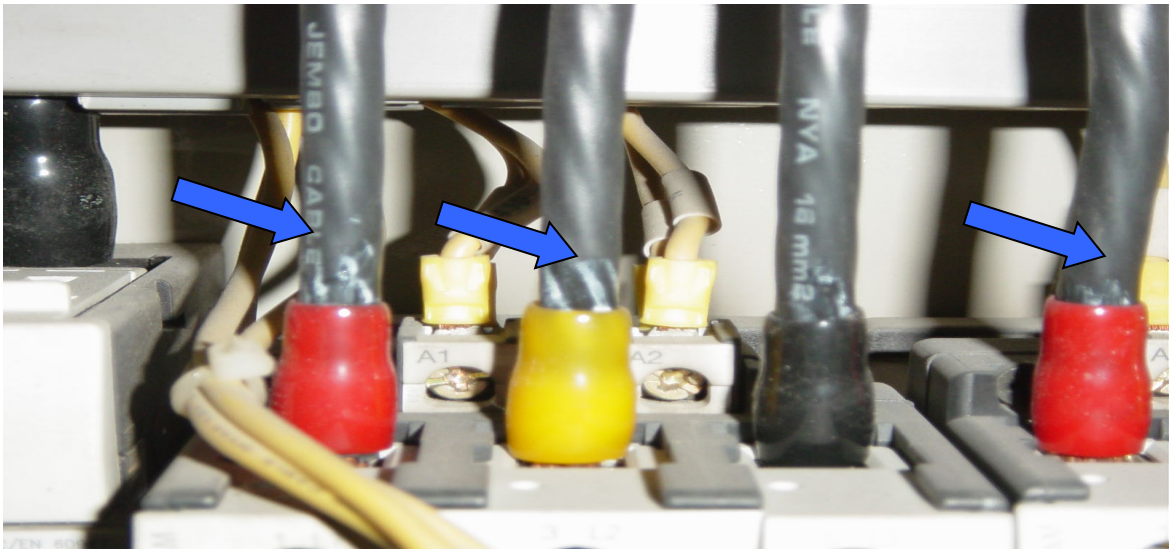
Deformation and discolourisation of cables are resultants of excessive heat loss from the cables and it might just weaken the whole cable insulation.

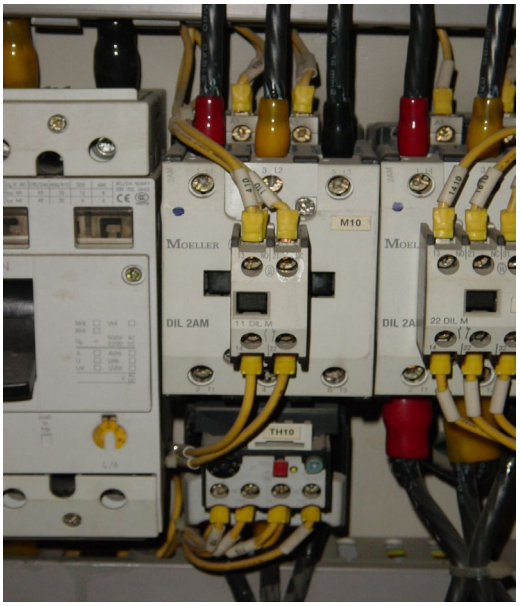


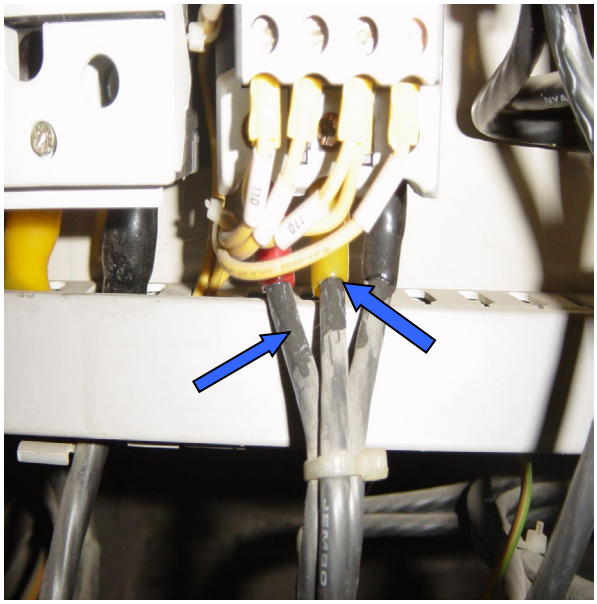


Fault No. 4

Deformation and discolourisation of cables are resultants of excessive heat loss from the cables and it might just weaken the whole cable insulation.

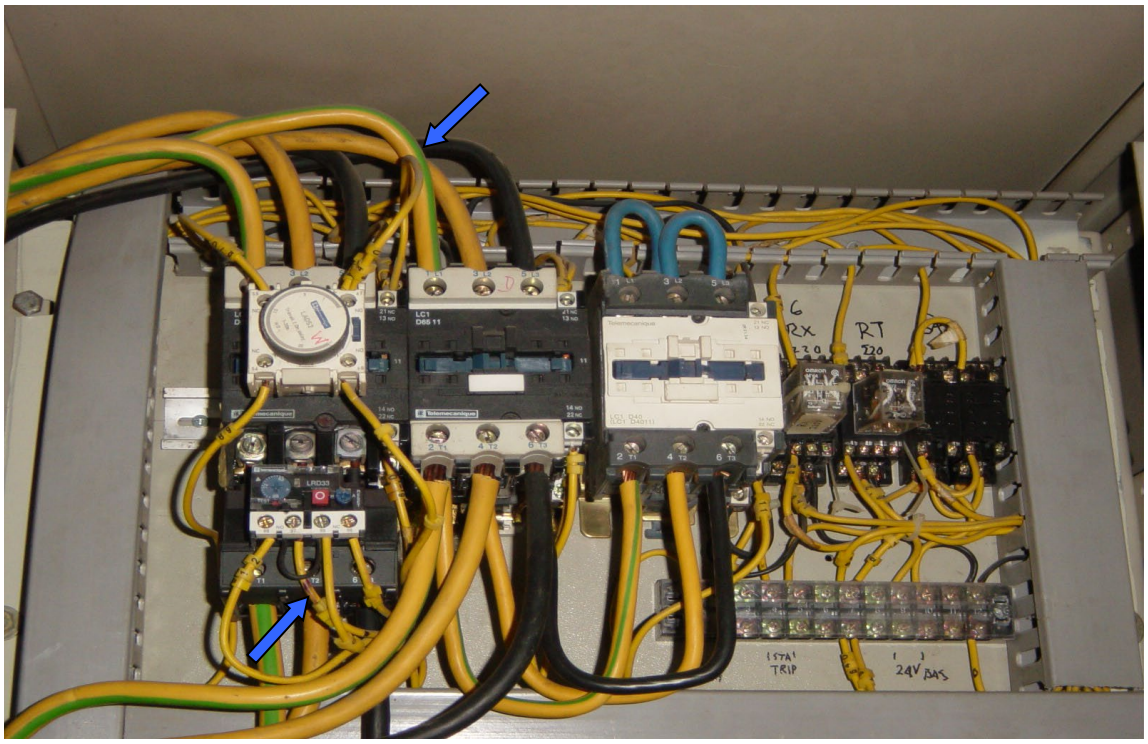




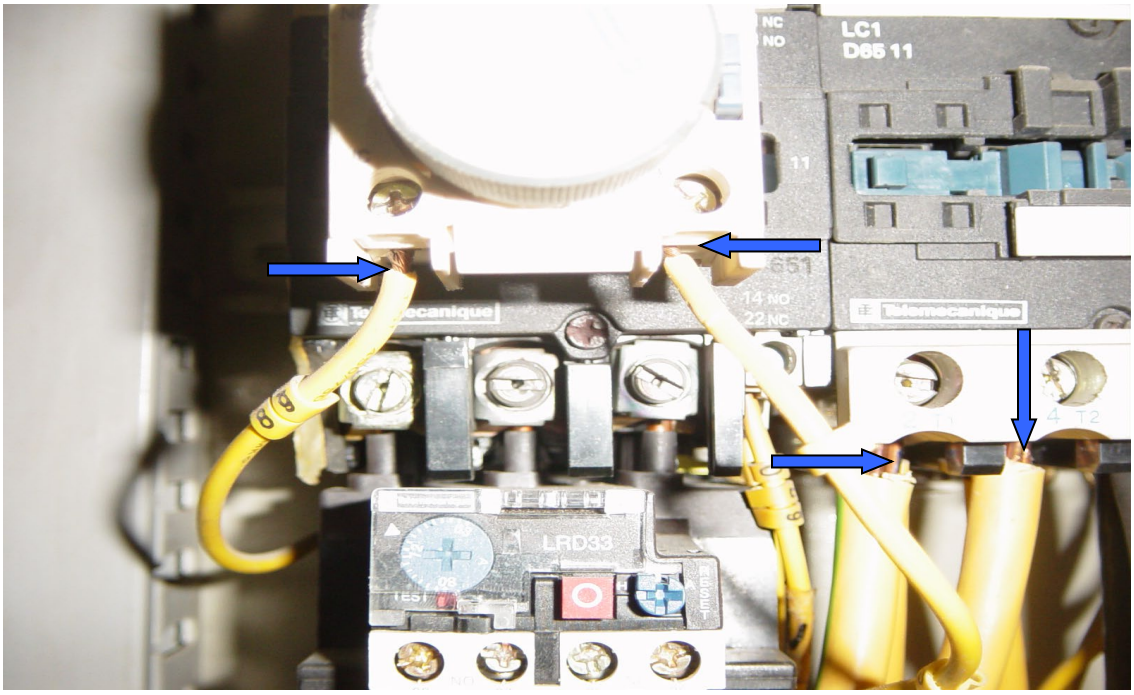


Fault No. 5

Insulation to the cables is deformed. Burn marks are found on both the cable and cable terminations.

