Volume 10, Issue 6, June – 2025 International Journal of Innovative Science and Research Technology
ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun050

Electrical Safety Audit and Power Quality Analysis of Electric Installation at Religious Place

Sarang Pande[1]; Girish Mahajan[2]

[1]Director, ENROVISION LLP
[2]Chairperson, Consumer Grievance Redressal Forum, (Electricity)

Publication Date: 2025/06/11

Abstract: This article presents a comprehensive overview of an Electrical Safety Audit conducted in religious worship premises, emphasizing compliance with the *Central Electricity Authority (Measures Relating to Safety and Electric Supply) Regulations, 2023*, notified by the Government of India. The audit aimed to evaluate the adequacy, reliability, and safety of electrical installations and systems in selected premises, with a focus on identifying potential hazards, adherence to statutory requirements, and opportunities for improvement. Key areas of assessment included the condition of wiring systems, earthing and bonding practices, working of circuit protection devices and maintenance procedures. The 2023 CEA Regulations serve as the foundational framework for the audit, mandating safety practices such as periodic inspection and testing, installation of Residual Current Devices (RCDs), and maintenance of safety records. Findings from the audit reveal varying levels of compliance, with common issues including outdated installations, absence of lightning arrestor and lack of regular testing protocols. The article concludes with recommendations for ensuring sustained electrical safety, including periodic training, use of compliant materials, and the establishment of internal safety monitoring mechanisms, thereby underscoring the critical importance of proactive safety management.

Keywords: *Electrical Safety Audit, Loop Impedance, Power Quality, Thermography, Earthing.*

How to Cite: Sarang Pande; Girish Mahajan (2025) Electrical Safety Audit and Power Quality Analysis of Electric Installation at Religious Place. *International Journal of Innovative Science and Research Technology*, 10(6), 80-90. https://doi.org/10.38124/ijisrt/25jun050

I. INTRODUCTION

Electrical safety is a critical aspect of building infrastructure, particularly in religious worship premises where complex electrical systems support diverse operations and high footfall. With growing dependence on electrical and electronic equipment, the risks associated with electrical faults—such as fire, electric shock, equipment failure, and operational disruptions—are increasingly significant. To mitigate these risks and promote safe electrical practices, the Government of India has introduced the *Central Electricity Authority (Measures Relating to Safety and Electric Supply) Regulations, 2023*. These regulations emphasize the mandatory implementation of safety protocols, regular inspection and testing of electrical installations, and adherence to standards for installation and maintenance.

In addition to the statutory framework provided by the CEA Regulations, Indian Standards such as **IS 3043:2018** (*Code of Practice for Earthing*) and **IS 2309:1989** (*Code of Practice for the Protection of Buildings and Allied Structures Against Lightning*) offer detailed technical guidelines for ensuring electrical safety. IS 3043 lays down best practices for designing, installing, and maintaining effective earthing systems—an essential component in protecting both people and equipment from electrical hazards. IS 2309/IEC 62305 provides methodologies for assessing lightning risk and implementing protective measures to safeguard structures.

This article presents an electrical safety audit conducted at religious premises, guided by the provisions of the CEA Regulations, 2023, and relevant Indian Standards. The audit focused on evaluating compliance levels, identifying safety gaps, and recommending improvements to enhance the overall safety and reliability of electrical systems.

➢ *Objective of the Electrical Safety Audit and Power Quality Study:*

The primary objective of the electrical safety audit conducted is to systematically evaluate the safety, reliability, and compliance of electrical installations with applicable statutory and technical standards. Specifically, the audit aims to:

- **Ensure Compliance with Regulations:** Assess adherence to the Central Electricity Authority (Measures Relating to Safety and Electric Supply) Regulations, 2023, including mandatory provisions for periodic inspection, protective devices, and documentation.
- **Evaluate Earthing and Lightning Protection Systems:** Verify the design, installation, and effectiveness of

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun050

earthing systems and lightning protection measures as per IS 3043:2018 and IS 2309:1989/IEC 62305 respectively.

- **Identify Electrical Hazards:** Detect potential safety risks such as faulty wiring, overloaded circuits, inadequate protection devices, and lack of maintenance, which may lead to fire, electric shock, or equipment damage.
- **Assess Safety Practices and Maintenance Procedures**: Review existing maintenance schedules, safety protocols, and personnel awareness regarding electrical safety to ensure that good practices are followed consistently.
- **Analyze Power Quality:** Examine parameters such as voltage fluctuations, harmonics, transients, and imbalances to ensure the stable and efficient operation of electrical equipment, minimize energy losses, and prevent premature equipment failure.
- **Recommend Corrective and Preventive Measures:** Provide actionable recommendations for rectifying identified deficiencies, improving system reliability, and preventing future incidents.
- **Promote a Culture of Safety:** Encourage the implementation of a proactive electrical safety management system that includes periodic audits, staff training, and continuous compliance monitoring.

By achieving these objectives, the audit contributes to creating a safer working environment, reducing the risk of electrical accidents, improving energy efficiency, and enhancing the overall operational resilience of religious establishments.

II. METHODOLOGY

➢ *The Methodology for Conducting the Electrical Safety Audit Includes:*

- **Discussions with Staff:** Engaging personnel to understand their knowledge of safety practices and identifying potential gaps.
- **Review of Safety Monitoring Programs:** Examining the existing electrical safety programs and records for regular inspections, testing, and compliance.
- **Visual Inspection of Equipment:** Conducting a thorough inspection of electrical panels, wiring, and equipment for physical hazards and irregularities

➢ *The Methodology Consists of Verifying the Documents, Physical Installation & Measurement and is not Limited to the Following:*

- Single line Diagram (SLD) for the facility vis a vis installation
- Physical conditions of Electrical Panels, DBs and sub DBs.
- Physical condition of Cables & Wires layout, termination and their condition
- Physical condition of Breakers & their operability
- Identification Labels for Feeders & Circuits
- Fixation of Danger Notices
- Measurement of Power Quality at main Incomer
- Measurement of load and its distribution
- Thermal imaging of all panels, DBs, sub DBs.
- Earthing
- Fire Safety procedures
- Training needs of maintenance personnel
- Personnel Protective Equipment availability
- Test records
- Previous abnormal incidents if any

➢ *Key Parameters Measured in an Electrical Safety Audit*

- *Insulation Resistance (IR Value)*

✓ **Purpose**: To confirm the dielectric strength between live conductors and earth parts.
✓ **Significance**: A proper IR value ensures minimal leakage current, thereby protecting individuals from electric shock and preventing insulation failure.

