Electrical Safety Audit Report

Sindhi Institute
College and School

6th to 8th October 2022

Conducted By

TUV

ACKNOWLEDGEMENT

We are grateful to the management of Sindhi Institute for giving an opportunity to conduct Electrical Safety Audit of their buildings in Hebbal, Bangalore

We are grateful to Dr. D Gopinath (Director MBA College) and Mr. Srinivas N (Incharge College Building) for the cooperation extended during entire audit period, and also to the entire support team of **Sindhi Institute** for the cooperation extended and furnishing all the required data.

For TUV Rheinland

Kunal Saxena (BEE Certified Energy Auditor)

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GENERAL INFORMATION

Consumer Information

1. Name of the installation	Sindhi Institute: College and School
2. Address of the installation	33/2B, Kempapura, Hebbal, Bangalore Karnataka 560024
3. Contact person	Dr. D Gopinath
4. Power supplier	BESCOM
5. Supply Voltage	HT: 11000 Volts
6. Transformers	1
7. Meters	1
8. DG Set	2 Nos. (200 kVA and 160 kVA)
9. Period of Audit	6-7-8 October 2022
10. Audit Participants	Mr. N Srinivas Mr. Purushottam Mr. Manjunath

Satellite image of School area

ELECTRICAL SYSTEMS

A. Supplies to Life Safety Systems

Three life safety systems and power supplies to same were observed during the assessment as follows;

System	Primary Power	Secondary Power
Emergency Lighting	Tube-lights	UPS Backup
Fire Detection and Alarm System	Raw	Battery Backup
Factory Fire Hoses	Raw Power	DG

B. Emergency Lighting

Emergency lighting throughout consist of tube-lights which are supplied through online UPS System of different capacity for different sections and buildings.

EXIT signages are not available at most of the places (especially in college building)

Emergency lights are also not available at the staircase

C. Fire Detection and Alarm System

Fire Detection	Smoke detectors and sprinklers in Parking Manual activation by Manual Call Points MCP) in school building
Fire Alarm	Alarm sounder located at all the floors in school building Activated manually by MCPs Fire Alarm Panel is available with battery backup

D. Earthing and Bonding

Connection of metalwork machines, electrical panels, LPS was evident, Neutral and Body earth pits for transformer and DGs are available.

Battery racks also need to be provided with body earthing. The earth-pits need to be maintained and checked periodically.

Earth pit resistance check is not done for any of the Earth pits across the facility.

F. Lightning Protection

Lightning protection system is not provided

G. Power

Power enters the site via 11kV underground feeder supply to DO pole and then to transformer of 350 kVA where the voltage is stepped down to 433 Volts

The stepped down voltage is then fed to LT Distribution panel and then to main panel in the College building panel room at basement

H. Distribution

The Main LT distribution panel is installed in the Panel room at basement of college building. The panels distribute power to school and college building plus the internal panels and equipment.

SLD for LT Distribution is not available

I. Maintenance and Records

Daily Maintenance records for most of the equipment are not maintained/ made. In-house checklists for the transformer, DGs, LT panels, Emergency lights, Fire hydrant pumps etc. need to be made, maintained and updated as per schedule and standards followed.

Earth pit test is not done.

Transformer Oil BDV test is not done

EXECUTIVE SUMMARY

TUV Rheinland is assigned with the job of conducting Electrical Safety Audit at **Sindhi Sewa Samiti's college and School buildings** at Hebbal, Bangalore

The audit was carried out on the basis of Central Electricity (Measures relating to safety and Electric Supply) Regulation 2010, relevant Indian Standards and Best Practices followed.

The Assessment was carried out as per the scope discussed. The HT yard/ Substation and Panel rooms, Utility area, college and school building, LABS and other areas were visited and audited along with related maintenance and statutory documents and test results of equipments.

Based on the state of the electrical safety systems and the condition of the facility observed, the level of maintenance appears to be good, provided that regular maintenance activities are implemented or continued, test of equipments done regularly and that detailed records are kept of these activities in the future.