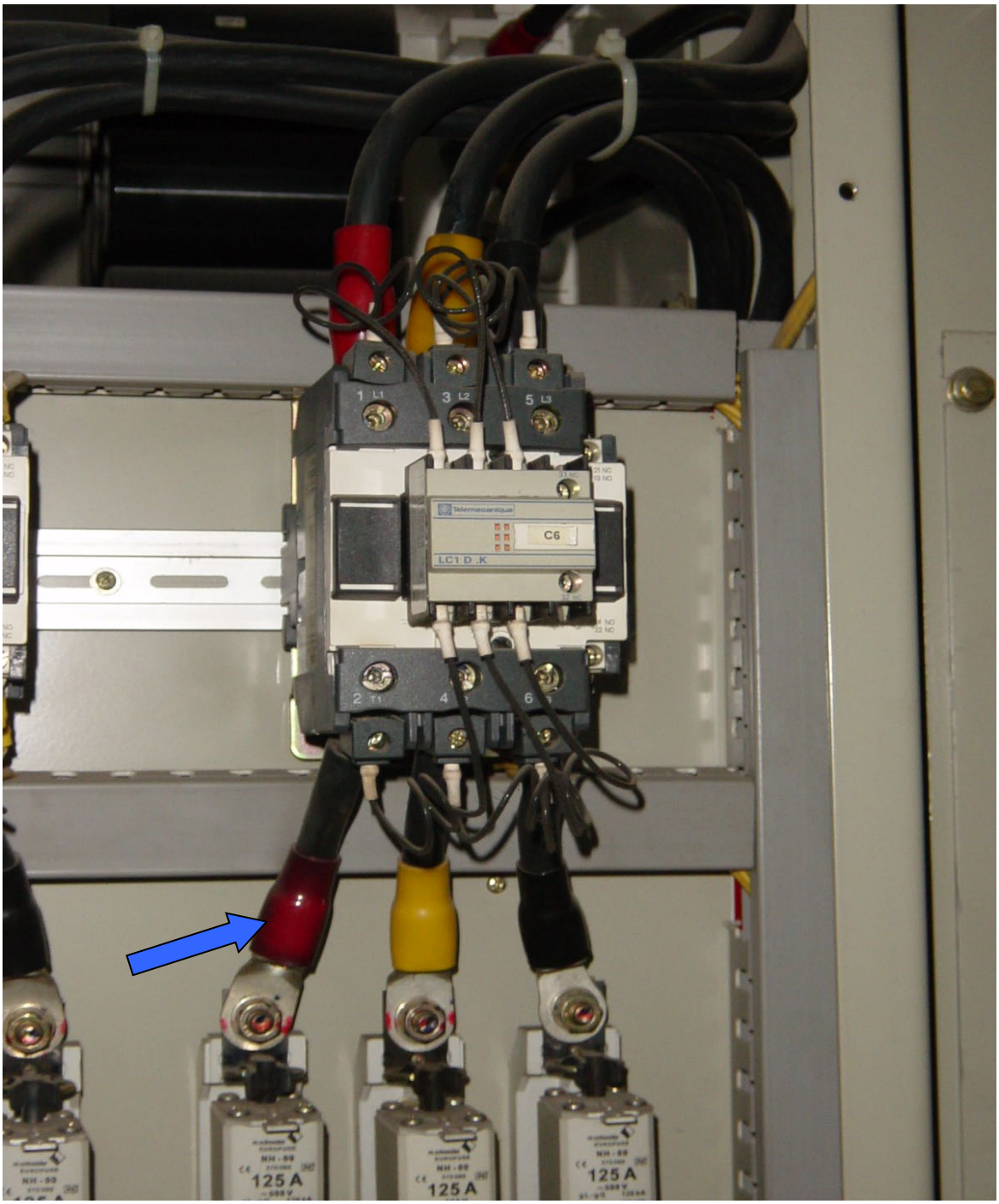


Improper cable terminations are dangerous and may lead to discharge and eventually flash over.



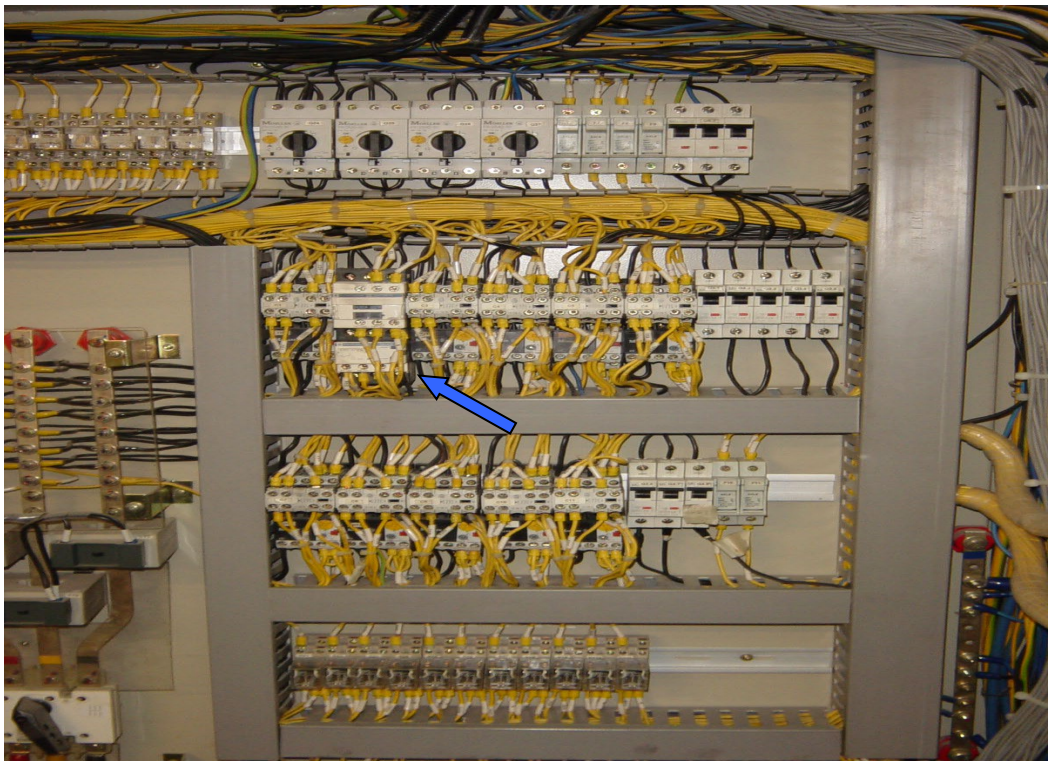
Fault No. 6

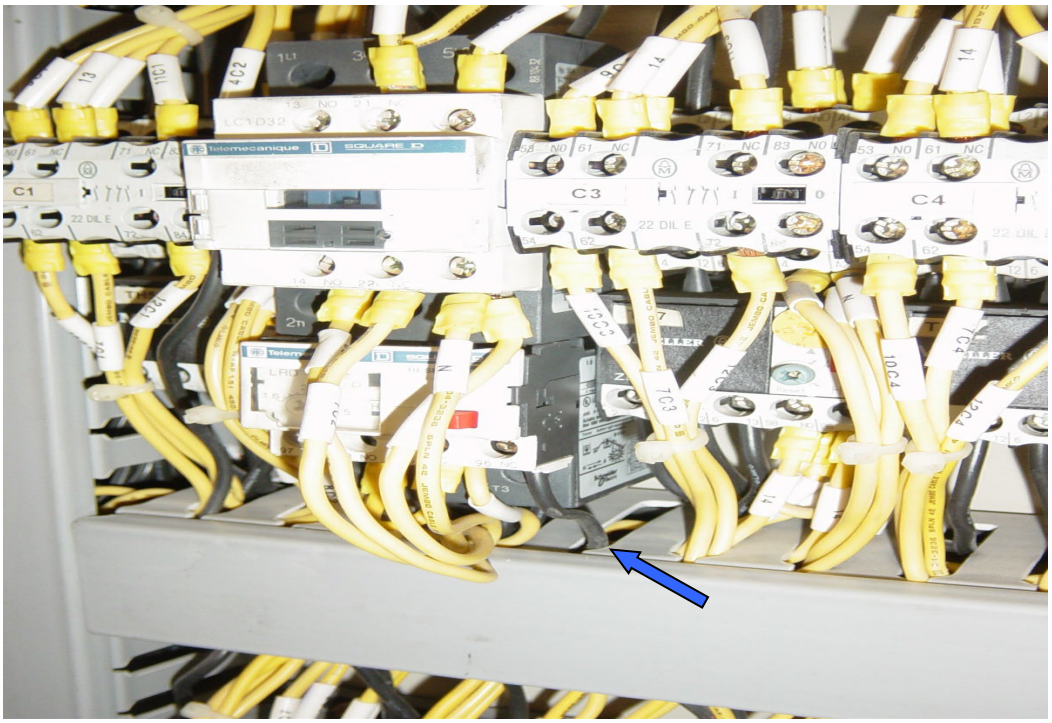
Burnt marks are found on the R phase (unbalance loading at load side). Measure the load at each phase (R, Y, and B) and try to balance or transfer the loading on each phase.