- *Earth Fault Loop Impedance*

✓ **Purpose**: To ensure that in the event of a fault, the resulting fault current is sufficient to trigger protective devices (like MCBs or fuses).
✓ **Significance**: If the impedance is too high, the fault current may go undetected, leading to overheating, fire hazards, or equipment damage.

- *Earth Pit Resistance*

✓ **Purpose**: To provide an effective grounding path for fault currents and lightning strikes.
✓ **Significance**: Low earth resistance values are essential to safely dissipate fault energy into the ground, thereby protecting both personnel and equipment from electrical hazards and surges.

- *Bonding*

✓ **Purpose**: To electrically connect metal parts that may be exposed to fault currents.
✓ **Significance**: Proper bonding ensures voltage equalization, reducing the risk of electric shock when touching different metal parts during a fault condition.

- *Thermography (Thermal Imaging)*

✓ **Purpose**: To detect abnormal heat patterns in electrical equipment.
✓ **Significance**: This non-invasive diagnostic technique helps identify:

  - Loose connections
  - Overloaded circuits
  - Insulation breakdown

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun050

Table 1 Use of Instruments

No	Instrument	Purpose
1	Meggar	Insulation Resistance
2	Earth Resistance Meter	Earthing Value of Earthing Electrode and Allied System
3	Thermo Vision Camera	Identify Hot Spots
4	PQM (Power Quality Meter)	Measure Power Quality (e.g., Harmonics Content, Load Profile)
5	Loop Impedance Meter	Determine Proper Tripping Current

Table 2 Extract of form II (Installations of voltage level more than 250V up to and including 650V)

Consumer Details	**The facility receives low tension (LT) power supply from MSEDCL connected to individual LT panels.**
Voltage & System of Supply	Volts: 415 V No. of Phases: 3 AC/DC: AC
Particulars of Installations: Total Connected Load=66Kw Electricity utilized by the facility is for AC, Lighting & Utility Equipment.	
Data Summary: Frequency: 49.98 Hz Voltage RMS (avg ph to ph): (L12) 399.4, (L23) 406.3, (L31) 401.8 V Voltage RMS (avg ph to N): (L1N) 230.6, (L2N) 234.5, (L3N) 231.9, (N-G) 3.1 V Current RMS (avg): (L1) 29.47 (L2) 38.03, (L3) 21.6, (N) 10.4 A THD Voltage: (L12) 1.9, (L23) 1.2, (L31) 1.5% THD Current: (L1) 14.6, (L2) 6.6, (L3) 11.5% Power (avg): (absorbed) 19.52 kW, (reactive) 6.09 kVAR, (apparent) 20.75 kVA Power (MD): (absorbed) 25.3 kW, (apparent) 26.0 kVA PF: (avg) 0.927	

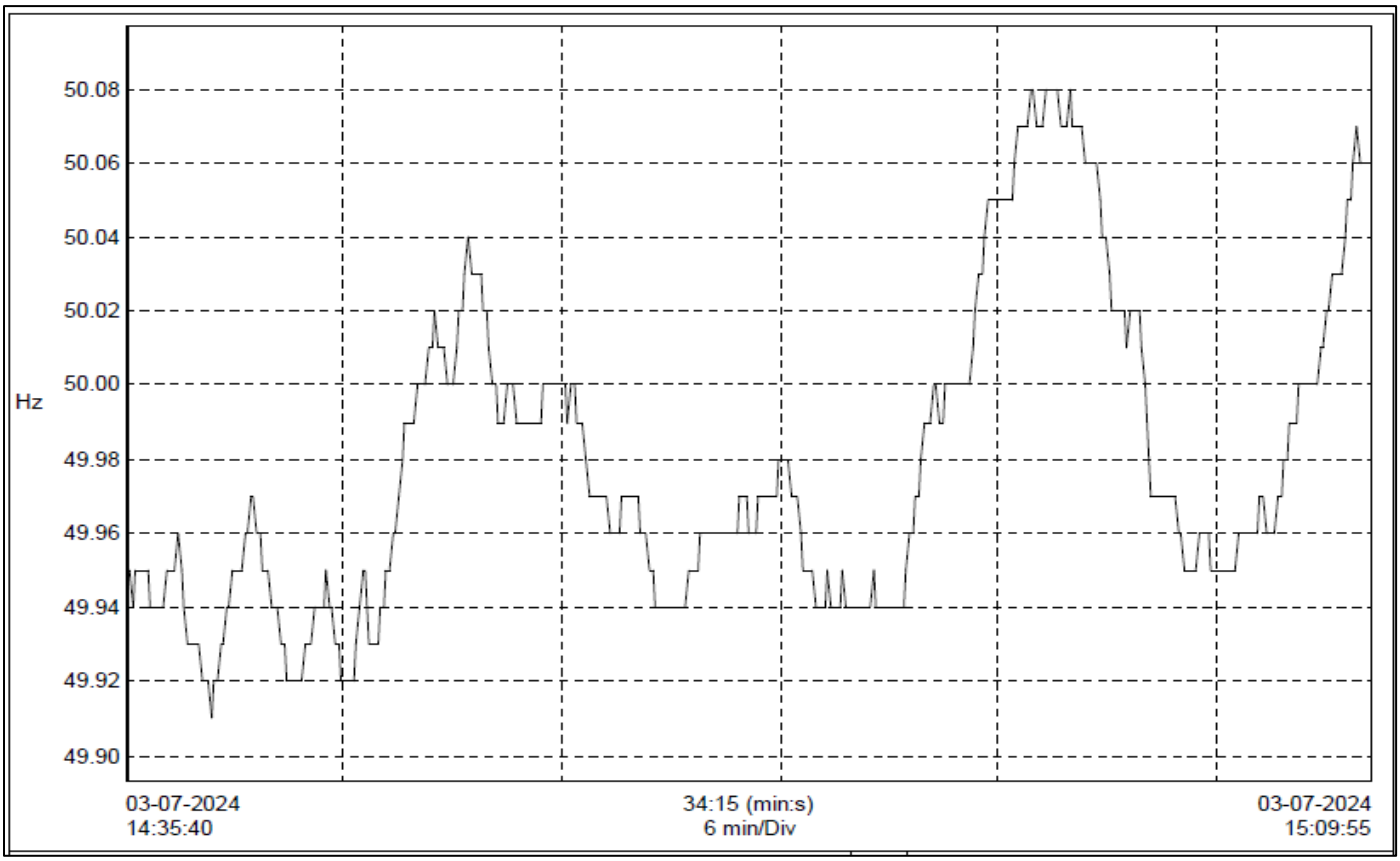


Fig 1 Frequency Graph

Table 3 Frequency

Frequency	Date	Time	Avg	Min	Max	Duration
F	03/07/2024	14:35:40	49.98 Hz	49.91 Hz	50.08 Hz	34.20 Min