Below are the Fair observations of the Assessment:

1. HT/ Transformer Yard

- Incomer Yard is enclosed with fencing from all sides, entry to the yard is restricted.
- Separate earthing to Transformer Neutrals and body are given
- Electrically insulated rubber gloves are available for operating the fuse
- Internal checking of earth pits is done in every two months

2. Main Panel Rooms

- The operation and maintenance of the HT yard and LT substation is done in-house. A team of well qualified and certified Electricians is available round the clock.
- Rubber mats as per standard are provided at the front of the panels
- Emergency lights are provided having back up of UPS
- Fire extinguishers and sand buckets are available

3. Distribution

- A transformer of 350 kVA is used for stepping down the voltage from 11 kV to 433 volts; Two Diesel Generators of 200 and 160 kVA are available as standby for providing power in case of BESCOM Failure
- Power is further distributed to down the line panels and DBs present in various sections of college and school buildings
- DGs are kept in Manual mode

4. Distribution boards and machine panels

- The Distribution boards are present in every section/ floors of both the buildings to cater the load. All the distribution panels (PDB, LDB etc.) are provided with door earthing and body earthing.
- All the DBs and Panels be indicated with a warning/Danger sign wherever missing (Danger signage with bone and skull as per statutory requirement)

5. Emergency Situations and Control measures for safe evacuation

- The egress paths are required to be specified in case of emergency. In case of fire, the electric supply is normally switched off. Hence in evening/night time such egress paths along with exit signs are required to be marked with fluorescent signs and illuminated with emergency lights
- Exit signage are available at all the floors in school building

6. Fire Pump House

The fire hydrant system consists of a single pumps installed at the terrace of both the buildings.

Capacity of Fire water tank in college building is 10 KL and for school it is 5 KL

Capacity of pumps at both the buildings: 7.5 HP

7. Protection Devices, Maintenance and Records

- Protection devices are available in the transformer and panels
- Maintenance of equipment is carried out periodically

The capacity of equipments, cables was found adequate, the power installations in the plant were found to be free from electrical shock & fire hazards due to proper installations & contravening of provisions of Central Electricity Authority regulations 2010

Areas which need rectifications are:

1. Earthing system

- Earth Pits for the Transformer and DGs neutral and Body are not identified and marked.
- The earth pits need to be kept clean and the termination of strip with the electrode should be protected against weathering conditions (rusting observed on the termination bolts)
- Continuity check of the earthing electrode needs to be checked regularly with the connected equipments
- The earth pit lay out was not evident.
- Body earthing to be provided to all electrical motors across the plant wherever not available

2. HT/ Transformer Yard

- Fence of the yards is not earthed. The gate also needs to be looped
- Sand buckets not provided at the transformer yard and DG area
- LT Panel for further distribution of power in the building is not sealed and as such Lizards were observed in it. Dust and cobwebs were also present

3. Main LT Panel and UPS rooms

- Single Line Diagram for the LT distribution is not present/ displayed in the panel room
- Shock Restoration chart is not available in the panel room
- Unwanted material kept around in the panel room
- The battery rack provided for the UPS needs to be provided with body earthing.
- Exhaust system in the UPS room needs to be improved

- Distribution of power is not clear as there is no SLD and also the panels and feeders are not identified and marked properly
- Earth Neutral voltage in the panels is at a little higher side, need to check the earthing and pit resistance
- Panels are not maintained properly; cobwebs, dust, open gland holes were evident in most of the panels
- Door locks of the feeders were either broken or were jammed at many places.
- DBs in the panel room are also not marked, kept open, cables not dressed, gland holes open, gland plate also not provided in one.
- Sockets provided on the Working table were not provided with earthing
- UPS room is totally filled with batteries and UPS; access to the MCBs and switches is blocked/restricted
- Panel area in the auditorium is not safe to access; if possible either improve the accessibility or remove the DBs to a more easily accessible place

4. Fire Protection / Hydrant

- Only one pump (of 7.5 kW) for respective buildings is provided, which may not be sufficient to douse fire in case.
- Water tank capacity is very less; 5 KL for school and 10 KL for College building
- There is no standby pump available for contingency
- In case of power failure, no dedicated power supply is available to run the pumps

5. Personal Protection

- Lock out and tags out devices and Work permit system was not evident; a check sheet for LOTO and work permit for third party service providers should be incorporated and adhered, so that all the precautions to be taken are checked and verified before taking on the work.