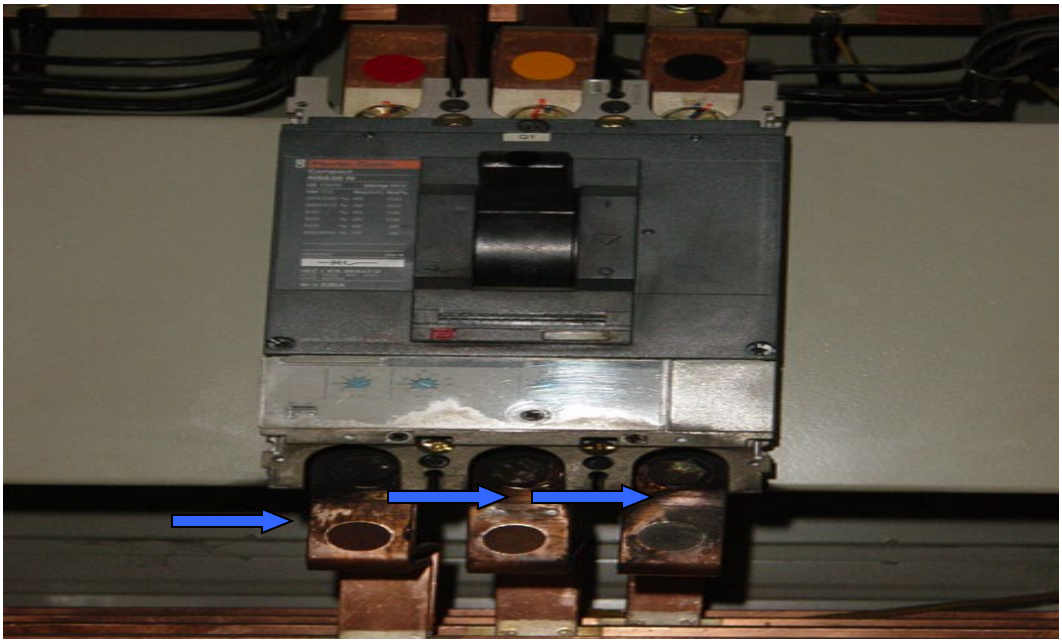


Fault No. 7

Carbonization on cable (might deteriorate the insulation and lead to flash over)



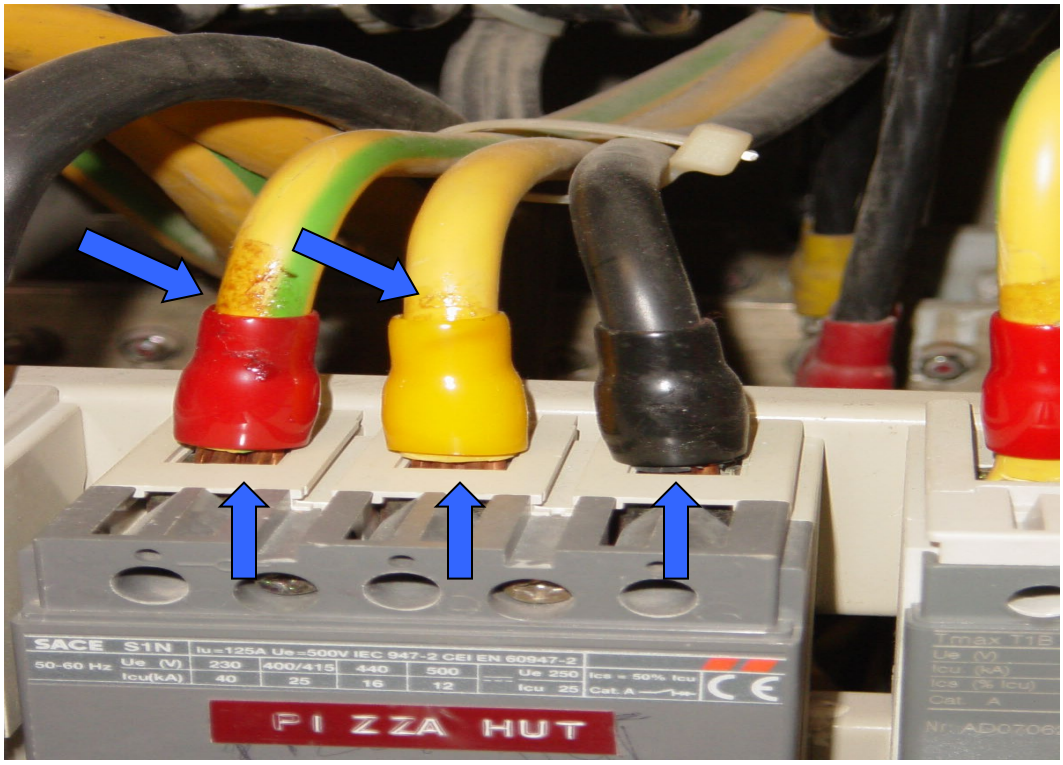




Burn marks on bus bar (clean and check for loose connections on bus bar during electrical maintenance).

Problem 8

Melted marks on cables insulation. Improper cables termination (check for loose any loose connections).



THERMOGRAPHIC REPORT

Project Name:	Shopping Mall
Fault No:	01

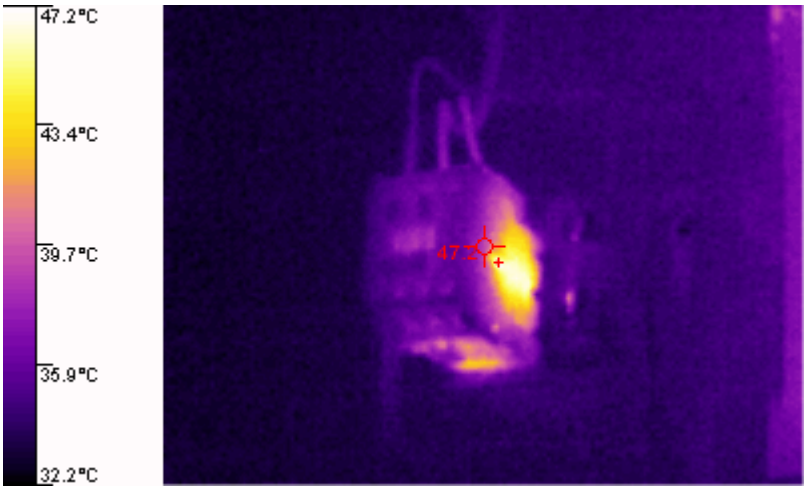
IDENTIFICATION

Location:	BASEMENT CHILLER & PUMP ROOM (CHILLER PANEL 1)
Equipment:	22E

PROBLEM DESCRIPTION:

- HOT SPOT DETECTED

THERMOGRAM



TEMPERATURE MEASUREMENTS

Image Date	May 2005
Target Temperature	47.2 °C
Emissivity	0.95
Reflected Temp	OFF

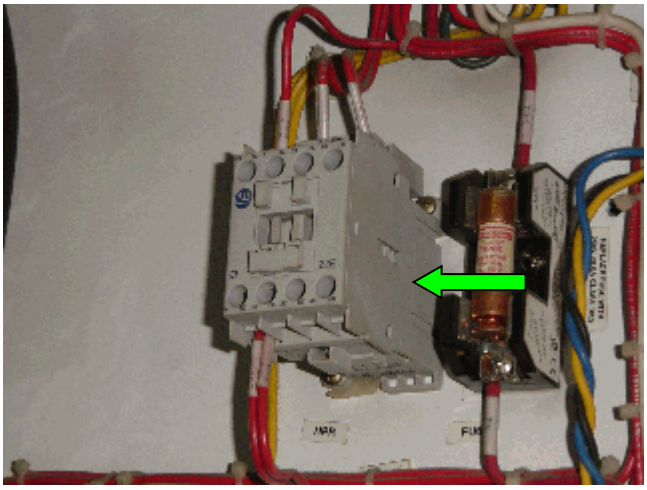
WEATHER

Air Temp	NA
Sky	NA
Wind Speed	NA
From	NA

Distance	Rated Load	Meas. Load	% Load
1M	20A	NA	NA

MAINTENANCE ACTION

Description	Repaired by
NA	NA



REPAIR PRIORITY

Priority	3
Temp. Difference	10.5 °C

INSPECTION

Inspected by	---
Date	---

Remarks:

- Check the insulation resistance of the cable.
- Test the function of the contactor during regular electrical inspection.
- Secure the connection of the cable to the contactor.