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun050

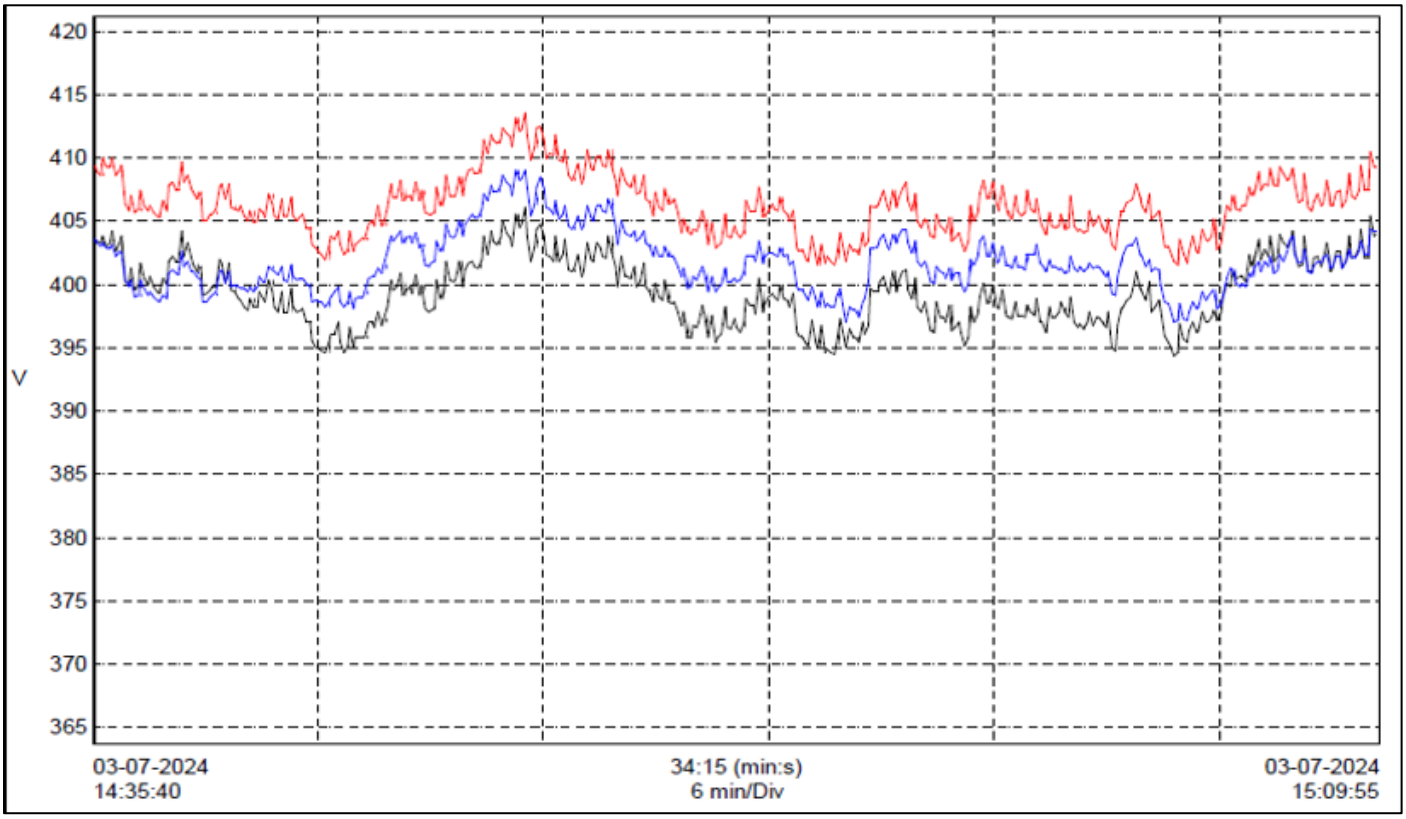


Fig 2 Voltage Profile Graph

Table 4 Voltage Profile

Line Voltage	Date	Time	Avg	Min	Max	Duration
U12 rms	03/07/2024	14:35:40	399.4 V	368.5 V	410.1 V	34:20 Min
U23 rms	03/07/2024	14:35:40	406.3 V	387.1 V	416.4 V	34:20 Min
U31 rms	03/07/2024	14:35:40	401.8 V	374.7 V	412.3 V	34:20 Min

