Electrical Energy & Safety Audit Report

of

Kharupetia College, Kharupetia, Darrang, Assam

Audit Period: 21/03/2023 – 01/04/2023

Audited by: MONADITYA
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ACKNOWLEDGEMENT

We sincerely thank Dr. Mausumi Saha Kalita, Principal, Kharupetia College, as well as Dr. Deepak Kalita, In-charge, IQAC; and Kinal Ali, electrician of the college for their facilitation and support in conducting the data collection and measurement for this Electrical Energy & Safety audit conducted on **21.03.2023**

Electricity utilization in the college campus is primarily for classroom / laboratory activities and management. Airconditioned conference/seminar halls too are there for occasional use.

Some safety weaknesses were observed in the electrical power distribution system and earthing arrangement. Suggestions for needful rectification/revamping of all these defects were verbally briefed to the college administration during the visit.

Detailed observations and suggestion for improvement are elaborated in this report.

We trust that the findings of this Electrical Energy & Safety Audit and the suggestions provided in this formal audit report will be helpful for safe and optimal use of electricity and upkeep of the electrical power distribution system and installations in the Kharupetia College.

MONADITYA

GST Number :18BTPPB7770M1ZY
MSME Reg. No.: UDYAM-AS-03-0000173

Date: 01.04.2023

CERTIFICATE OF ENERGY AUDIT

(Certificate no.: **TS / Energy Audit /22-23/ 001/ Kharupetia College)**

This is to certify that we had conducted **Electrical Energy & Safety Audit** of **Kharupetia College, Kharupetia, Assam** on **21 March, 2023** (as per the Work Order of the Office of the Principal, Kharupetia College, dated **13.03.2023**

The audit observations and findings reveal that there are scopes for improving the safety and economy in the existing electrical power sourcing and distribution arrangement at the college campus:

- There is scope for significant reduction in the monthly electricity bills by lowering the Electricity Supply Contract Demand in accordance with the actual requirement.
- A defective solar panel should be repaired/replaced urgently to utilize full installed capacity of the rooftop solar plant. Currently one of the two arrays of solar plant is lying disconnected.
- Some other tweaking in the electricity distribution arrangement are necessary to optimize the energy utilization at the college campus.
- Some major safety weakness/discrepancies were observed in the power distribution arrangement and earthing arrangement which need immediate rectification.

The observed weaknesses and suggested remedial/improvement measures are elaborated in our submitted **"Electrical Energy & Safety Audit Report."**

The electrical energy utilization at the audited installation (**Kharupetia College**) may be considered fully safe and economical after implementing the suggested rectification and improvement measures.

(Mrinmoy Boruah)
Chief Energy Auditor
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FOREWORD

This audit was carried out as per the work order of office of the Principal, Kharupetia College (dated 13.03.2023 for the Electrical Energy & Safety Audit of Kharupetia College, Kharupetia, Assam. A copy of the work order is attached as an annexure to this report.

The broad scope of this audit was to evaluate the energy usage efficiency and safety status of the Power distribution system of the Kharupetia College campus. The audit was carried out in the presence of electrical support staff of the College.

As part of the audit work (physical observation, testing and necessary data collection) a physical inspection visit was made to the college campus on 21.03.2023

Review of electricity bills and physical observations reveal that there is scope for optimizing electricity utilization in the college campus and reduction of the monthly electricity bills.

Some safety weakness/discrepancies were observed in the electricity distribution system of the college during the data collection part of the audit work. These were briefed and highlighted to all those present during the audit.

The audited installation (Kharupetia College) will be considered fully safe after rectification of the discrepancies highlighted in this report. Regular maintenance and upkeep are utmost essential for optimal and safe use of electricity.

Approach and methodology

The approach and methodology in carrying out the work were as follows:

Conducting of audit:

Conducting of audit and training of personnel was done by experienced Power quality and safety auditors. The audit team of three persons was headed by Mr. Mrinmoy Boruah, BEE certified Energy Auditor & Electrical Consultant, having wide experience of conducting such audit. The other assisting team members were also experienced and have been regularly assisting Mr. Boruah in energy audit related works. The names of the team members and their years of experiences are enlisted in the following table.

Sl. No.	Name	Qualification	Experience (years)
1.	Mr. Mrinmoy Boruah, B.E.(Electrical) & BEE certified Energy Auditor	Energy Auditor & Head of the audit team	10+years' experience in auditing
2.	Mr. Aditya Boruah B.Tech. (Electrical)	Associate Engineer	5+ years
3.	Mr. Hironmoy Baruah	Technical Assistant	10+ years

Instruments for conducting audit: The following instruments were deployed for on-site measurements

a) 2 nos. of Three-phase Power Loggers along with analyzing software (Hioki 31000-94 and Fluke 1735)
b) Single-phase clamp-on power meter (Meco)
c) Digital Multimeter (Metravi)
d) Thermal Camera (Seek CompactPro)
e) IR temperature gun (Benetech GM550)
f) Earth resistance tester
g) Insulation tester
h) Lux Meter

Data analysis: Data collected and monitored during the field work were analyzed and report on analysis are presented in subsequent pages.

Report preparation: Compilation of the Audit Report, highlighting scope for economizing electricity usage and suggesting ways to improve safety and regulatory compliances, if any. Photographs, diagrams, measured data and power-logs taken during the audit are to be included in the compiled report for reference and record.

EXECUTIVE SUMMARY

1) There is scope for significant reduction in the monthly electricity bills. The Contracted Demand of 59KVA can be lowered to 15KVA (which is closer to the actual Maximum Demand recorded in the monthly electricity bills of previous two years) by entering into a new power supply agreement with the APDCL. This change will amount to a saving of approx. **Rs. 6,160/- per month,** i.e., **Rs. 73,920/- per year.** (Elaborated below in **Section 4.1**)

2) There some major safety weaknesses were observed in the transformer substation. These weaknesses should be relayed to the APDCL for necessary rectification / revamping. (Elaborated below in **Section 4.2 (a)**)

3) One of the solar panels in one of the two groups of solar arrays has developed defect. Due to this the whole array is kept disconnected from the solar inverter. This defective panel needs to be repaired at the earliest so that the entire 40KWp (from two solar arrays) capacity of the installed solar plant may be utilized. (Elaborated below in **Section 4.2 (c)**)

4) The protection switchgear arrangement in the power distribution system is not adequate. The fuse switches need to be replaced with MCBs / MCCBs of appropriate ratings. The Distribution Boards should have a combination of MCB and RCCB as the main incomer, and MCB switches for each of the outgoing circuits. (Elaborated below in **Section 4.3**)

5) A complete revamping of the earthing arrangement is necessary. New earth-pits should be constructed for the DG sets and major load centres. Earthing connections should be provided to each of the switchboards and DBs at each room of the college campus. (Elaborated below in **Section 4.5**)

Audit observations

of

Electrical installations

and

Power Distribution System

4.1 Analysis of electricity bill records

Scope for reduction of fixed charge in monthly electricity bills:

The electricity bill records for the past two years have been tabulated below:

Month	Billing period		Maximum Demand (KVA)	Contract Demand (KVA)	MD/CD
Jan'21	01-01-2022	31-01-2022	6.8	59.000	12%
Feb'21	01-02-2022	28-02-2022	8.2	59.000	14%
Mar'21	01-03-2022	31-03-2022	13.4	59.000	23%
Apr'21	01-04-2022	30-04-2022	7.4	59.000	13%
May'21	01-05-2022	31-05-2022	12.4	59.000	21%
Jun'21	01-06-2022	30-06-2022	12.4	59.000	21%
Jul'21	01-07-2022	31-07-2022	10.4	59.000	18%
Aug'21	01-08-2022	31-08-2022	14.4	59.000	24%
Sep'21	01-09-2022	30-09-2022	13	59.000	22%
Oct'21	01-10-2022	31-10-2022	13.8	59.000	23%
Nov'21	01-11-2022	30-11-2022	13.8	59.000	23%
Dec'21	01-12-2022	31-12-2022	7.2	59.000	12%
Jan'22	01-01-2023	31-01-2023	4.8	59.000	8%
Feb'22	01-02-2023	28-02-2023	11	59.000	19%
Mar'22	01-03-2023	31-03-2023	10.4	59.000	18%
Apr'22	01-04-2023	30-04-2023	10.4	59.000	18%
May'22	01-05-2023	31-05-2023	12.4	59.000	21%
Jun'22	01-06-2023	30-06-2023	10	59.000	17%
Jul'22	01-07-2023	31-07-2023	11	59.000	19%
Aug'22	01-08-2023	31-08-2023	23.4	59.000	40%
Sep'22	01-09-2023	30-09-2023	26.4	59.000	45%
Oct'22	01-10-2023	31-10-2023	23.4	59.000	40%
Nov'22	01-11-2023	30-11-2023	10.6	59.000	18%
Dec'22	01-12-2023	31-12-2023	7.8	59.000	13%
		Average=	**12.283**	**59.000**	**21%**

Table: Electricity bill records of past few years

From the table above, it is seen that the average maximum demand (MD) in a month is about 12KVA only. The maximum MD was found to be only 26.4KVA in the month of September 2023. The MD is significantly lower than the contracted demand of 59KVA.

The fixed charge in the monthly electricity bills can be significantly reduced by lowering the contracted demand. The contracted demand should be lowered to say 15KVA by entering into a new power supply agreement with the electricity provider (APDCL).

The rate of fixed demand charge is Rs. 140/- per KVA. Hence by lowering the CD from 59KVA to 15KVA, the saving on the monthly electricity bills will be approximately 44 x 140 = **Rs. 6,160/-.** The yearly savings will amount to approximately **Rs. 73,920/-.**

Note: A penalty will be levied on the months where the Maximum Demand exceeds this lowered Contracted Demand of 15KVA at three times the normal fixed charge rate (i.e. @ Rs. 420/- per KVA). For example, the maximum MD recorded in the past 2 years was in the month of September 2023 (26.4KVA). The MD of 26.4KVA would have exceeded this new CD of 15KVA by (26.4 - 15=) 11.4KVA. Hence the penalty levied on this bill will be (11.4 x 420=) **Rs. 4,788/-.** In the bill records of the past 2 years, the MD was seen to have been higher than 15KVA in only 3 months. So this penalty will only be levied on a few exceptional months. The penalties incurred in those few months will be insignificant in comparison to the overall yearly savings being made by lowering the CD from 59 to 15KVA.

4.2 Sources of power supply

a) Primary source of power supply:

The primary source of power supply for the Kharupetia College campus is from a 63KVA, 11/0.415KV pole-mounted transformer. The transformer's LT output is drawn out to an overhead line. Multiple tappings are taken from this OH line for power supply to various parts of the college campus.

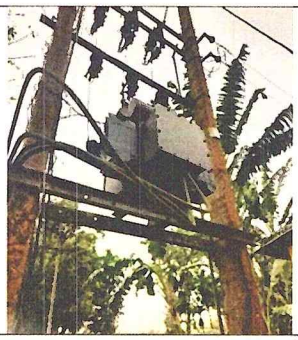
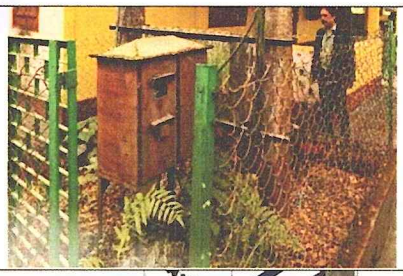
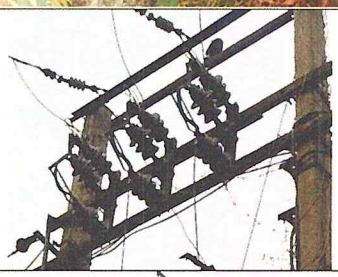
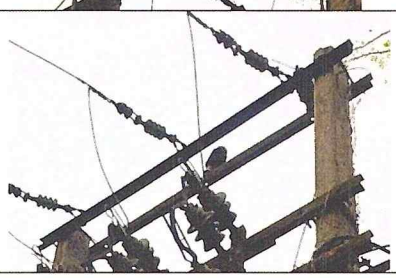


Photo: 63KVA, 11/0.433KV pole-mounted transformer for power supply to the college campus

Observed safety weaknesses of the transformer substation:

Sl. No.	Observation	Photo
1.	The transformer substation area was found to be fully covered by weeds and creepers. During the audit, the substation area was partially cleaned up under our direction.	
2.	The DO fuses for the transformer have been replaced by simple wires and have no barrels.	
3.	One of the three Line type lighting arresters is missing.	

Sl. No.	Observation	Photo
4.	The naked GI wire drawn from the Line Type LAs to its earth-pit is touching the GI channels mounted on the PSC DP structure. The transformer and other substation accessories are all mounted on this structure. In the event of a lightning strike, there is a possibility of this naked wire energizing the mounting channels and equipment mounted on this DP structure with high voltage lightning strikes. This GI wire should be replaced by a 11 or 33KV insulated 1 core 75sq.mm Cu or Al cable to avoid such a hazard.	
5.	There are no cable glands / gland plate installed for the LT cables outgoing from the transformer's Power Receiving Panel (PRP).	
6.	**Earthing:** • The earth-pits for the substation equipment's earthing have been buried under concrete cover and are untraceable. • There is no earthing provided for the transformer's PRP.	

b) Stand-by Diesel Generator (DG) sets:

To provide power supply during failure of Grid power-supply, four nos. of standby diesel generator (DG) sets are installed-

(i) DG-1: for backup power supply to the Computer Lab, Health centre, IQAC, NSS, Geography Lab, Depts. Of Geography, Assamese, Commerce, IT, Retail Management, Sanskrit, English, Economics, Political Science, Philosophy, Hindi, Education, Arabic, History and classrooms AT-1, 2, 3, 4, 5, 6 and 7.

(ii) DG-2: for backup power supply to the, Central Library, Girls Common Room, and the Vice Principal's Office.

The DG-2 is non-functional and kept disconnected. The DG-1 is currently being used to provide backup power to the DG-2's loads.

(iii) DG-3: for backup power supply to the Principal's Office and the Main college building, which houses the classrooms RCC-1 to 18, Language Lab and Exam Control Room.

(iv) DG-4: for backup supply to the KKHSOU, and classrooms AT-8 , AT-9 and AT-10.

i. DG set-1 :

The ratings of this DG set is as given below:

DG set's Capacity: **10 KVA**

Output: 230V, 1-phase, 50 Hz

Make: Kohler Power Systems.

Model: KK10 II

Photo: DG set-1

Photo: Nameplate of the DG set-1

ii. DG set-2 :

This DG set is non-functional and kept disconnected.