THERMOGRAPHIC REPORT

Project Name:	Shopping Mall
Fault No:	02

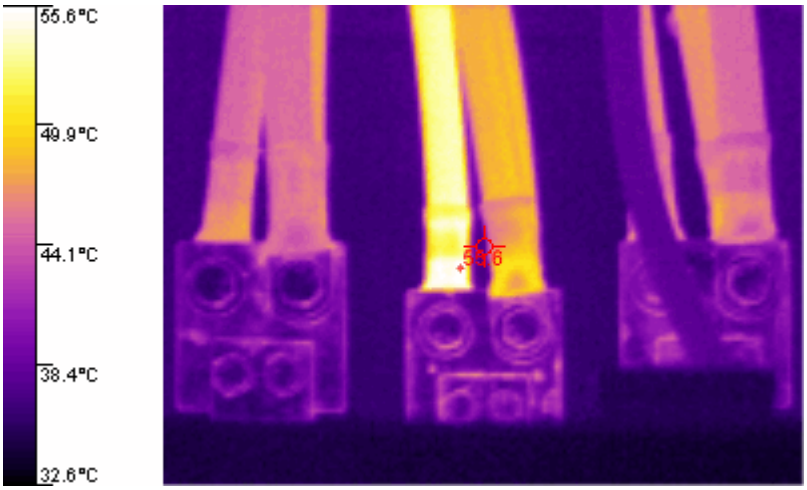
IDENTIFICATION

Location Name	BASEMENT CHILLER & PUMP ROOM (MAIN INCOMING, CHILLER /OUTGOING4)
Equipment	TERMINATION OF INCOMING FEEDER

PROBLEM DESCRIPTION:

- HOT SPOT DECTED

THERMOGRAM



TEMPERATURE MEASUREMENTS

Image Date	May 2005
Target Temperature	55.6 °C
Emissivity	0.95
Reflected Temp	OFF

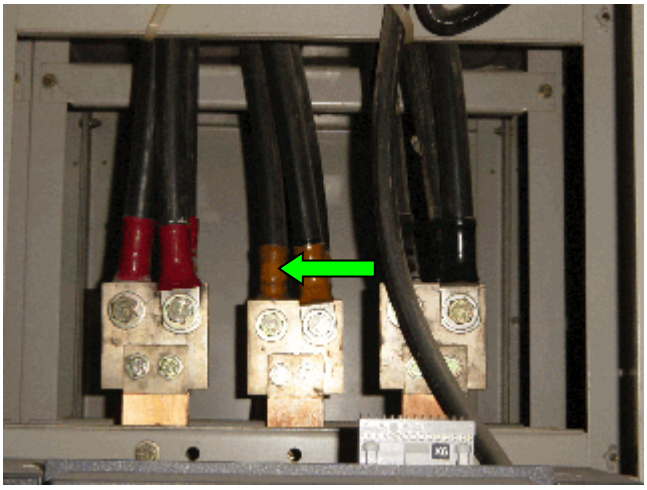
WEATHER

Air Temp	NA
Sky	NA
Wind Speed	NA
From	NA

Distance	Rated Load	Meas. Load	% Load
1M	NA	NA	NA

MAINTENANCE ACTION

Description	Repaired by
NA	NA



REPAIR PRIORITY

Priority	3
Temp. Rating	12.1 °C

INSPECTION

Inspected by	
Date	

Remarks:

- Melted marks and discoloration of cable and cable sleeve were spotted (Insulation resistance check).
- Carbonization on cable and cable termination (clean and service during regular maintenance).
- Unbalance loading, check the load on each phase (R, Y, and B).

THERMOGRAPHIC REPORT

Project Name:	Shopping Mall
Fault No:	03

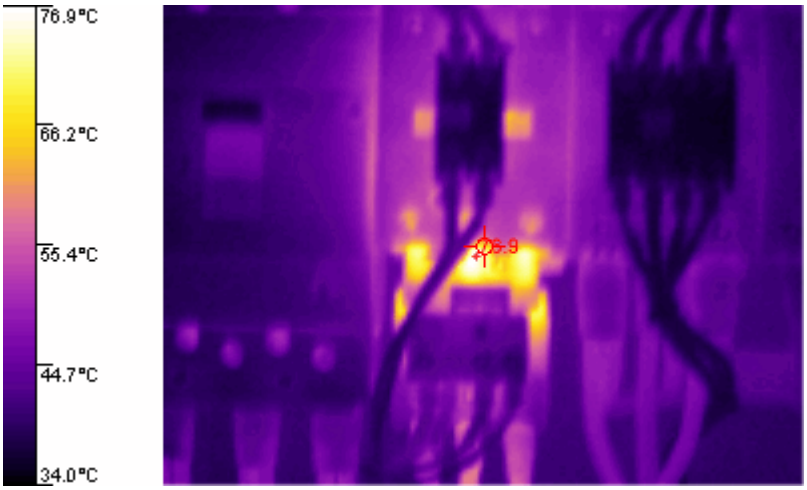
IDENTIFICATION

Location Name	BASEMENT CHILLER & PUMP ROOM (MAIN INCOMING, MMC CHILLER)
Equipment	CONTACTOR / RELAY

PROBLEM DESCRIPTION:

- HOT SPOT DETECTED

THERMOGRAM



TEMPERATURE MEASUREMENTS

Image Date	May 2005
Max. Temperature	76.9 °C
Emissivity	0.95
Reflected Temp	OFF

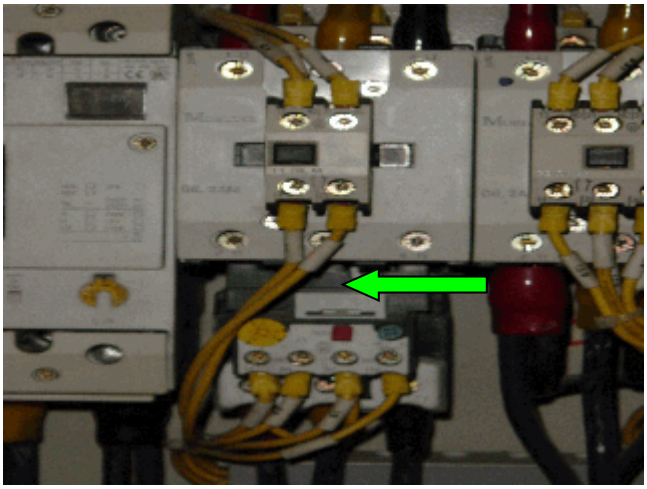
WEATHER

Air Temp	NA
Sky	NA
Wind Speed	NA
From	NA

Distance	**Rated Voltage**	**Meas. Load**	**% Load**
1M	220V	NA	NA

MAINTENANCE ACTION

Description	**Repaired by**
NA	NA



REPAIR PRIORITY

Priority	2
Temp. Difference	20 °C

INSPECTION

Inspected by	
Date	

Remarks:

- Discoloured cables insulation. Deformed of cable insulation was spotted (Insulation resistance check).
- Test the function of the relay.
- Check for loose connections of the contactor, relay and the cables (secure the connections).

THERMOGRAPHIC REPORT

Project Name:	Shopping Mall
Fault No:	04

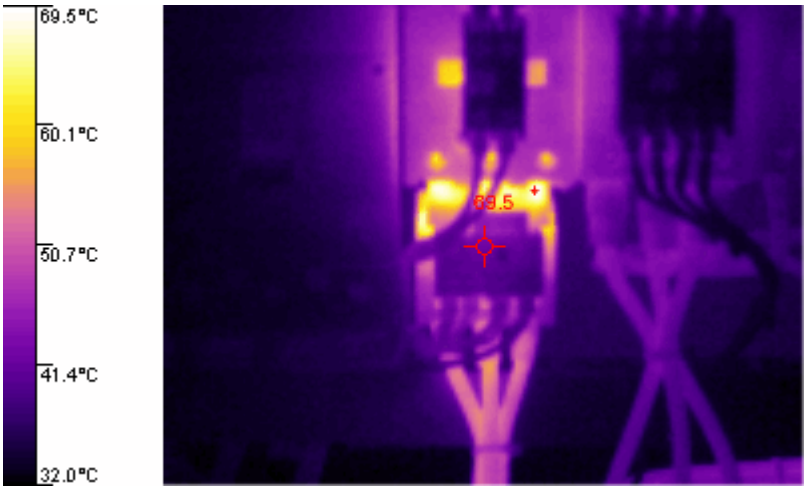
IDENTIFICATION

Location Name	BASEMENT CHILLER & PUMP ROOM (MAIN INCOMING, MMC CHILLER)
Equipment	CONTACTOR / RELAY

PROBLEM DESCRIPTION:

- HOT SPOT DETECTED

THERMOGRAM



TEMPERATURE MEASUREMENTS

Image Date	May 2005
Max. Temperature	69.5 °C
Emissivity	0.95
Reflected Temp	OFF

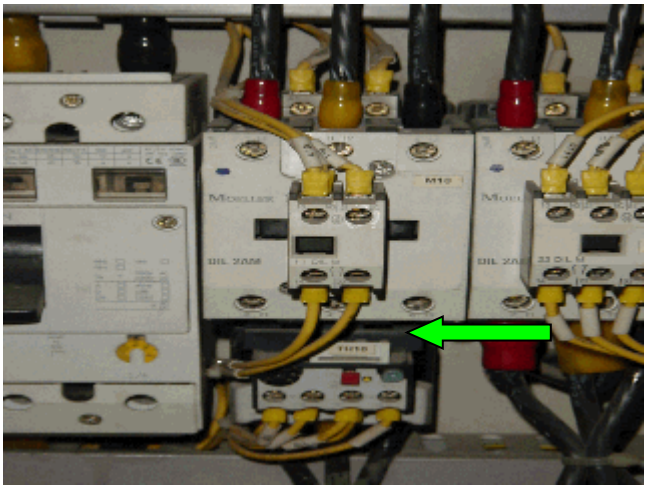
WEATHER

Air Temp	NA
Sky	NA
Wind Speed	NA
From	NA

Distance	**Rated Voltage**	**Meas. Load**	**% Load**
1M	220V	NA	NA

MAINTENANCE ACTION

Description	**Repaired by**
NA	NA



REPAIR PRIORITY

Priority	2
Temp. Difference	23.5 °C

INSPECTION

Inspected by	
Date	

Remarks:

- Discoloured cables insulation. Deformed of cable insulation was spotted (Insulation resistance check).
- Test the function of the relay.
- Check for loose connections of the contactor, relay and the cables (secure the connections).