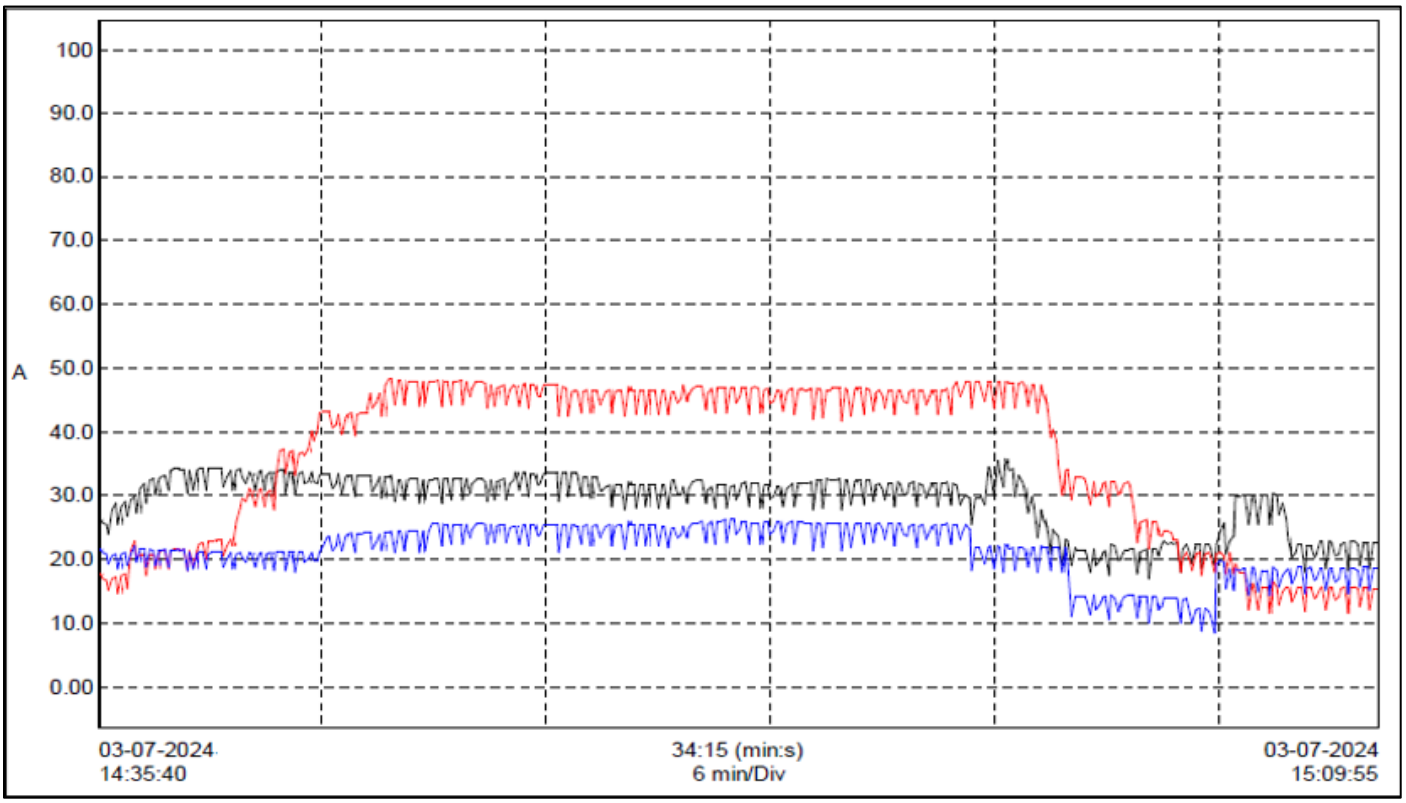


Fig 3 Current Profile Graph

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun050

Table 5 Current Profile

Current	Date	Time	Avg	Min	Max	Duration
A1 rms	03/07/2024	14:35:40	29.47 A	12.49 A	81.52 A	34:20 Min
A2 rms	03/07/2024	14:35:40	38.03 A	06.98 A	95.29 A	34:20 Min
A3 rms	03/07/2024	14:35:40	21.65 A	02.75 A	71.41 A	34:20 Min