6. Thermal Imaging

Thermography is done for the panels. Results are checked and appropriate actions to be taken are mentioned wherever hot spot was detected.

- The hot spots are mainly due to termination of copper cables with aluminum bus bar. Since these metals have different coefficient of thermal expansion, the gap develops in these contact surface due to variation in thermal expansion and contraction over a period due to which there is increase in contact resistance, causing temperature rise. The problem can be reduced by employing bimetallic lugs, washers etc.
- The other reasons for critical hot spots are due to bad workmanship in respect of termination:
  - Use of wrong sized lugs (either small or large)
  - Not using lugs
  - Rusted parts
  - Cables/lugs not tightened
- Multiple terminations on one terminal is another reason for hot spots, same should be avoided and corrected
- Overloading of cables (Not choosing correct specification w.r.t. load)
  Most of the starters are having overloads fixed to the contactors; the overload gets loose over a time period due to vibrations of contactor ON and OFF. It is recommended to tighten the overloads periodically. It will avoid tripping of motors and will also reduce the burning of terminals

7. Power Quality

High level of current harmonics are observed in the power supply; may be due to presence of computers and electronic devices in the two buildings

8. Adequacy of electrical personnel and training

- Hazard Identification, protection devices, near miss incidents and their prevention etc. should be imparted to all the maintenance employees from time to time.

Special focus on the topics of Electrical hazard identification and their mitigation should be given specially to third party electricians. Electrical Hazards can be of various types such as

- Contact with live wire resulting in shock
- Electric burns due to arc flash or short circuiting
- Fires due to overheating, short circuit, arc flash etc.

- Exposed electric parts
- Presence of energies other than regular power supply
- Un insulated tools
- Use of aluminum or steel ladders
- Presence of water, using wet hands, damp locations
- Frayed chords, damaged insulation, broken plugs or sockets

It is suggested to identify all the hazards associated with the Electrical work and develop a training plan for all the electricians; the training can be on-job, classroom or at external facility depending upon the skill level of the electricians

1.0 INTRODUCTION

TUV Rheinland is working with **Sindhi Sewa Samiti's college and school** for Electrical Safety Assessment with a vision to check how much electrically safe workplace is maintaining in this factory and reduce accidents caused by Electricity and mitigate potential risks for making work place safer for the staffs complying CEA 2010 Regulations & Electricity Act 2003 standard.

The Electrical Safety Assessment at Sindhi college and School has been carried out by Mr. Kunal Saxena, who is an Electrical Engineering graduate and a Certified Energy Auditor from BEE- Ministry of power. He has an overall experience of 22 years in Electrical Maintenance and Safety. He is having an experience of more than 150 Safety assessments of various industries, major being Auto ancillary, Garment production, Chemical Industries, Banks and Buildings, Consumer Electronics and other manufacturing industries.

1.1 FACILITY INTRODUCTION

Sindhi College, Bengaluru was established in the year 2002, under the aegis of Sindhi Seva Samiti, a philanthropic organization managed by the Sindhis with, "Service to Human kind" as their motto. Since then, the growth of the Institution has been phenomenal and is recognized as one of the premier institutions not only in the city of Bengaluru but also among the other states of India. The college is permanently affiliated to Bengaluru City University. It is a self-financing, co-education college imparting quality education in the streams of Science and Commerce, offering UG and PG courses.