Project Name:	Shopping Mall
Fault No:	05

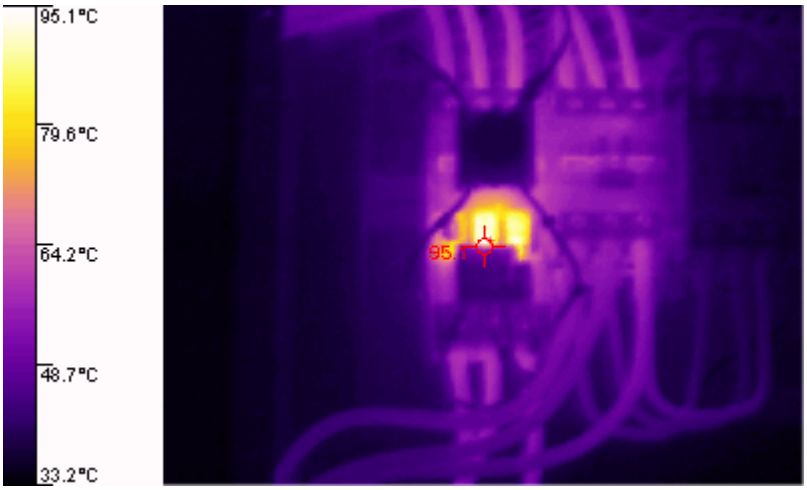
IDENTIFICATION

Location Name	BASEMENT CHILLER & PUMP ROOM (OUTGOING 6, MMC CHILLER)
Equipment	CONTACTOR / ON DELAY TIMER / RELAY

PROBLEM DESCRIPTION:

- HOT SPOTS DETECTED

THERMOGRAM



TEMPERATURE MEASUREMENTS

Image Date	May 2005
Max. Temperature	95.1 °C
Emissivity	0.95
Reflected Temp	OFF

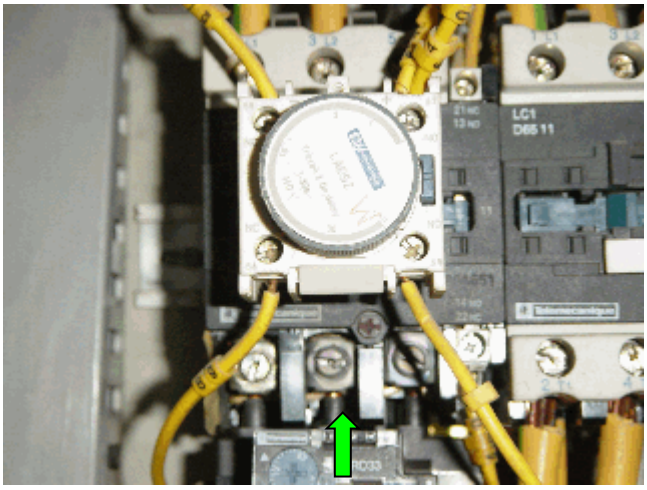
WEATHER

Air Temp	NA
Sky	NA
Wind Speed	NA
From	NA

Distance	Rated Voltage	Meas. Load	% Load
1M	220V	NA	NA

MAINTENANCE ACTION

Description	Repaired by
NA	NA



REPAIR PRIORITY

Priority	1
Temp. Difference	41.2 °C

INSPECTION

Inspected by	
Date	

Remarks:

- Improper cable terminations (bare wire), Burn marks were spotted on cables and cable terminations.
- Deformed cable insulation spotted (Insulation resistance test).
- Check the function of the contactor, relay and the on delay timer. Check for loose connections of components.

THERMOGRAPHIC REPORT

Project Name:	Shopping Mall
Fault No:	06

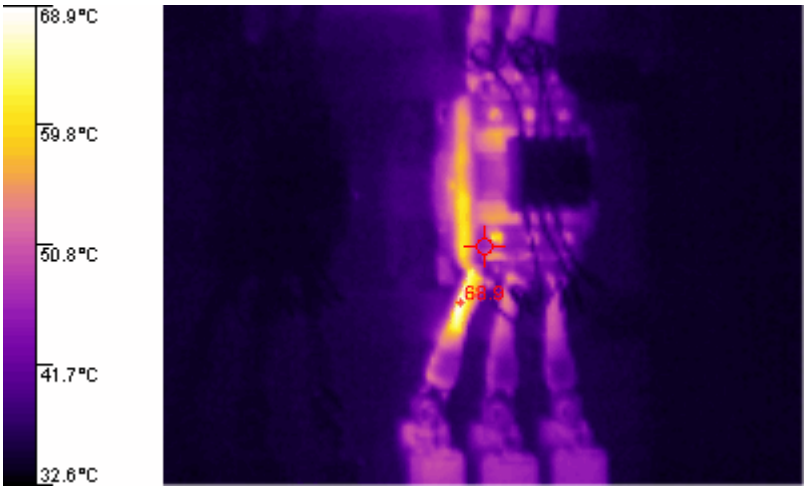
IDENTIFICATION

Location Name	BASEMENT CHILLER & PUMP ROOM (CAPACITOR BANK)
Equipment	CAPACITOR BANK

PROBLEM DESCRIPTION:

- HOT SPOT DETECTED

THERMOGRAM



TEMPERATURE MEASUREMENTS

Image Date	May 2005
Max. Temperature	68.9 °C
Emissivity	0.95
Reflected Temp	OFF

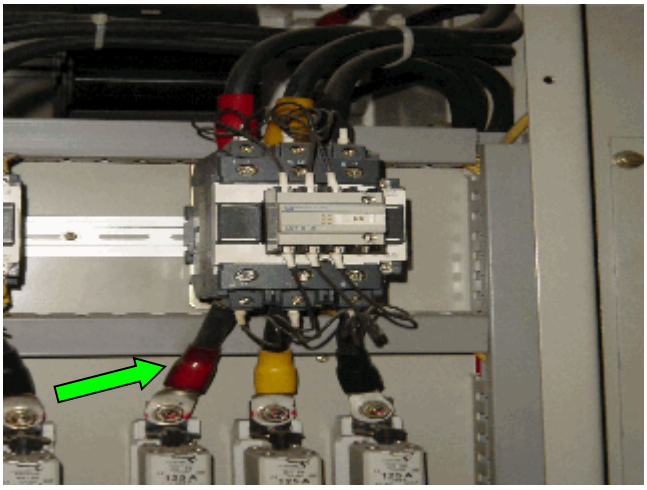
WEATHER

Air Temp	NA
Sky	NA
Wind Speed	NA
From	NA

Distance	Rated Load	Meas. Load	% Load
1M	125A	NA	NA

MAINTENANCE ACTION

Description	Repaired by
NA	NA



REPAIR PRIORITY

Priority	2
Temp. Difference	24.7 °C

INSPECTION

Inspected by	
Date	

Remarks:

- Burn mark spotted on the R phase.
- Check for loose connections (secure loose connection if any).
- Measure the load on each phase (Unbalance loading at load side).

THERMOGRAPHIC REPORT

Project Name:	Shopping Mall
Fault No:	07

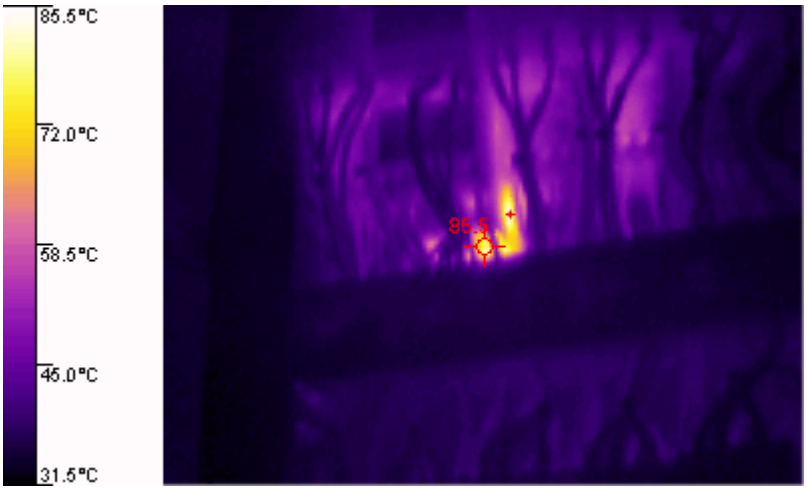
IDENTIFICATION

Location Name	ROOF TOP
Equipment	CONTACTOR

PROBLEM DESCRIPTION:

- HOT SPOT DETECTED

THERMOGRAM



TEMPERATURE MEASUREMENTS

Image Date	May 2005
Max. Temperature	85.5 °C
Emissivity	0.95
Reflected Temp	OFF

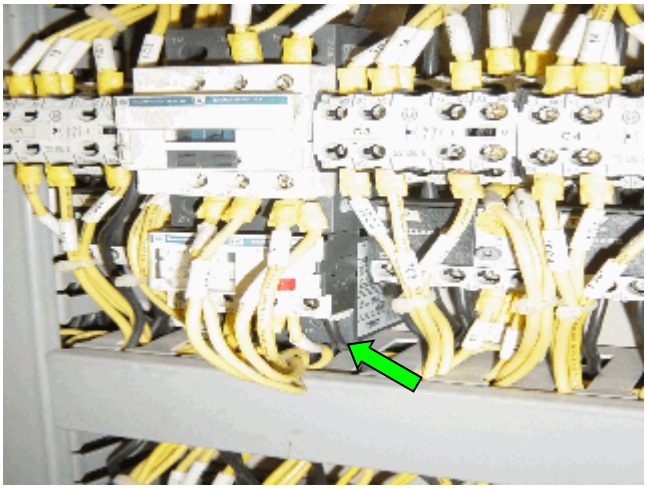
WEATHER

Air Temp	NA
Sky	NA
Wind Speed	NA
From	NA

Distance	Rated Load	Meas. Load	% Load
1M	32A	NA	NA

MAINTENANCE ACTION

Description	Repaired by
NA	NA



REPAIR PRIORITY

Priority	2
Temp. Difference	30 °C

INSPECTION

Inspected by	
Date	

Remarks:

- Carbonization and discolouring was spotted on cable (Insulation resistance test).
- Check for loose connections and test the function of the contactor (secure loose connections if any).

THERMOGRAPHIC REPORT

Project Name:	Shopping Mall
Fault No:	08

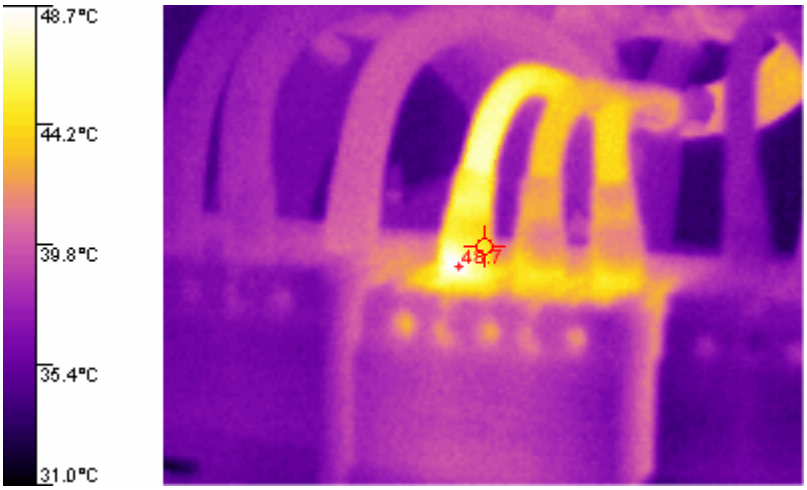
IDENTIFICATION

Location Name	LEVEL 1
Equipment	CIRCUIT BREAKER

PROBLEM DESCRIPTION:

- HOT SPOT DETECTED

THERMOGRAM



TEMPERATURE MEASUREMENTS

Image Date	May 2005
Max. Temperature	48.7 °C
Emissivity	0.95
Reflected Temp	OFF

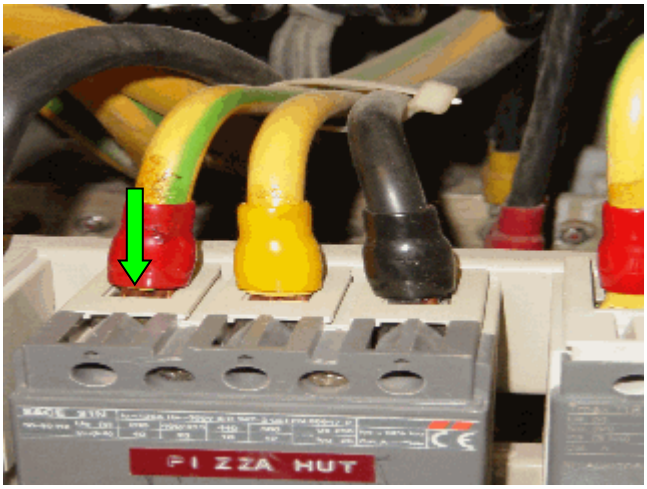
WEATHER

Air Temp	NA
Sky	NA
Wind Speed	NA
From	NA

Distance	Rated Load	Meas. Load	% Load
1M	80A	NA	NA

MAINTENANCE ACTION

Description	Repaired by
NA	NA



REPAIR PRIORITY

Priority	3
Temp. Difference	10 °C

INSPECTION

Inspected by	
Date	

Remarks:

- Improper cable terminations (bare wire), melted marks spotted on cables.
- Check for loose connections (secure loose connections if any).

THERMAL SCANNING REPORT

Project Information

The thermal scanning has been carried out in Sept 2005 at a Factory.

Summary Report

Faults boxed in red are found to have a higher temperature than the normal:

FAULT NO.	LOCATION	EQUIPMENT NAME	PRIORITY	REMARKS
1	Production Block 2nd level LT switch room	Transformer 2 (Bus Bar Connection)	2	Carbonization / Scratches
2	Production Block 2nd level LT switch room	Transformer 2 (Yellow, Blue & Neutral)	2	Carbonization / Scratches
3	Production Block 2nd level LT switch room	Transformer 2 (Red & Yellow)	2	Carbonization / Scratches
4	Production Block 3rd level LT switch room	Transformer 5 (Red, Yellow & Blue)	2	Carbonization / Scratches

Priority Scale of Repair

Temperature Difference (°C)	>40	20 - 40	10 - 20	<10
Priority Scale	1	2	3	4
Corrective Measures	Schedule immediately	Rectify during the next opportunity	Check the electrical circuit	No action required

Thermal Scanning (Transformer)

S.NO	LOCATION	TRANSFORMER NO.	NAME	RATED VOLTAGE	MAX TEMP (Deg C)	REMARKS
1	SUPPORT BLOCK 1st FLOOR LT SWITCH ROOM	9	MSB S-2	400V	27	NTA
2	SUPPORT BLOCK 1st FLOOR LT SWITCH ROOM	10	MSB S-1	400V	25.8	NTA
3	PRODUCTION BLOCK 2nd FLOOR LT SWITCH ROOM	2	ATS 18	400V	62.3	Ref to Fault # 1,2 & 3
4	PRODUCTION BLOCK 2nd FLOOR LT SWITCH ROOM	3	ACB 49	400V	26.8	NTA
5	PRODUCTION BLOCK 2nd FLOOR LT SWITCH ROOM	4	ATS 97	400V	36	NTA
6	PRODUCTION BLOCK 2nd FLOOR LT SWITCH ROOM	1	ACB M1	400V	28.2	NTA
7	PRODUCTION BLOCK 3rd FLOOR LT SWITCH ROOM	7	ATS 2	400V	24.9	NTA
8	PRODUCTION BLOCK 3rd FLOOR LT SWITCH ROOM	8	ATS1	400V	24.7	NTA
9	PRODUCTION BLOCK 3rd FLOOR LT SWITCH ROOM	6	ATS 24	400V	24.6	NTA
10	PRODUCTION BLOCK 3rd FLOOR LT SWITCH ROOM	5	ATS 2	400V	44.9	Ref to Fault # 4

NTA – No Thermal Anomaly

THERMOGRAPHIC REPORT

Project Name:	A Factory
Fault No:	01

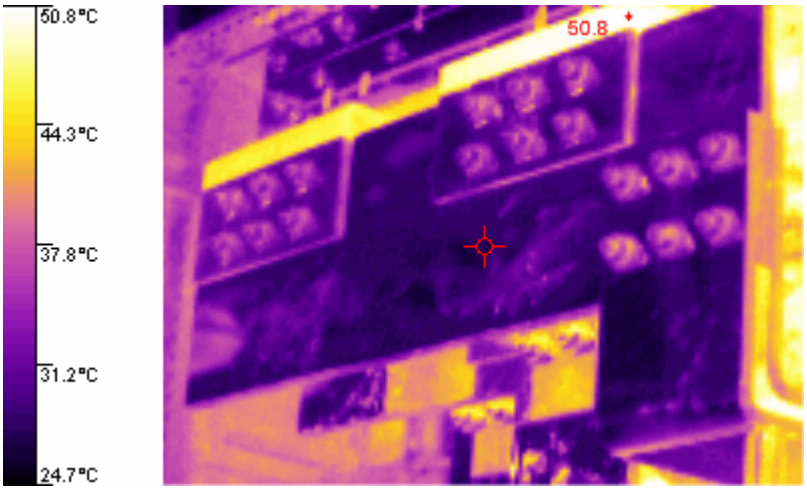
IDENTIFICATION

Location Name	PRODUCTION BLOCK 2ND FLOOR LT SWITCH ROOM
Equipment	TRANSFORMER

DESCRIPTION:

- HOT SPOT DETECTED

THERMOGRAM



TEMPERATURE MEASUREMENTS

Image Date	Sept 2005
Max. Temperature	50.8 °C
Emissivity	0.95
Reflected Temp	OFF

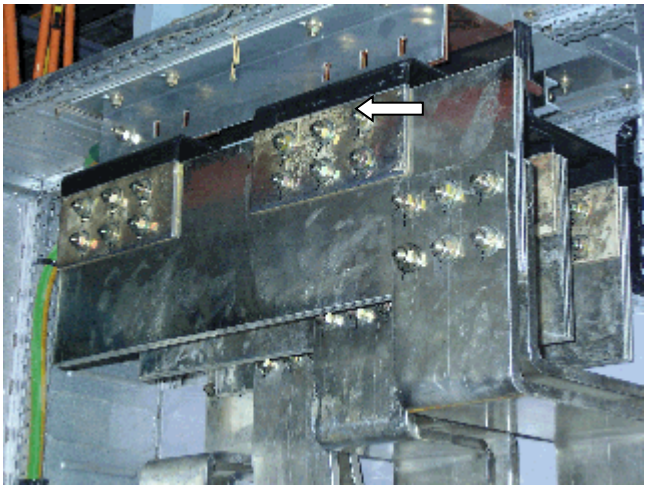
WEATHER

Air Temp	NA
Sky	NA
Wind Speed	NA
From	NA

Distance	**Rated Voltage**	**Meas. Load**	**% Load**
1 M	400V	NA	NA

MAINTENANCE ACTION TAKEN

Description	**Repaired by**
NA	NA



REPAIR PRIORITY

Priority	2
Temp. Difference	26.7°C

INSPECTION

Inspected by	
Date	

Remarks:

- To clean and service during shut down maintenance (thick carbon particles were found all over the bus bars).
- Deep scratches marks were found all over the bus bars (to be rectified).

THERMOGRAPHIC REPORT

Project Name:	A Factory
Fault No:	02

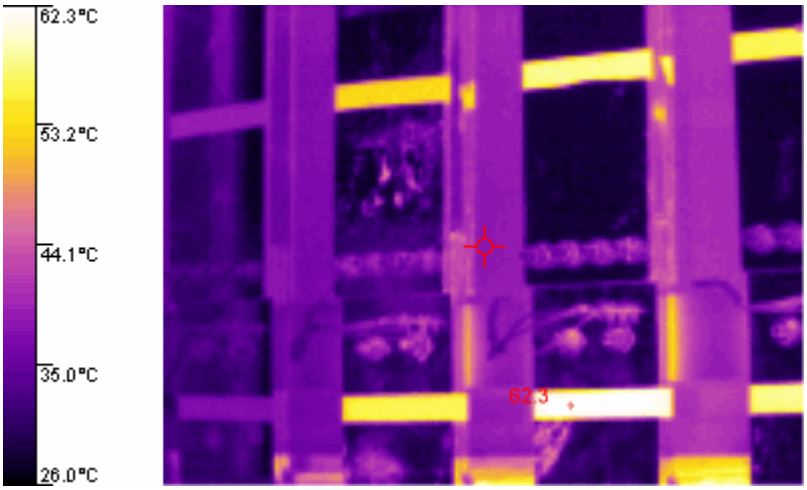
IDENTIFICATION

Location Name	PRODUCTION BLOCK 2ND FLOOR LT SWITCH ROOM
Equipment	TRANSFORMER (YELLOW, BLUE & NEUTRAL)

DESCRIPTION:

- HOT SPOT DETECTED

THERMOGRAM



TEMPERATURE MEASUREMENTS

Image Date	Sept 2005 AM
Max. Temperature	62.3 °C
Emissivity	0.95
Reflected Temp	OFF

WEATHER

Air Temp	NA
Sky	NA
Wind Speed	NA
From	NA

Distance	**Rated Voltage**	**Meas. Load**	**% Load**
1 M	400V	NA	NA

MAINTENANCE ACTION TAKEN

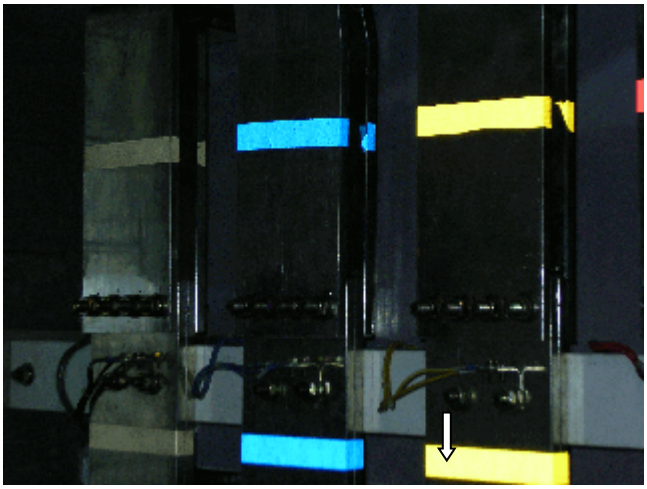
Description	**Repaired by**
NA	NA

REPAIR PRIORITY

Priority	2
Temp. Difference	36.4 °C

INSPECTION

Inspected by	
Date	



Remarks:

- To clean and service during shut down maintenance (thick carbon particles were found all over the bus bar connections).
- Deep scratches marks were found on bus bar connection (to be rectified).
- To secure the connections of the bus bar during shut down maintenance.

THERMOGRAPHIC REPORT

Project Name:	A Factory
Fault No:	03

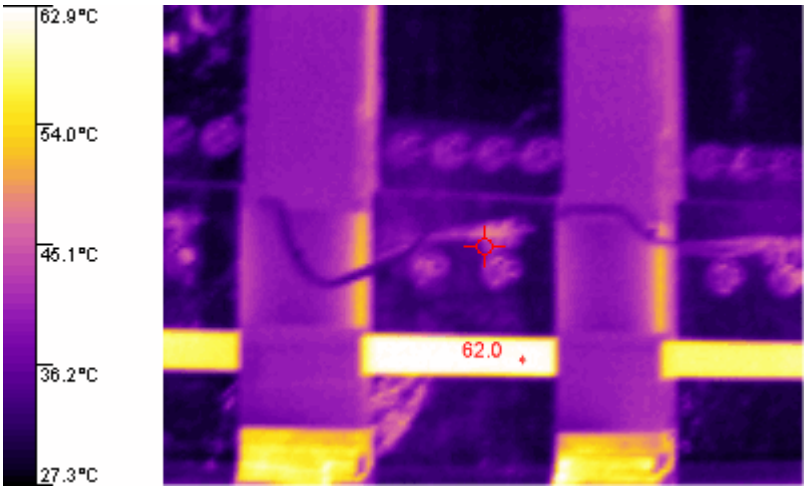
IDENTIFICATION

Location Name	PRODUCTION BLOCK 2ND FLOOR LT SWITCH ROOM
Equipment	TRANSFORMER (RED & YELLOW)

DESCRIPTION:

- HOT SPOT DETECTED

THERMOGRAM



TEMPERATURE MEASUREMENTS

Image Date	Sept 2005
Max. Temperature	62 °C
Emissivity	0.95
Reflected Temp	OFF

WEATHER

Air Temp	NA
Sky	NA
Wind Speed	NA
From	NA

Distance	**Rated Voltage**	**Meas. Load**	**% Load**
1 M	400V	NA	NA

MAINTENANCE ACTION TAKEN

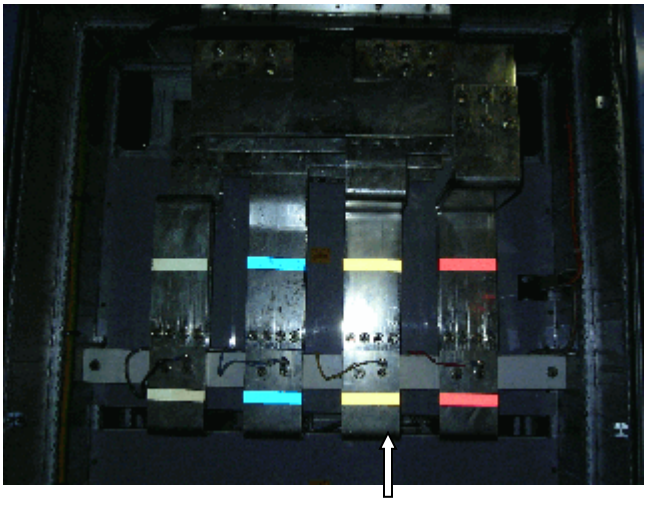
Description	**Repaired by**
NA	NA

REPAIR PRIORITY

Priority	2
Temp. Difference	36°C

INSPECTION

Inspected by	
Date	



Remarks:

- To clean and service during shut down maintenance (carbon particles were found all over the bus bars).
- Deep scratches marks were found all over the bus bars (to be rectified).
- To secure the connections of the bus bar during shut down maintenance.