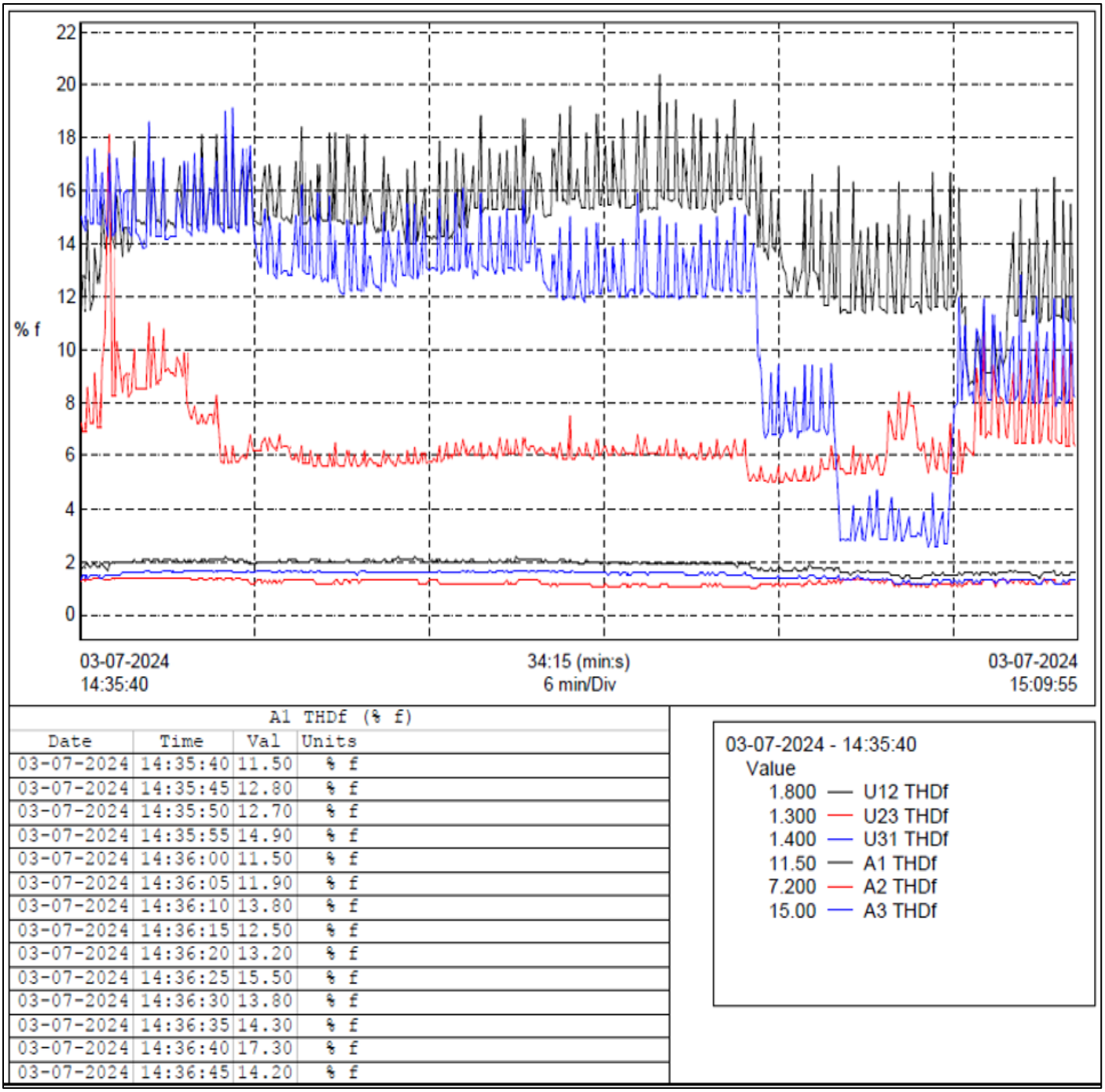
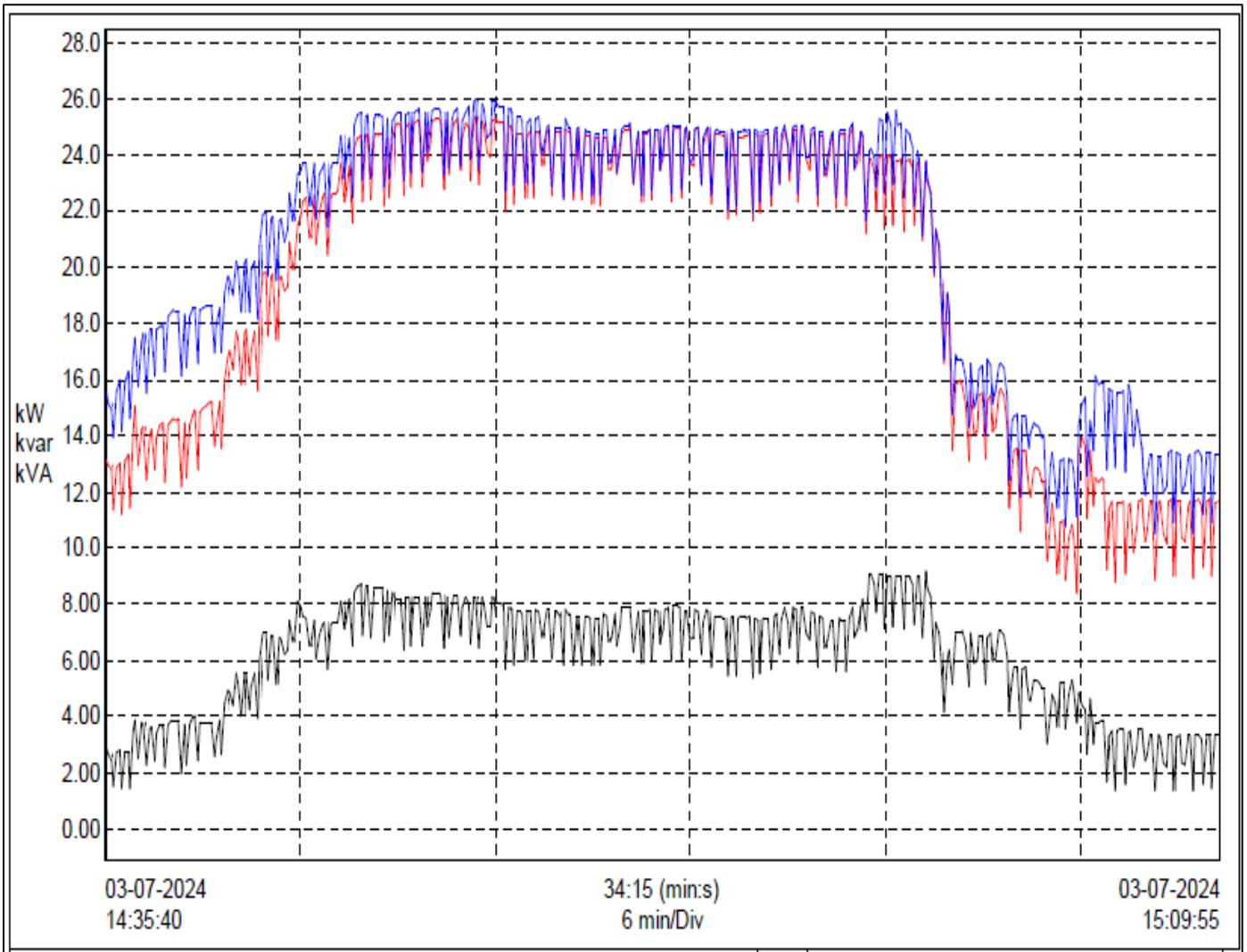


Fig 4 Total Harmonic Distortion Graph

Table 6 Total Harmonic Distortion

Current /Volt THD	Date	Time	Avg	Min	Max	Duration
A1 THDf	03/07/2024	14:35:40	14.65 %f	8.70 %f	20.40 %f	34:20 Min
A2 THDf	03/07/2024	14:35:40	06.56 %f	5.00 %f	18.10 %f	34:20 Min
A3 THDf	03/07/2024	14:35:40	11.50 %f	2.60 %f	19.10 %f	34:20 Min
U12 THDf	03/07/2024	14:35:40	1.878 %f	1.400 %f	2.200 %f	34:20 Min
U23 THDf	03/07/2024	14:35:40	1.238 %f	1.000 %f	1.400 %f	34:20 Min
U31 THDf	03/07/2024	14:35:40	1.514 %f	1.200 %f	1.700 %f	34:20 Min

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun050



PT (W) (W)

Date	Time	Val	Units
03-07-2024	14:35:40	13.09	kW
03-07-2024	14:35:45	12.97	kW
03-07-2024	14:35:50	12.79	kW
03-07-2024	14:35:55	11.34	kW
03-07-2024	14:36:00	12.87	kW
03-07-2024	14:36:05	13.03	kW
03-07-2024	14:36:10	11.20	kW
03-07-2024	14:36:15	13.08	kW
03-07-2024	14:36:20	13.35	kW
03-07-2024	14:36:25	11.45	kW
03-07-2024	14:36:30	14.15	kW
03-07-2024	14:36:35	15.09	kW
03-07-2024	14:36:40	12.96	kW
03-07-2024	14:36:45	14.23	kW