Photo: DG set-2

iii. DG set-3 :

The ratings of this DG set is as given below:

DG set's Capacity: **10 KVA**

Output: 230V, 1-phase, 50 Hz

Make: Kirloskar Oil Engines Ltd.

Model: KG1-10AS5

	
Photo: DG set-3	Photo: Nameplate of the DG set-3

iv. DG set-4 :

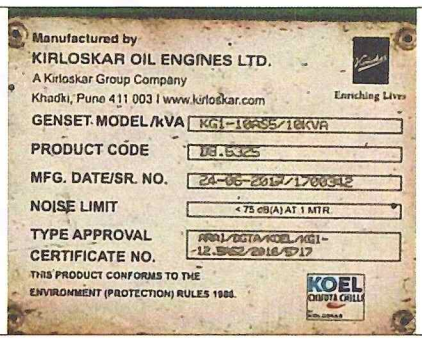
The ratings of this DG set is as given below:

DG set's Capacity: **10 KVA**

Output: 230V, 1-phase, 50 Hz

Make: Kirloskar Oil Engines Ltd.

Model: KG1-10AS5

	
Photo: DG set-4	Photo: Nameplate of the DG set-4

c) <u>Alternate source of power supply (On-grid solar power):</u>

There are roof-top solar arrays installed as an alternate power source for the college. The solar power is fed to a solar PV Grid inverter. This is an on-grid solar system. The solar power output is fed to the power distribution system through the input terminals of the Main Grid Incomer MCCB of the Main College Building.

The total capacity of this solar plant is 40KWp. There are two sets of solar arrays installed. Set-1 has 5 nos. of solar panels which are capable of generating a total of 25KWp of solar power. The set-2 has 3 nos. of solar panels which are capable of generating total 15KWp of solar power. The solar power generated from the two sets of solar panels are separately supplied to the solar inverter through a Solar Array Combiner Unit. The solar inverter then feeds the solar power to the college's power distribution system.

Photos: Solar PV arrays installed on the rooftop of the Main College Building

The ratings of the solar inverter is given below:

Make: Shenzen INVT Electric co. Ltd.
Model: iMars BG40KTR
Max. Input DC Voltage: 1100V
Max. Continuous Power: 63.5KVA
Nominal Output AC Voltage: 230V (P-N)

Photo: Solar PV Grid Inverter

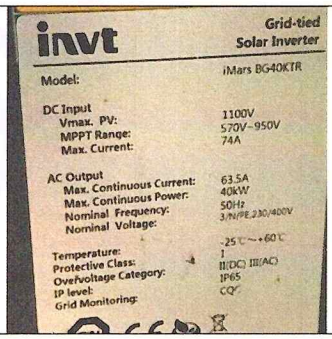


Photo: Nameplate of the solar inverter

Observation:

One of the three solar panels in the solar array set-2 was found to be damaged. Since the solar panels are connected in series, this entire solar array set has been disconnected. Currently, only 25KWp (from the solar array set-1) out of total capacity of 40KWp of the solar plant is being generated.

This damaged solar panel should be repaired at the earliest so that the entire solar power capacity of the solar plant can be utilized.

4.3 Electrical distribution topology

At present there is no Single Line Diagram of power distribution circuit available for verification. During the audit we had traced out the power distribution circuits to the extent possible.

The existing power distribution circuits should be traced out and a single line diagram representation of the same should be prepared. A mandatory approval of the final SLD is to be secured from the office of the Chief Electrical Inspector cum Advisor, Govt. of Assam. It is a safety rule/measure for enabling easy tracing of electric circuits in case of any trouble and for any necessary alteration in the power distribution arrangement.

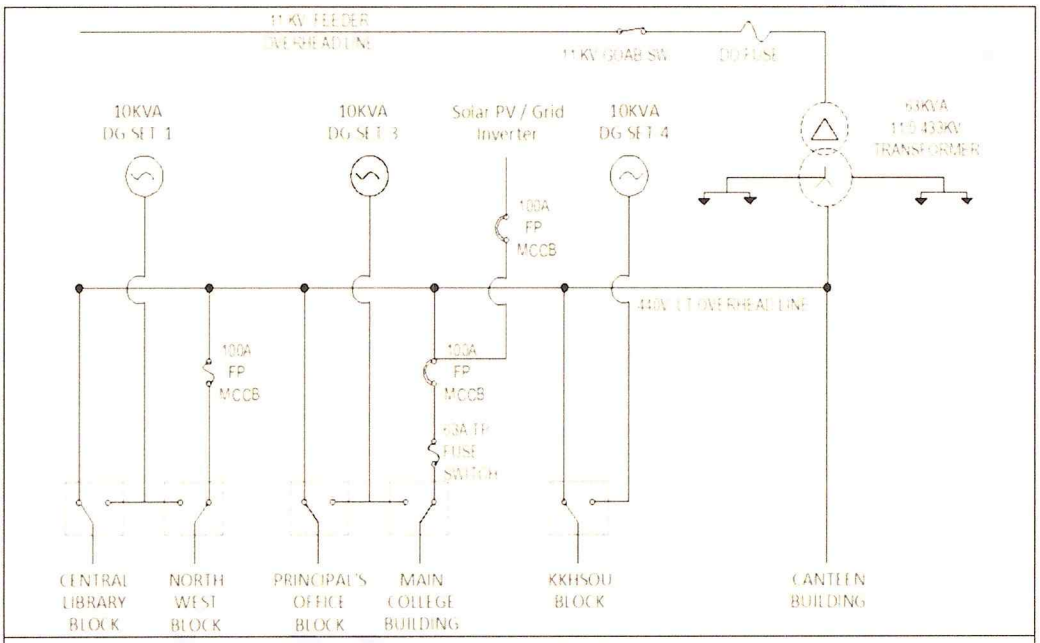


Fig: SLD of main power distribution circuit

Canteen building:

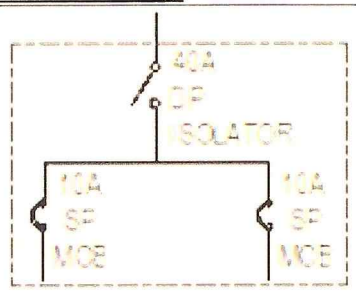


Photo: SLD of power distribution of Canteen building

Photo: Tapping #1 taken from LT OH line to the canteen

Photo: Canteen DB

KKHSOU block:

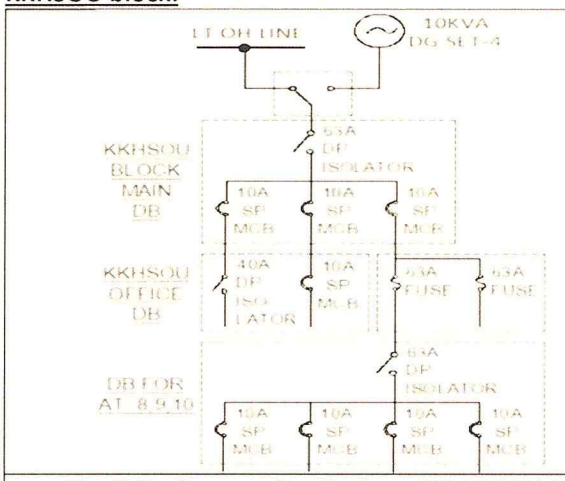


Fig: SLD of power distribution of KKHSOU block

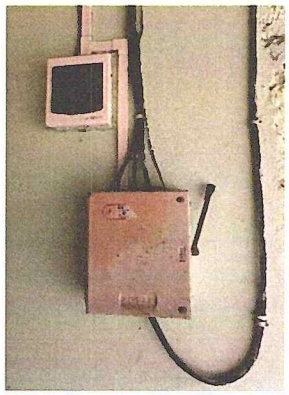


Photo: Grid / DG-4 Changeover

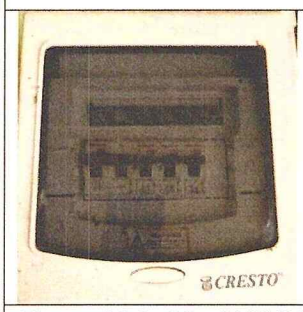


Photo: Main DB of KKHSOU block

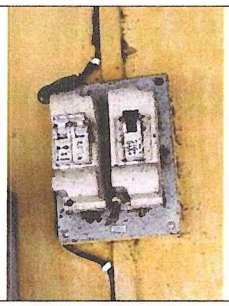


Photo: KKHSOU office DB

Photo: Fuse switch and DB for power supply to AT-8, 9, 10

North West Block :