1.2 OBJECTIVE OF THE ELECTRICAL SAFETY AUDIT

Electrical safety Audit is systematic approach to evaluate potential electrical hazards. Electrical Safety Audit is an important tool for identifying deviation from Local and International regulations & standards (CEA 2010 regulations & Electricity Act 2003), areas of risks or vulnerability, potential accidents in plants for determining necessary actions to minimize hazards and for ensuring that the whole safety effort is effective

and meaningful.

So, an ESA states the Identification, localization of gaps following regulations. ESA also tells how the occupants are safe in their workplace and the whole electrical system safety status at a glance.

1.3 SCOPE OF THE AUDIT

Unless the scope of study is well understood, the objectives of the audit cannot be attained. Defining scope of Electrical Safety audit based on the specific requirements is the first step in the process of Electrical Safety Auditing.
The typical ESA scope of work includes:

- Physical inspection to identify electrical hazards (shock, fire, explosion, overloading) and to suggest electrical safety solutions.
- Review of plant lightning protection system (need, adequacy, installation and Maintenance)
- Review of static electricity hazards in the plant operations (if applicable)
- Review of electrical preventive maintenance system (including tests, documentation, history cards, etc.)
- Review of electrical accidents and near misses in the plant to identify the root causes
- Review of electrical systems & procedures (work permits, interlocks, lockout tags, etc.).
- Review of the importance given to electrical safety in the company safety policy, safety committee, continuous electrical risk identification, etc.
- Review of the grounding system (installation & maintenance aspects), including sample earth resistance tests. To identify areas of overloading by carrying out load
- Review of Hotspot detection done using infrared hot spot detection equipment/ thermal imaging (as necessary)

1.4 METHODOLOGY

Identification & evaluation of electrical hazards at the Building has been focused upon Electrical Mains Panel, Building, Pumps, Air conditioners, Lighting, Protection from lightning & cable condition at the premises. Based on scope of work & Objectives of the Electrical Audit a check list has been prepared for thorough examination of the existing system from Electrical safety point of view.

CEA 2010 Regulations & Electricity Act 2003 have been considered to evaluate the Electrical Systems. Then, the international and convenient codes have been taken and applied to check the systems and recommend the modification and safety.

1.5 ELECTRICAL DISTRIBUTION SYSTEMS

Electric Power to the facility is supplied by MESCOM. It is an HT connection of 11 kV; one meter is installed at LT side. One Transformer of 350 kVA step down the voltage to 433 volts cater the load of the institute.

The Main Electrical panels are Separate for both the buildings but are fed from one main panel in the college building basement. Breakers and other isolators are provided in the panels for supplying different load centers across the plant

1.6 ELECTRICAL SAFETY AND ITS IMPLEMENTATION

Electricity is a source of hazard. It's a potential threat to man and material if not used in a safe and secured way. There are a number of regulations and standards framed to ensure safe use of electricity. Electrical safety of any installation is ensured in three stages: - At design stage; through selection of proper equipment and their layout from safety point of view, At Construction / Erection stage; as per design and drawing. At the time of Maintenance and Operation based on Standard Operation and Maintenance Practices with observance of safety rules and protocols.

1.7 RECOGNIZING ELECTRICAL HAZARDS

- Inadequate wiring Hazard
- Exposed Electrical Part Hazard
- Defective Insulation Hazard
- Improper Grounding Hazard
- Overload Hazard
- Wet Conditions hazard
- Other Hazards

2.0 IDENTIFICATION & EVALUATION OF ELECTRICAL HAZARDS

2.1 COMPLIANCE TO STATUTORY REQUIREMENTS

2.1.1 List of Authorized Persons:

Rules	Provisions	Status	Action recommended
CEA Reg 3	List of Authorized persons has to be maintained at the office / premises of person authorizing for such purpose by entering the name of such persons in the list & giving the purpose for which such person is authorized & attesting the list by authorized person & by person authorizing him/her.	NA HT is not handled by the facility electricians	Suggest to prepare an authorized person list for working at different voltages