THERMOGRAPHIC REPORT

Project Name:	A Factory
Fault No:	04

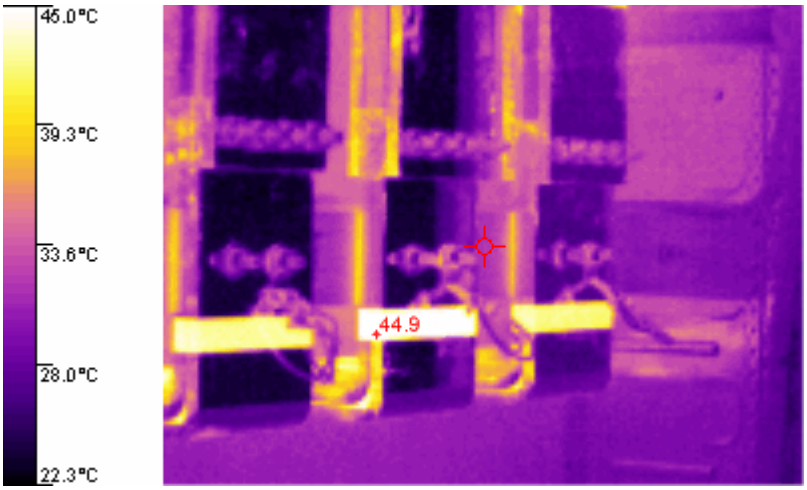
IDENTIFICATION

Location Name	PRODUCTION BLOCK 3RD FLOOR LT SWITCH ROOM
Equipment	TRANSFORMER (RED, YELLOW & BLUE)

PROBLEM DESCRIPTION:

- HOT SPOT DETECTED

THERMOGRAM



TEMPERATURE MEASUREMENTS

Image Date	Sept 2005
Max. Temperature	44.9°C
Emissivity	0.95
Reflected Temp	OFF

WEATHER

Air Temp	NA
Sky	NA
Wind Speed	NA
From	NA

Distance	**Rated Voltage**	**Meas. Load**	**% Load**
1 M	400V	NA	NA

MAINTENANCE ACTION TAKEN

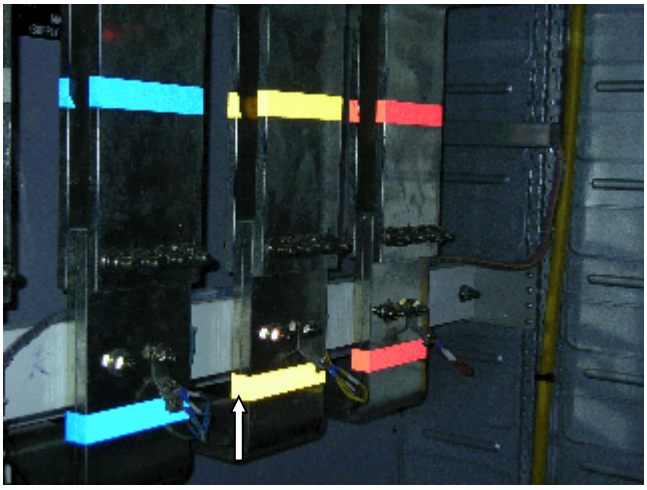
Description	**Repaired by**
NA	NA

REPAIR PRIORITY

Priority	2
Temp. Difference	19°C (near to 20°C)

INSPECTION

Inspected by	
Date	



Remarks:

- To clean and service during shut down maintenance (carbon particles were found all over the bus bars).
- To secure the connections of the bus bar during shut down maintenance.

THERMOGRAPHIC REPORT

Project Name:	A HDB Flat Lift
Fault No:	01

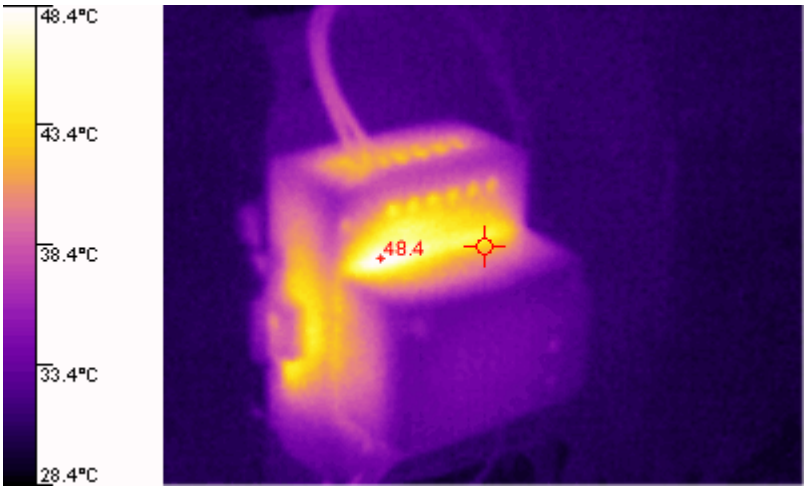
IDENTIFICATION

Location Name	Switch Room
Equipment	Earth leakage relay

PROBLEM DESCRIPTION:

- Hot spot detected

THERMOGRAM



TEMPERATURE MEASUREMENTS

Image Date	Feb 2005
Target Temperature	48.4 °C
Emissivity	1.00
Reflected Temp	OFF

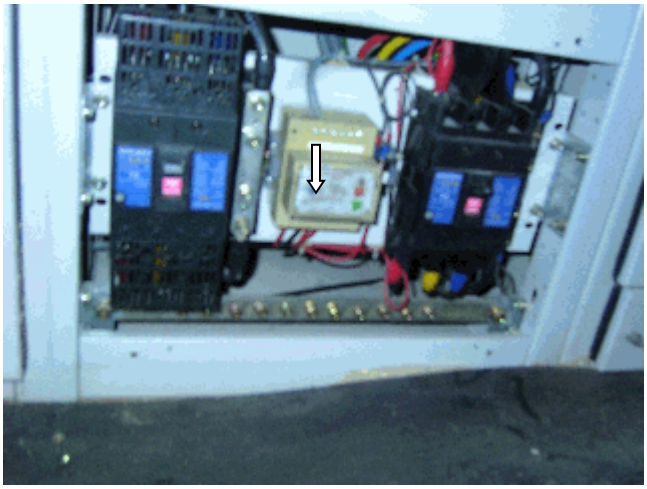
WEATHER

Air Temp	NA
Sky	NA
Wind Speed	NA
From	NA

Distance	Rated Load	Meas. Load	% Load
1 M	NA	NA	NA

MAINTENANCE ACTION

Description	Repaired by
To check and service	NA



REPAIR PRIORITY

Priority	3
Temp. Difference	15.7 °C

INSPECTION

Inspected by	
Date	

Remarks:

- Check the connections of the Earth leakage relay
- Check on the Earth leakage relay

THERMOGRAPHIC REPORT

Project Name:	A HDB Flat Lift
Fault No:	02

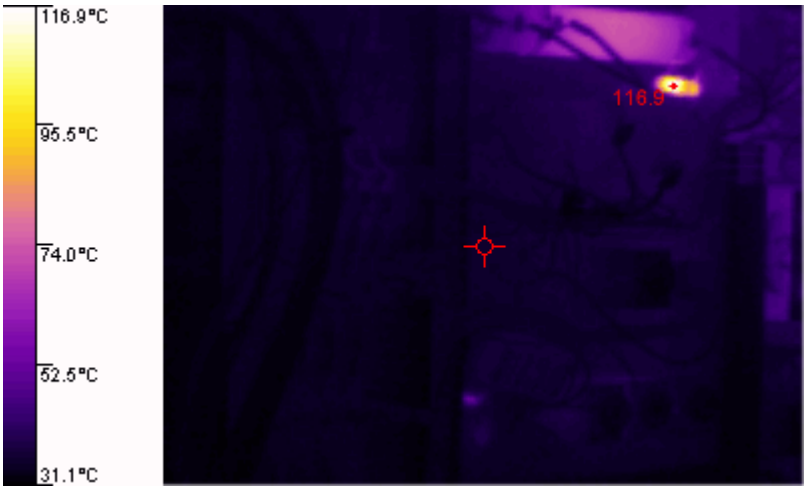
IDENTIFICATION

Location Name	Motor room
Equipment	Lift control panel

PROBLEM DESCRIPTION:

- Hot spot detected

THERMOGRAM



TEMPERATURE MEASUREMENTS

Image Date	Feb 2005
Target Temperature	116.9 °C
Emissivity	1.00
Reflected Temp	OFF

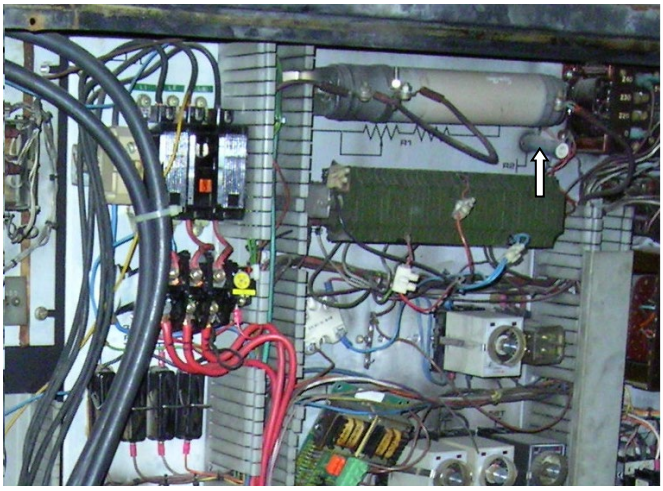
WEATHER

Air Temp	NA
Sky	NA
Wind Speed	NA
From	NA

Distance	Rated Load	Meas. Load	% Load
1 M	NA	NA	NA

MAINTENANCE ACTION

Description	Repaired by
To check and service	NA



REPAIR PRIORITY

Priority	1
Temp. Difference	65.6 °C

INSPECTION

Inspected by	
Date	

Remarks:

- Check the component R2 where hot spot was detected
- Check the connections
- Replace component as soon as possible