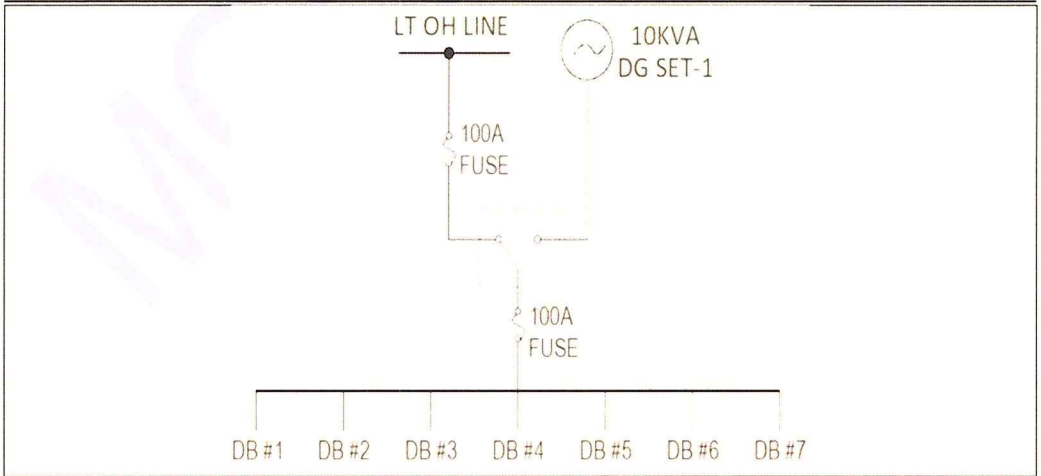


Fig: SLD of power distribution of North West Block

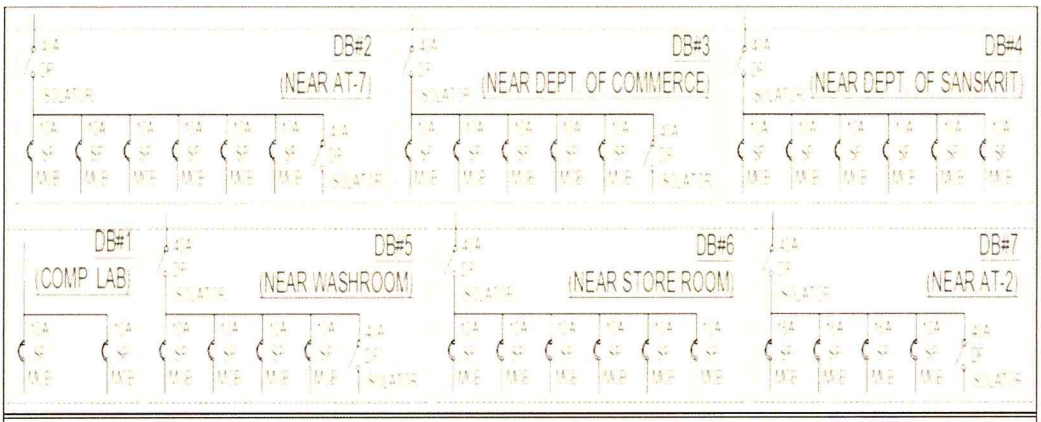


Fig: SLD of DBs of North West Block

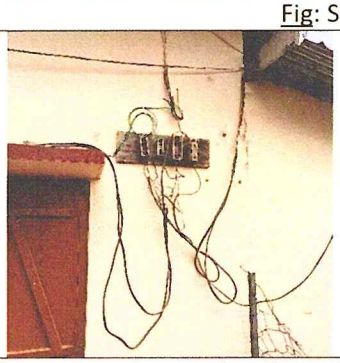


Photo: Tapping #2 taken from LT OH line (backside of Computer Lab)

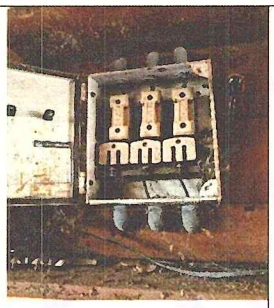


Photo: Main Incomer near Computer lab

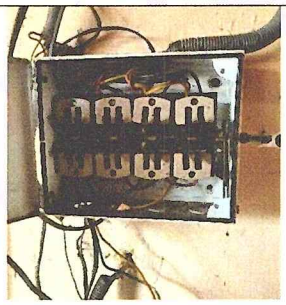


Photo: Grid / DG-1 Changeover

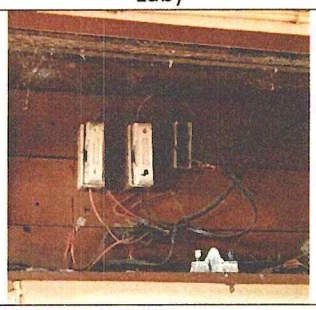


Photo: Fuses at Changeover outgoing

Photo: DB#1 (Computer Lab)

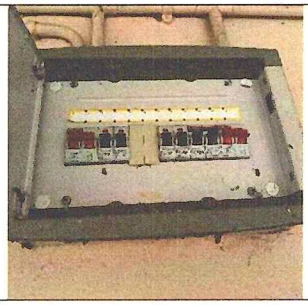


Photo: DB#2 (near AT-7)

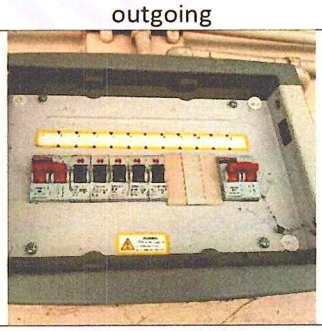


Photo: DB#3 (near Dept. of Commerce)

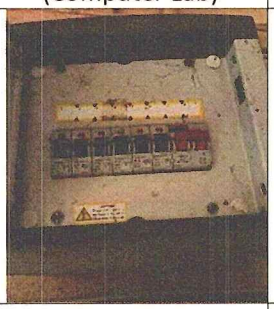


Photo: DB#4 (near Dept. of Sanskrit)

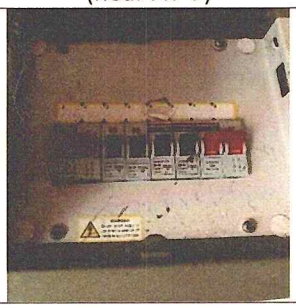


Photo: DB#5 (near Teachers' Washroom)