2.1.2 Danger Board & Shock Treatment Chart:

Rules	Provisions	Status	Action recommended
IE Rule 35 CEA 18	The danger notice as per I.E. Rule 35 in Hindi/ English & local language is required to be affixed near Medium & high voltage installation like every motor, generator, transformer together with apparatus for controlling the same.	Affixed	Put a danger sign with skull and bone written in English/Hindi plus kannada (wherever not provided)
IE Rule 44 CEA 28	The instructions for restoration of persons suffering from electric shock in English/ Hindi & local language are affixed in substation & switch rooms. The consumer has to ensure that all authorized persons engaged by him are acquainted with & are competent to apply these instructions.	Instruction charts not available. Not Evident	Provide shock restoration charts in the Substations Training for Shock resuscitation needs to be imparted

2.1.3 Line Diagram:

- Electrical single line diagram of distribution is not available; LT distribution diagram should be displayed/ pasted at the distribution substations also and on Panels and DBs

2.2 ELECTRICAL SHOCK PREVENTION

2.2.1 Electrical Panel Boards:

Rules	Provisions	Status	Action recommended
CEA 12	All apparatus, materials, lines are installed, protected, worked & maintained in such a manner so as to ensure safety of human beings, animals & property	Panels are having body earthing Sockets in the Work table at panel room are not having earthing Fence at transformer and HT yard is not earthed	Sockets to be provided with earthing Fence and Gates at the HT / transformer yard needs to be earthed and looped
CEA 17	The consumer has to ensure the inaccessibility of bare conductors & easy accessibility of switches for their disconnection.	Kept as per standard	Nil
CEA 19(6)	All panels shall be painted with the description of its identification at front and at the rear	Not Identified	Identification of the connected load to be done on priority

2.2.2 Proper Fitting & Isolation of Portable Equipments:

Rules	Provisions	Status	Action recommended
CEA 21	The cable shall be three core & four core type for portable & transportable type apparatus working on single or three phases respectively. No flexible cables shall be used for portable & transportable type apparatus.	Ensured	Nil

2.2.3 Sufficient access and working space is provided near panel boards, switch boards and safety switches:

Rules	Provisions	Status	Action recommended
CEA 37	All conductors shall be enclosed in metal casing which is electrically & mechanically continuous unless the said conductors are accessible to authorized persons.	Enclosed	Nil
CEA 37	A clear space not less than 1 meter in width shall be provided in front of switch box.	Provided at most places Accessibility is poor in UPS room	All the DBs and switches should be made accessible; remove the obstructions

- Rubber mats are provided around working space of electrical panels (OK)

Suggested- Rubber mats/ Insulated paint to be provided at the back side of the panel also

2.2.4 Junction box:

- Body earthing?
  Provided
- Gland sealing?
  Not Done at many places
- Glands appropriateness vis-a-vis cable size and type?
  Not Provided as per sizing at many places

2.2.5 Works & Inspection:

Rules	Provisions	Status	Action recommended
IE Rule 45 CEA 29	The work of electrical installations & repairs thereof except work of replacement of fuse, lamp, switches, fans etc. Shall be carried out by the LEC.	Ensured	Nil
IE Rule 46 CEA 30	Every installation connected to supply will be tested & inspected by the electrical inspector at intervals not exceeding the period of five years.	Not evident	
IE Rule 50 CEA 35	The controls of requisite capacities are installed to carry & break the current after commencement of supply	Installed	Nil
IE Rule 50 A CEA 36	A suitable isolation device with cutout or breaker to operate on all phases except for neutral is to be fixed at not more than 1.70 meters above ground level so as to completely isolate the supply of the building in case of emergency.	As per standard available Except at one place	Nil

2.2.6 Safety procedure/ guideline:

Rules	Provisions	Status	Action recommended
CEA 19	Before, handling of any conductor or apparatus the adequate precaution has to be taken so as to prevent the accidental charging of conductor or apparatus.	Lock out Tag out system is not available	LOTO and Work Permit system should be incorporated and adhered to prevent any accident while working on electrical equipment and panels
	No person shall work on live electric supply line or apparatus unless he is authorized.	Work permit is not available /followed	