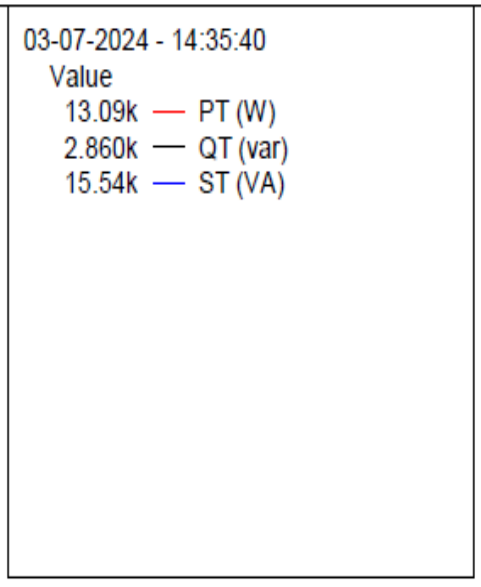
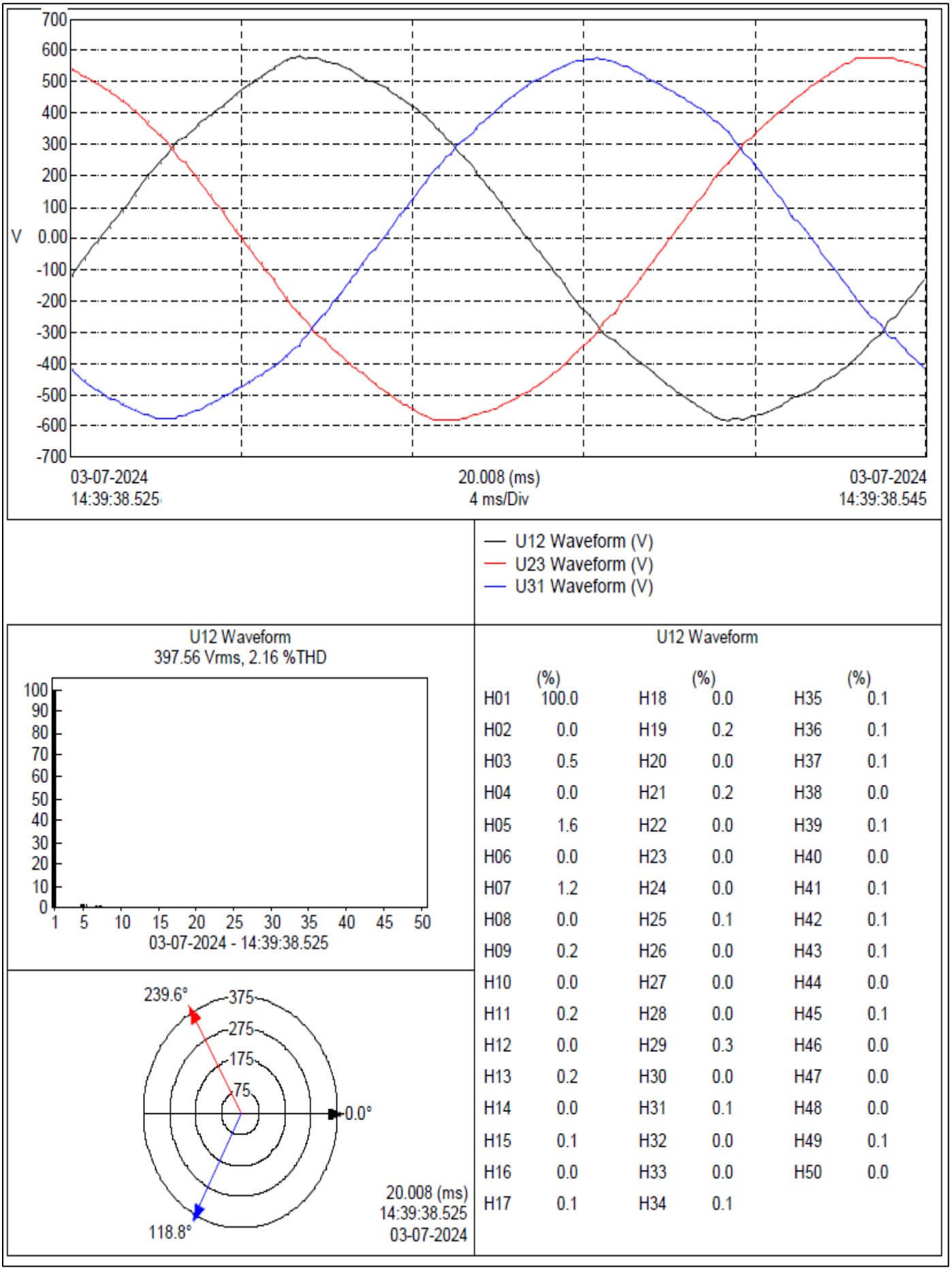


Fig 5 Active, Reactive & Apparent Power graph

Table 7 Active, Reactive & Apparent Power

Power	Date	Time	Avg	Min	Max	Duration
PT(W)	03/07/2024	14:35:40	19.52KW	8.418KW	25.35KW	34:20Min
QT(VAR)	03/07/2024	14:35:40	6.097KVAR	1.337KVAR	9.134KVAR	34:20Min
ST(VA)	03/07/2024	14:35:40	20.75KVA	10.54KVA	25.99KVA	34:20Min

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun050



U12 Waveform

	(%)		(%)		(%)
H01	100.0	H18	0.0	H35	0.1
H02	0.0	H19	0.2	H36	0.1
H03	0.5	H20	0.0	H37	0.1
H04	0.0	H21	0.2	H38	0.0
H05	1.6	H22	0.0	H39	0.1
H06	0.0	H23	0.0	H40	0.0
H07	1.2	H24	0.0	H41	0.1
H08	0.0	H25	0.1	H42	0.1
H09	0.2	H26	0.0	H43	0.1
H10	0.0	H27	0.0	H44	0.0
H11	0.2	H28	0.0	H45	0.1
H12	0.0	H29	0.3	H46	0.0
H13	0.2	H30	0.0	H47	0.0
H14	0.0	H31	0.1	H48	0.0
H15	0.1	H32	0.0	H49	0.1
H16	0.0	H33	0.0	H50	0.0
H17	0.1	H34	0.1		