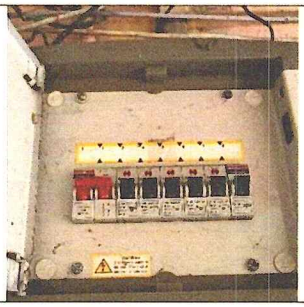
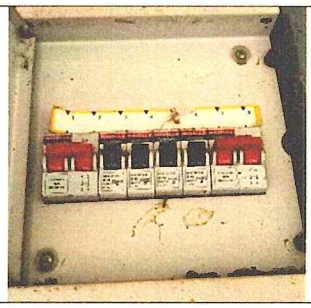
	

Photo: DB#6 (near Store Room)	Photo: DB#7 (near AT-2)

Central Library Block:

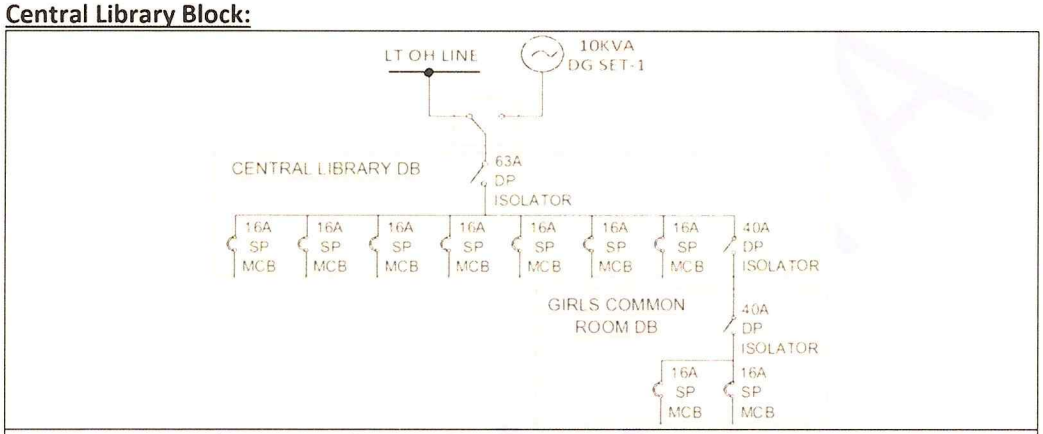
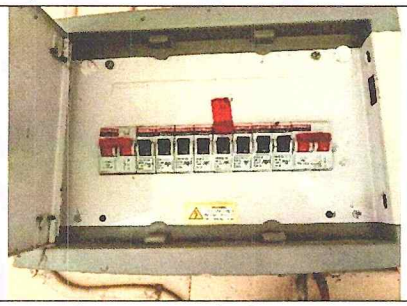


Photo: SLD of power distribution of Central Library Block

		
Photo: Grid / DG-2 Changeover	Photo: Central Library DB	Photo: DB near Girls Common Room

Principal's Office Block:

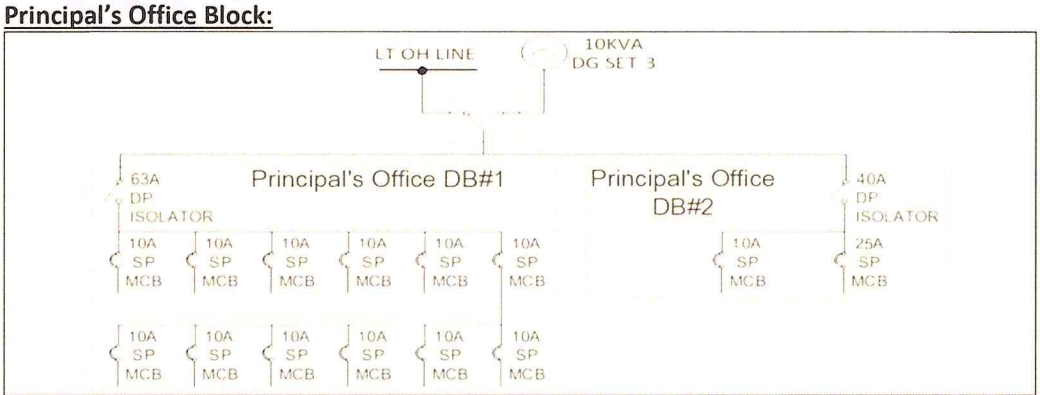


Photo: SLD of power distribution at the Principal's Office

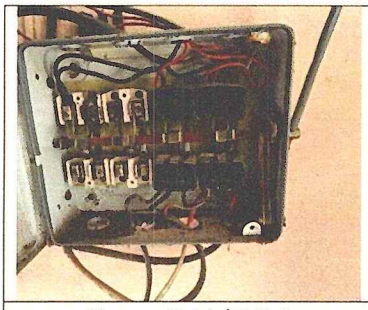
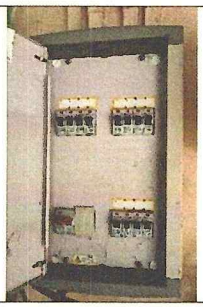
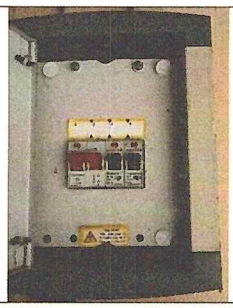
		

Photo: Grid / DG-3 Changeover	Photo: Principal's Office DB#1	Photo: Principal's Office DB#2

Main College Building:

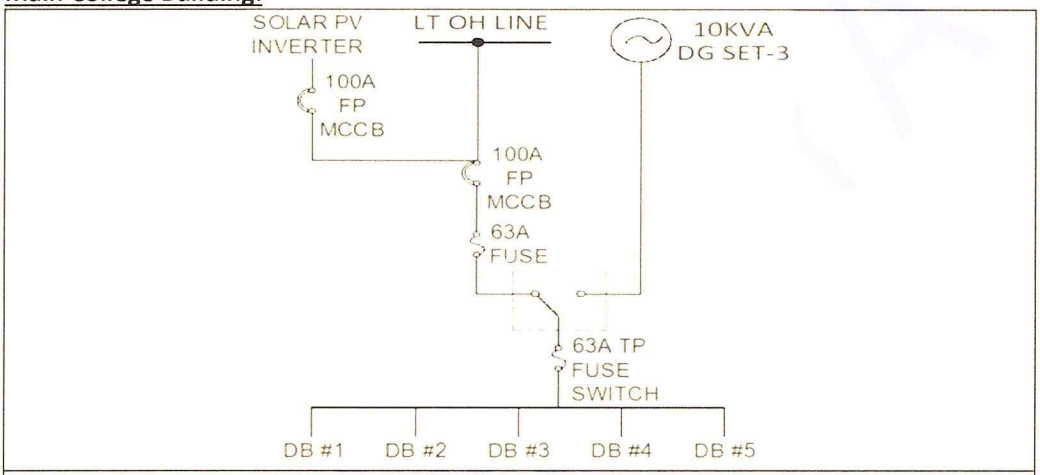


Photo: SLD of power distribution at the Main College Building

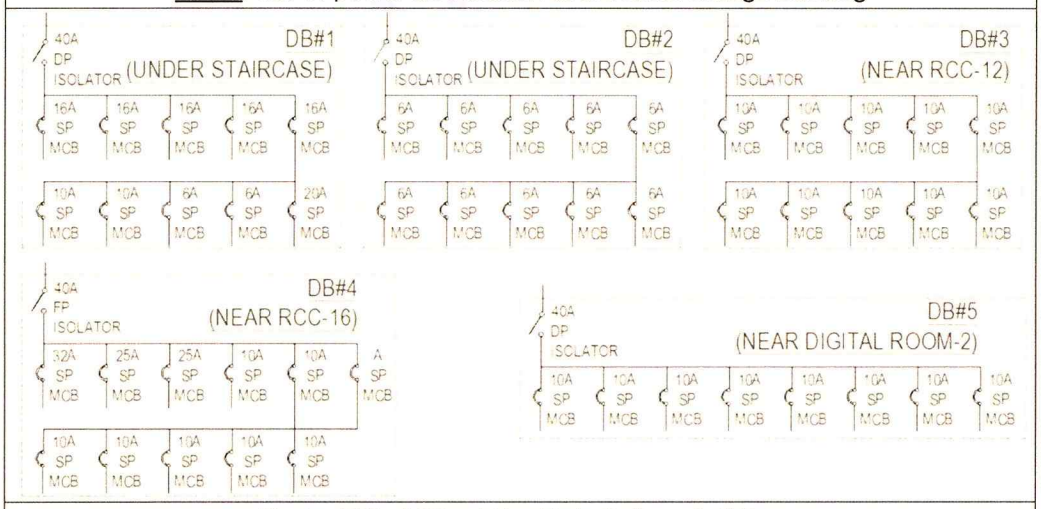


Photo: SLD of DBs at the Main College Building

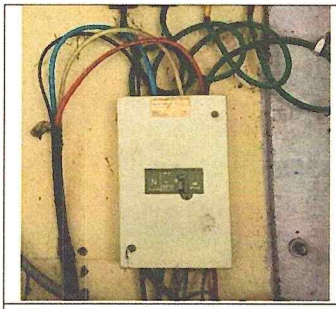
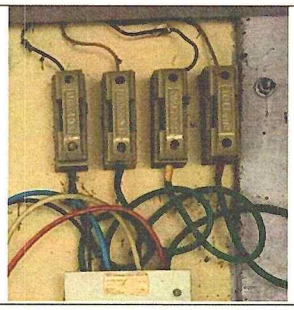
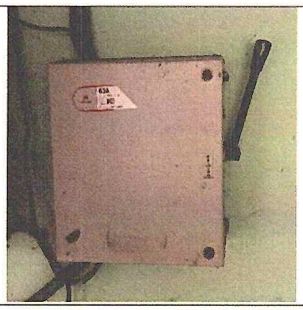
		

Photo: Main Incomer MCCB	Photo: Fuses at Changeover incoming	Photo: Grid / DG-3 Changeover

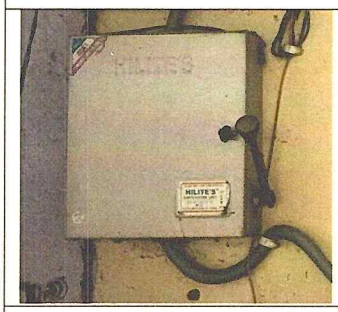
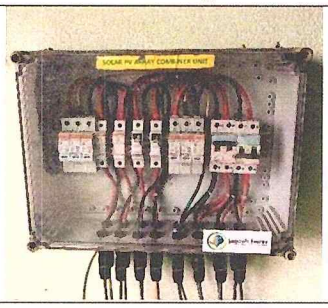
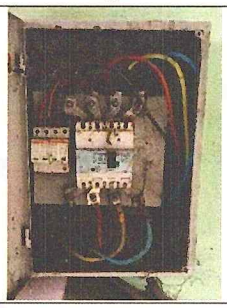

		

Photo: Fuse switch at Changeover outgoing	Photo: Solar Array Combiner Unit	Photo: MCCB at Solar Inverter outgoing

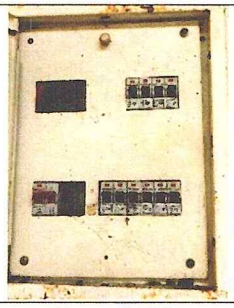
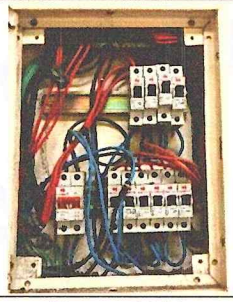
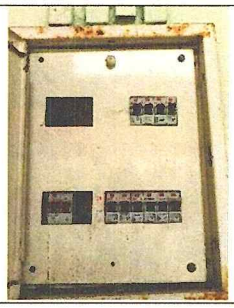

		

Photo: DB#1 (under staircase)	Photo: DB#2 (under staircase)	Photo: DB#3 (near RCC-12)

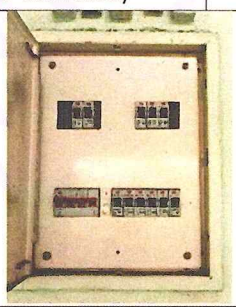
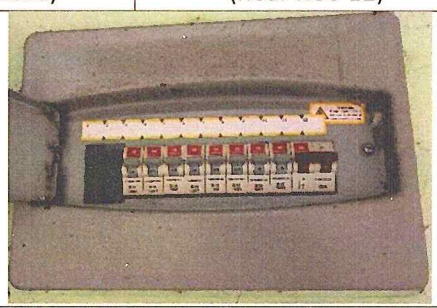

	

Photo: DB#4 (near RCC-16)	Photo: DB#5 (near Digital Room-2)	

Observations:

The protection switchgear arrangement in the power distribution system is not adequate.

There are fuses and fuse switch boxes installed for the protection of some of the circuits in the college campus. These fuses are obsolete and need to be replaced with MCBs / MCCBs

of appropriate ratings. MCBs / MCCBs are reusable and offer better over-current protection to the circuits.

It is seen that the Distribution Boards (DBs) installed at the various blocks of the college have isolators as their Main Incomer Switch. These isolators provide no over-current protection for the power circuit. These isolators should be replaced by MCB switches of appropriate ratings.

A combination of MCB and Earth leakage protection switchgear (RCCBs/ ELCBs etc.) may be put at the main incomer of these DBs. These RCCBs provide protection against any accidental human contact with the power circuit. These RCCBs should have a current sensitivity rating of 30mA to ensure human safety.

4.4 Measurement and analysis of Power Quality Parameters

Grid supply:

The graph below is a representation of the voltages recorded at the Grid supply:

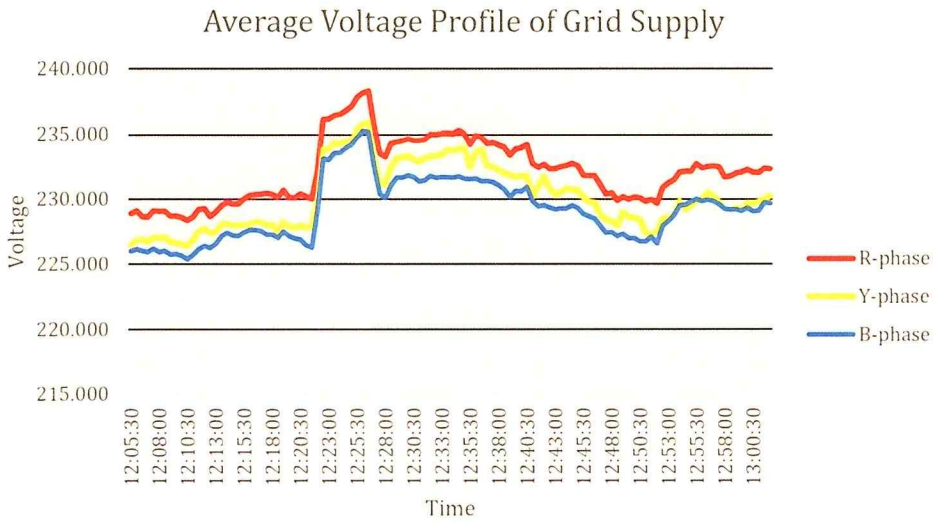


Fig: Average Voltage Profile – Grid supply

The average voltage of the Grid Supply, as can be seen in the graph above, is tabulated below.