2.3 ELECTRICAL FIRE PREVENTION

2.3.1 Appropriate Placement of Fire Extinguisher Suitable for Electric Use:

Rules	Provisions	Status	Action recommended

IE Rule 43 CEA 27	Fire buckets filled with dry sand & fire extinguishers shall be placed in enclosed substations & switch stations. The fire extinguishers are to be tested at least once a year for its satisfactory operation & a record of such testing has to be maintained.	Sand buckets not available near transformer and DGs	Adequate number of sand buckets to be provided at the transformer yard

2.3.2 Presence of any inflammable /combustible materials near electrical equipments/ fuse panels / distribution boards (CEA 49):

Found clear

2.3.3 Capacity of equipments (CEA 104):

The capacity of all electrical equipments, controlling devices & associated cable was found to be adequate enough to meet the existing load

Adequate

2.3.4 Actual load calculation:

Cable is of the appropriate rating with specified conductor material aluminum and/or copper to ensure that no overloading takes place.

Available as per requirement

2.3.5 Check for loose connection & overheating:

Refer the Thermal Imaging report
(Done during assessment)

2.3.6 Check for equipments running in over load condition/ heating/ burning smell:

Refer the Thermal Imaging report
(Done during assessment)

2.4 EARTHING

Rules	Provisions	Status	Action recommended
CEA 41	The frame of generator, transformer is earthed & record of earth resistance is maintained. All exposed non-current carrying metal parts of fixed equipments are grounded.	Earthing is provided to almost all the Equipments across the plant	Provide body earthing to motors and battery racks wherever missing
CEA 42	The supply of energy to every installation other than low voltage installation above 5 KW shall be controlled by earth leakage circuit breaker.	Provided	Nil
CEA 101	All non-current carrying metal parts in power distribution & neutrals of generators & transformers are required to be connected to ground.	Connected	Nil
CEA 48 (8)	Every earthing system shall be tested for its resistance to earth on a dry day during dry season not less than once in a year and record of tests shall be maintained.	Testing not done	Get the earth pits tested by third party during dry season

2.4.1 Provision of earth pits:

- Earth Pits are marked for identification?
  Need to be marked again wherever it has discolored
- Earth Pit layout is available?
  Not evident

2.4.2 Earthing grid:

- Availability of earthing grid diagram?
  Not Applicable
- Whether resistance of earth pits is being measured and recorded with identification of pits, as per schedule?
  Not Done
- Next date of resistance test mentioned in records and painted at covers of earth pits?
  Not Mentioned

2.5 ELECTRICAL PROTECTION

Rules	Provisions	Status	Action recommended
CEA 26	all systems & circuits shall be so protected as to automatically disconnect the supply under abnormal conditions	Breakers and Isolators are provided	Nil
CEA 24	Distinction of different circuits: The owner of every generating station, substation, junction box pillar in which there are circuits or apparatus, whether intended for operation at different voltage or at the same voltage, shall ensure by means of indication of permanent nature that the respective circuits are readily distinguishable from one another.	NA	

2.5.1 Whether of adequate capacity and as per electrical connection from local EB and all of these are in working order:

: CTs (Current Transformer)

Available and Working

: Breakers

Available and Working

: Power isolators

Available and Working

: Metering units

Available and Working

2.5.2 Settings of protection relays:

Seems OK

Rules	Provisions	Status	Action recommended
CEA 74	Protection against lighting: (1) the owner of every overhead line, substation or generating station which is exposed to lightning shall adopt efficient means for diverting to earth any electrical surges due to lightning which may result in to injuries.	Not Provided	Check relevant national codes and proceed as per requirement
CEA 115 (3-i)	Supervision: The electrical supervisor shall be responsible for the proper performance of the following duties, by himself or by an electrician (i) thorough examination of all apparatus, including the testing of earth conductors and metallic coverings for continuity, as often as may be necessary to prevent danger;	Not Done	Continuity test needs to done and recorded

2.5.3 Whether lightening arrestor is installed and is connected to earth pit:

Lightning arrestors are not available

2.6 ELECTRICAL MAINTENANCE

2.6.1 Record of periodic calibration of meters (ammeter, voltmeter) & test instruments:

Insulation resistance megger, earth resistance meter, multimeters etc. CB & Relay Testing?