Fig 6 Voltage Waveform

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun050

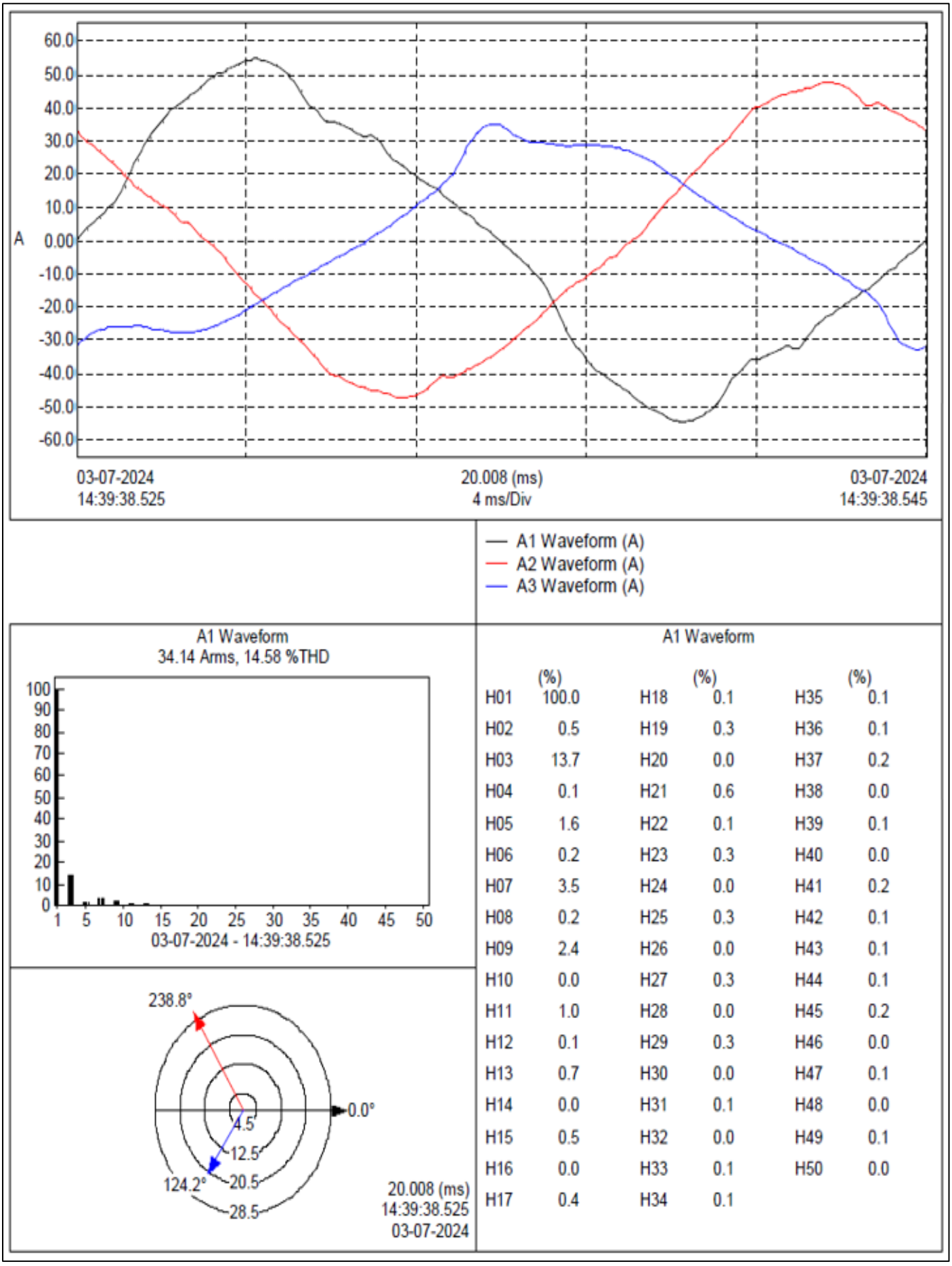


Fig 7 Current Waveform

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun050

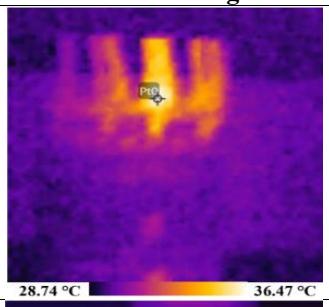
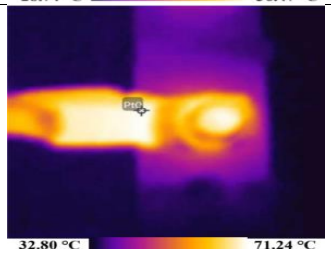
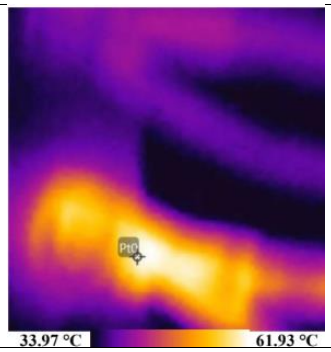
Table 8 Loop Impedance test Values:

Sr. No.	Location	Loop Impedance Ohm
1	New Office Socket	1.7
2	Old Office 1st floor	0.8/0.74/1.74
3	Prasadalay	0.8/0.69/0.6
4	Mandir 1st Floor	8.9
5	Lodge 2	0.37/0.45/0.38
6	Lodge 1	5.5/5.45/5.38
7	Temple Socket	6.7

➢ *Thermography:*

Thermography is carried out as per the guidelines given in IS 16168 (2014) for Infrared Thermography Inspection of Electrical Installations [Non-Destructive Testing]. The terminals identified with the temperature above 45^0 C is given herewith. These terminals need attentions.

Table 9 Terminals having Temperature above 45°C.

Location & Equipment	Thermal Image	General Image	Issue & Recommendations
Location: New office LT Panel **Equipment:** Incomer MCCB Y ph terminal			**Issue:** Comparatively higher temperature than other terminals **Recommendations:** Loose connection secure the terminals
Location: New Office Stabilizer **Equipment:** B ph input terminal			**Issue:** Comparatively higher temperature than other terminals. **Recommendations:** Loose connection secure the terminals
Location: New Office Stabilizer **Equipment:** B ph output terminal			**Issue:** Comparatively higher temperature than other terminals. **Recommendations:** Loose connection secure the terminals

➢ *Observations and Recommendations*

Based on the electrical safety audit and power quality analysis conducted at the religious establishment, the following key observations were made, accompanied by corresponding recommendations to enhance electrical safety, system reliability, and compliance with statutory standards:

- *Danger and Warning Signage*

✓ **Observation:** Electrical panels lacked proper danger and warning signage.
✓ **Recommendation:** Danger warning boards should be installed at every electrical panel to alert personnel and visitors of potential electrical hazards.

- *Residual Current Devices (RCDs)*

✓ **Observation:** RCDs were either missing or not strategically located.
✓ **Recommendation:** Residual Current Devices should be installed at the load end and in public access areas to ensure protection against electric shock.