	Voltage Outputs			Variations in Voltage Outputs		
	R-N (Volt)	Y-N (Volt)	B-N (Volt)	R-N	Y-N	B-N
Max=	238.300	235.880	235.230	3.61%	2.56%	2.27%
Average=	232.158	230.133	229.176	0.94%	0.06%	0.36%
Min=	228.360	226.390	225.360	0.71%	1.57%	2.02%

The average voltage of the Grid Supply as can be seen in the graph above is 230.49V (L-N). The voltage variation was found to be within 225.36 to 238.3 V.

Analysis of power quality parameters in respect of limit:

Table: Industrial Limits for Power Quality

Sr. No	Description	Limits	Reference Standard
1.	RMS voltage	± 6%	I.E Rules
2.	Frequency	± 3%	I.E. Rules
3.	Voltage harmonics, THD V	3%	IEEE standard 519
4.	Current harmonics, THD I	15%	IEEE standard 519
5.	Neutral to ground Voltage	3 Volts	Industry practice
6.	Earth resistance	1 Ohm	Industry practice

Parameters		Value	Variation (%)	Limit	Remarks
Voltage	R-Phase to N	232.158	0.94%	**6%**	OK
	Y-Phase to N	230.133	0.06%		OK
	B-Phase to N	229.176	0.36%		OK
Frequency		49.996	0.008%	**3%**	OK
THD-V	R-Phase to N	1.99%		**3%**	OK
	Y-Phase to N	2.11%			OK
	B-Phase to N	2.23%			OK
THD-I	R-Phase to N	37.24%		**15%**	**High**
	Y-Phase to N	25.29%			**High**
	B-Phase to N	32.30%			**High**
Neutral to Ground Voltage		1 V		**3V**	OK

Table: Analysis of parameters in respect of limit

Observations:

- The transformer's voltage output was found to be within limit.
- The supply frequency and its variation was noted to be within limit.
- The Voltage THD levels were found to be within limit.
- **The Current THD levels of the Grid supply were found to be very high.**
- The neutral to ground voltage was found to be OK.

4.5 Study/findings on Earthing System

DG sets' earthing:

1. DG set-1:

   The earth-pits for the DG set-1's body and neutral earthing are untraceable as they have been buried under concrete cover.

2. DG set-3:
   - The DG set-3 has one earth-pit each for its Body and Neutral earthing. The earthing connections for both the DG's Body and Neutral are provided through 8 SWG GI wires which are connected to 40mm dia. GI earth-pipes.
   - These earth-pits do not have any protection chamber, hinged cover or watering funnel.
   - The earth-pipe for the DG-3's Neutral earthing is broken and damaged. It needs to be replaced at the earliest.

		
Photo: DG-3's Body and Neutral earthing connections	Photo: Earth-pit for DG-3's Body earthing.	Photo: Earth-pit for DG-3's Neutral earthing.

3. DG set-4:
   - The DG set-4 has one earth-pit for its Neutral earthing. The DG's neutral is connected through 8 SWG GI wires to a 40mm dia. GI earth-pipe.
   - This earth-pit does not have any protection chamber, hinged cover or watering funnel.
   - The earth-pit(s) for DG set-4 (if any) could not be traced out during the audit.

Photo: Earth-pit for DG-3's Neutral earthing.

Earthing for Distribution Boards and Changeover boxes:

There is no earthing connection provided for any of the DBs and Changeover boxes installed in the college campus.

Earthing for switchboards:

There are two earth-pits constructed for the earthing of the switchboard circuits:

1. Earth-pit near the Health Centre:
   - Earthing connection to the switchboards at the North West Block of the college campus is provided through 1.5 sq.mm. copper wires. These copper wires are connected to a 25x3 mm GI earthing strip. This earthing strip is drawn out to an earth-pit constructed near the Health Centre room. This earth-pit has been buried under concrete cover and could not be traced out.

   - Earth resistance was measured at the GI earthing strip connected to this earth-pit. The earth resistance value was found to be extremely high (>100 Ohms).

2. Earth-pit near the Principal's Office:
   - Earthing connection to the switchboards at the Principal's Office block, Central Library block and Main College Building is provided through 1.5 sq.mm. copper wires. These copper wires are connected to a 40mm dia. GI earth-pipe buried near the Principal's office.

   - This earth-pit does not have any protection chamber, hinged cover or watering funnel.

   - The earth resistance value measured at this earth-pit was found to be extremely high (>100 Ohms).

Photos: Earth-pit constructed near the Principal's office

Recommendations:

A complete revamping of the earth arrangement is necessary.

Earthing connections should be provided for each of the DBs and Changeover Boxes of the college campus.

New earth-pits should be constructed for providing earthing to the switchboard circuits. These earth-pits should be placed at easily accessible locations.

The four DG sets should each be provided with two earth-pits each for their Body and Neutral earthing, as per prevalent industry standards.

The earthing conductors should be neatly drawn to the earth-pit and securely fastened to the earth-pipe.

Concrete earth-pit protection chambers having a hinged CI cover should be constructed for each of the new earth-pits.

The earth-pits should be regularly watered to keep the earth resistance values at a minimum. A funnel should be installed for pouring water into these earth-pits.

CONCLUSION

Through this electrical energy & safety audit it has been found that there is scope for improving the safety and economy of the electrical power utilization at the college campus:

- There is scope for reduction in the monthly electricity bills by adjusting the contracted demand in accordance with the actual requirement.
- Some major safety weakness/discrepancies were observed in the power distribution arrangement and earthing arrangement which need immediate rectification.

A summary of observations and recommendations is enlisted here at the "Executive Summary" section of this report. Suggestions for the needful rectification/ improvement works were stressed upon all concerned for optimizing safety and economy of the power distribution system.

The power distribution system of the Kharupetia College campus will be considered completely safe for its continued operation after completion of rectification of each of the observed discrepancies.