Records not available for any testing done

2.6.2 DG Sets:

Maintenance checklist & log book is maintained?

Maintained (Third Party)

2.6.3 Check on transformers:

BDV, Gas Analysis, Physical and acidity checks, Buchholz relay healthiness, temperature gauge calibration not Done

2.6.4 Transformer loading:

Loaded at around 50 %

2.7 VENTILATION

Ventilation in the panels is adequately provided as the temperature rise was not seen in the thermography report

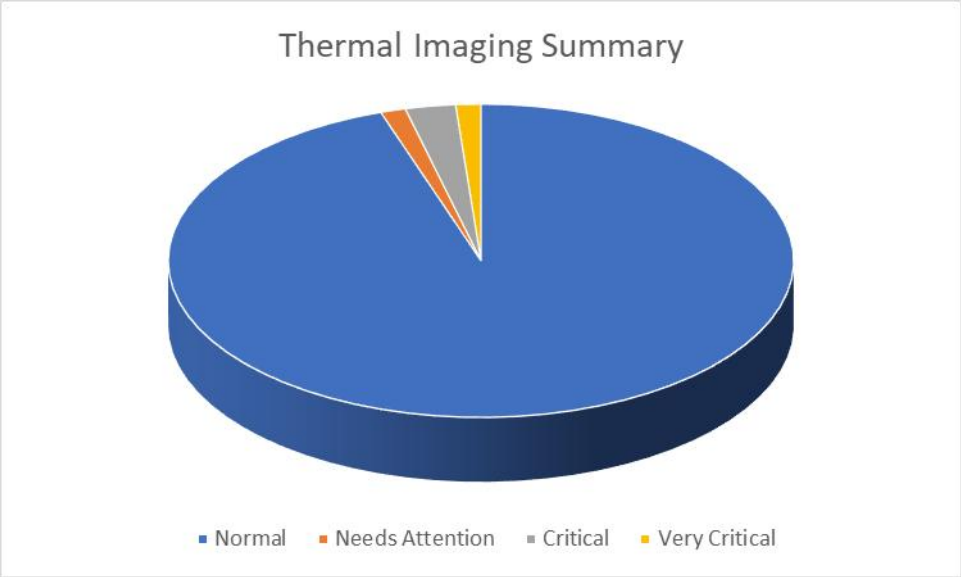
2.8 ILLUMINATION

- Whether illumination is provided for all the working space around service equipment, switchboards and motor control centers installed indoor/outdoor

  Illumination is provided around the panels and DBs as per the standard requirements

3.0 THERMOGRAPHY OF PANELS

Temperature range (°C)		Condition	Nos.
Air-Conditioned area	**Non-Air-Conditioned area**		
≤ 35 °C	≤ 45 °C	Normal	73
> 35 °C to ≤ 50 °C	> 45 °C to ≤ 60 °C	Needs Attention	1
> 50 °C to ≤ 90 °C	> 60 °C to ≤ 100 °C	Critical	2
> 90 °C	> 100 °C	Very Critical	1



See details in attached annexure

INSTRUMENTS AVAILABLE FOR AUDIT:

Following instruments were available for measurement purposes during audit

Sr. No.	Model No	Make
1	Power & Harmonics Analyzer	KryKard
2	3 Phase Power Clamp-On Meter	Kusam-Meco
3	IR Thermometer	FLUKE
4	Lux meter	Lutron
5	Earth Tester	Motwani
6	Digital Camera	Sony
7	Thermal Imager	FLIR E-30

Annexures

1. Pictorial Evidences of non-compliance
2. Cable Isolator Study
3. A. Summary of Thermography
   B. Images of Thermography
4. Earth Neutral Voltage study
5. Power Quality Analysis