- *Cable and Wire Tagging*

✓ **Observation:** Cables and wires were not properly identified or tagged.
✓ **Recommendation:** All electrical cables and wiring should be tagged clearly for ease of identification, maintenance, and fault isolation.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun050

- *Earthing System*

✓ **Observation:** The existing earthing arrangement did not meet recommended safety standards. Leakage Current measured at Lightning Earth Pit is 90 mA & resistance is 13 ohms (when Lightning Earth pit is connected to another Earth Pit). Earthing Pits are not sufficient & testing is not done regularly. Every Earth pit created at site shall be connected with the Main Earth pit so that during Earth fault the Breaker trips i.e connection shall be either TNS or TT and accordingly Circuit Breaker at main Incomer shall have protection provided for tripping in case of fault. Every Earth pit created at site shall be connected with the Main Earth pit so that during Earth fault the Breaker trips i.e connection shall be either TNS or TT and accordingly Circuit Breaker at main Incomer shall have protection provided for tripping in case of fault.
✓ **Recommendation:** An earthing grid should be established in areas with suitable soil resistivity to enhance grounding effectiveness and reduce fault potential. Every Earth pit created at site shall be connected with the Main Earth pit so that during Earth fault the Breaker trips i.e connection shall be either TNS or TT and accordingly Circuit Breaker at main Incomer shall have protection provided for tripping in case of fault. Earthing conductor shall be sized in accordance to the IS 3043.

- *Lightning Protection*

✓ **Observation:** No functional lightning protection system was in place.
✓ **Recommendation:** A comprehensive lightning protection system should be installed as per IS/IEC standards to safeguard structures and occupants during lightning events.

- *Designated Electrical Safety Officer*

✓ **Observation:** No clearly identified person was responsible for electrical safety.
✓ **Recommendation:** A designated and trained individual should be appointed to oversee all aspects of electrical safety and ensure compliance with applicable norms.

- *Documentation of Electrical System*

✓ **Observation:** The Single Line Diagram (SLD) and system layout were either missing or outdated.
✓ **Recommendation:** Up-to-date SLDs and electrical system layouts must be documented and maintained for reference during troubleshooting and future audits.

- *Fire Safety Measures*

✓ **Observation:** Fire extinguishers were not adequately distributed or located.
✓ **Recommendation:** Fire extinguishers should be installed at all critical locations, especially near electrical panels and equipment.

- *Condition of Electrical Wiring*

✓ **Observation:** A number of wires were found hanging loosely; older cables were deteriorated.
✓ **Recommendation:** All hanging wires should be rerouted underground using HDP pipes. Old or undersized wires must be replaced with appropriately rated FRLS (Fire Retardant Low Smoke) cables to minimize fire risk.

- *Meter Cabin Infrastructure*

✓ **Observation:** The existing meter cabin showed signs of wear and lacked structural integrity.
✓ **Recommendation:** Revamp the meter cabin to meet safety and operational requirements, ensuring secure housing of metering equipment.

- *New Electric Connections*

✓ **Observation:** Shared connections across multiple locations posed reliability and safety concerns.
✓ **Recommendation:** Independent electric meter connections with separate service lines should be provided for key zones such as the main Mandir structure, Prasadlay, and other auxiliary facilities.

- *Diesel Generator Compliance*

✓ **Observation:** Diesel generator layout drawings and approvals were outdated.
✓ **Recommendation:** Layout drawings and necessary approvals for the DG set must be renewed through the Electrical Inspector's office prior to the expiration date to ensure regulatory compliance.

This structured approach ensures that each audit finding is supported by a clear and actionable recommendation, forming a strong foundation for risk mitigation, compliance enhancement, and electrical safety improvement within the premises.

III. CONCLUSION

The electrical safety audit and power quality analysis conducted at the religious establishment have provided critical insights into the current state of the electrical infrastructure. The assessment revealed areas of non-compliance with statutory regulations, potential safety hazards, and opportunities for improving both system reliability and operational efficiency. The evaluation of earthing systems, lightning protection, wiring conditions, and protective devices highlighted the importance of regular inspections and maintenance in safeguarding occupants and property.

Implementing the recommended improvements, along with adopting a culture of continuous monitoring, staff training, and compliance, will significantly contribute to a safer, more resilient electrical environment. For religious institutions, where large gatherings are common and uninterrupted operation is vital, maintaining high standards of

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun050

electrical safety and power quality is not just a regulatory requirement but a moral responsibility.

REFERENCES

[1]. Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2023

[2]. IS: 3043 - 1987 Indian Standard Code of practice for Earthing.

[3]. The Complete Guide to Electrical Safety Audits: What You Need to Know by Elion Technologies and consulting

[4]. Ghosh Manik C, et all (2015). 'An article on Electrical safety', *International Journal for Scientific Research & Development| Vol. 3, Issue 10, 2015*

[5]. Becker, T. (2010), 'Measuring performance of your Electrical Safety Program by audit', Petroleum and Chemical Industry Conference (PCIC), Record of Conference Papers Industry Applications Society 57th Annual, San Antonio, 20-22 Sept. 2010, IEEE, pp. 1 – 10.

[6]. Gautam Krishna Kant, 'Electrical Hazards, Safety and Regulations Global Concerns and Indian Perspective', International Journal of Engineering Innovation & Research, Vol.5, Issue 3, ISSN: 2277-5668.

[7]. Md. Shahadat Hossain, K.M.A. Salam 'Basic Approach of an Electrical Safety Assessment in RMG Industries: Development of Electrical Hazards' *Journal of Modern Science and Technology, Vol. 3. No. 1. March 2015 Issue. Pp.40-46.*

[8]. J. M. Gallagher and L. B. McClung, "Electrical hot work safety program," in *IEEE Transactions on Industry Applications*, vol. 24, no. 1, pp. 64-69, Jan.-Feb. 1988, doi: 10.1109/28.87252.

[9]. Kumbhar, N. R., and Joshi, R. R. (2012), 'An Industrial Energy Auditing: Basic Approach', International Journal of Modern Engineering Research, Vol. 2, No. 1, pp. 313-315.

[10]. Richard L. Doughty, Senior Member, IEEE, Richard A. Epperly, Member, IEEE, and Ray A. Jones, Member, IEEE, 'Maintaining Safe Electrical Work Practices in a Competitive Environment', *IEEE TRANSACTIONS ON INDUSTRY APPLICATIONS*, VOL. 28, NO. 1, JANUARY/FEBRUARY 1992.