--END OF REPORT--

ANNEXURES

Annexure-1: Voltage variation log of Grid supply

Date	Time	R-phase Voltage, V	Y-phase Voltage, V	B-phase Voltage, V
21.03.2023	12:05:30	228.900	226.470	225.990
21.03.2023	12:06:00	229.110	226.820	226.130
21.03.2023	12:06:30	228.660	226.900	226.000
21.03.2023	12:07:00	228.620	226.730	225.920
21.03.2023	12:07:30	229.100	227.010	226.180
21.03.2023	12:08:00	229.070	227.030	225.920
21.03.2023	12:08:30	229.080	227.040	226.000
21.03.2023	12:09:00	228.710	226.710	225.730
21.03.2023	12:09:30	228.700	226.600	225.780
21.03.2023	12:10:00	228.600	226.530	225.650
21.03.2023	12:10:30	228.360	226.390	225.360
21.03.2023	12:11:00	228.630	226.820	225.710
21.03.2023	12:11:30	229.210	227.510	226.130
21.03.2023	12:12:00	229.270	227.710	226.390
21.03.2023	12:12:30	228.660	227.410	226.230
21.03.2023	12:13:00	229.010	227.430	226.540
21.03.2023	12:13:30	229.480	228.040	227.140
21.03.2023	12:14:00	229.790	228.130	227.400
21.03.2023	12:14:30	229.630	227.970	227.200
21.03.2023	12:15:00	229.630	227.980	227.150
21.03.2023	12:15:30	230.030	228.040	227.420
21.03.2023	12:16:00	230.290	228.020	227.630
21.03.2023	12:16:30	230.370	228.260	227.630
21.03.2023	12:17:00	230.390	228.220	227.530
21.03.2023	12:17:30	230.460	227.990	227.260
21.03.2023	12:18:00	230.350	228.050	227.250
21.03.2023	12:18:30	230.140	227.490	227.030
21.03.2023	12:19:00	230.690	228.260	227.500
21.03.2023	12:19:30	230.120	227.880	227.160
21.03.2023	12:20:00	230.100	227.810	226.960
21.03.2023	12:20:30	230.400	227.930	226.870
21.03.2023	12:21:00	230.220	227.820	226.420
21.03.2023	12:21:30	230.020	227.870	226.270
21.03.2023	12:22:00	232.070	230.040	229.050
21.03.2023	12:22:30	236.100	233.860	233.100
21.03.2023	12:23:00	236.140	233.800	233.040
21.03.2023	12:23:30	236.410	234.310	233.540
21.03.2023	12:24:00	236.490	234.200	233.570
21.03.2023	12:24:30	236.770	234.450	233.920
21.03.2023	12:25:00	237.120	234.450	234.180
21.03.2023	12:25:30	237.820	235.320	234.780
21.03.2023	12:26:00	238.150	235.690	235.230
21.03.2023	12:26:30	238.300	235.880	235.170
21.03.2023	12:27:00	235.650	233.250	232.550
21.03.2023	12:27:30	233.520	231.280	230.410
	Max=	**238.300**	**235.880**	**235.230**
	Average=	**232.158**	**230.133**	**229.176**
	Min=	**228.360**	**226.390**	**225.360**

Annexure-1: Voltage variation log of Grid supply

Date	Time	R-phase Voltage, V	Y-phase Voltage, V	B-phase Voltage, V
21.03.2023	12:05:30	228.900	226.470	225.990
21.03.2023	12:06:00	229.110	226.820	226.130
21.03.2023	12:06:30	228.660	226.900	226.000
21.03.2023	12:07:00	228.620	226.730	225.920
21.03.2023	12:07:30	229.100	227.010	226.180
21.03.2023	12:08:00	229.070	227.030	225.920
21.03.2023	12:08:30	229.080	227.040	226.000
21.03.2023	12:09:00	228.710	226.710	225.730
21.03.2023	12:09:30	228.700	226.600	225.780
21.03.2023	12:10:00	228.600	226.530	225.650
21.03.2023	12:10:30	228.360	226.390	225.360
21.03.2023	12:11:00	228.630	226.820	225.710
21.03.2023	12:11:30	229.210	227.510	226.130
21.03.2023	12:12:00	229.270	227.710	226.390
21.03.2023	12:12:30	228.660	227.410	226.230
21.03.2023	12:13:00	229.010	227.430	226.540
21.03.2023	12:13:30	229.480	228.040	227.140
21.03.2023	12:14:00	229.790	228.130	227.400
21.03.2023	12:14:30	229.630	227.970	227.200
21.03.2023	12:15:00	229.630	227.980	227.150
21.03.2023	12:15:30	230.030	228.040	227.420
21.03.2023	12:16:00	230.290	228.020	227.630
21.03.2023	12:16:30	230.370	228.260	227.630
21.03.2023	12:17:00	230.390	228.220	227.530
21.03.2023	12:17:30	230.460	227.990	227.260
21.03.2023	12:18:00	230.350	228.050	227.250
21.03.2023	12:18:30	230.140	227.490	227.030
21.03.2023	12:19:00	230.690	228.260	227.500
21.03.2023	12:19:30	230.120	227.880	227.160
21.03.2023	12:20:00	230.100	227.810	226.960
21.03.2023	12:20:30	230.400	227.930	226.870
21.03.2023	12:21:00	230.220	227.820	226.420
21.03.2023	12:21:30	230.020	227.870	226.270
21.03.2023	12:22:00	232.070	230.040	229.050
21.03.2023	12:22:30	236.100	233.860	233.100
21.03.2023	12:23:00	236.140	233.800	233.040
21.03.2023	12:23:30	236.410	234.310	233.540
21.03.2023	12:24:00	236.490	234.200	233.570
21.03.2023	12:24:30	236.770	234.450	233.920
21.03.2023	12:25:00	237.120	234.450	234.180
21.03.2023	12:25:30	237.820	235.320	234.780
21.03.2023	12:26:00	238.150	235.690	235.230
21.03.2023	12:26:30	238.300	235.880	235.170
21.03.2023	12:27:00	235.650	233.250	232.550
21.03.2023	12:27:30	233.520	231.280	230.410
	Max=	**238.300**	**235.880**	**235.230**
	Average=	**232.158**	**230.133**	**229.176**
	Min=	**228.360**	**226.390**	**225.360**

Annexure-2: Power-log of the Transformer

Date	Time	KW	KVAR	KVA
21.03.2023	12:05:30	7.070	1.920	7.330
21.03.2023	12:06:00	7.000	1.920	7.260
21.03.2023	12:06:30	7.120	1.930	7.380
21.03.2023	12:07:00	6.980	1.920	7.240
21.03.2023	12:07:30	6.930	1.910	7.190
21.03.2023	12:08:00	6.830	1.930	7.090
21.03.2023	12:08:30	6.780	1.940	7.050
21.03.2023	12:09:00	6.730	1.940	7.000
21.03.2023	12:09:30	6.700	1.950	6.970
21.03.2023	12:10:00	6.680	1.940	6.950
21.03.2023	12:10:30	6.670	1.930	6.940
21.03.2023	12:11:00	6.710	1.950	6.980
21.03.2023	12:11:30	6.730	1.950	7.010
21.03.2023	12:12:00	6.770	1.970	7.050
21.03.2023	12:12:30	7.120	1.970	7.390
21.03.2023	12:13:00	6.880	1.980	7.160
21.03.2023	12:13:30	6.830	1.990	7.110
21.03.2023	12:14:00	6.780	1.980	7.070
21.03.2023	12:14:30	6.760	1.970	7.040
21.03.2023	12:15:00	6.770	1.970	7.050
21.03.2023	12:15:30	6.820	1.970	7.100
21.03.2023	12:16:00	7.000	2.010	7.280
21.03.2023	12:16:30	6.920	2.010	7.200
21.03.2023	12:17:00	6.820	2.020	7.110
21.03.2023	12:17:30	6.560	2.050	6.880
21.03.2023	12:18:00	6.480	2.070	6.800
21.03.2023	12:18:30	6.660	2.090	6.980
21.03.2023	12:19:00	6.370	2.090	6.710
21.03.2023	12:19:30	6.320	2.070	6.650
21.03.2023	12:20:00	6.270	2.070	6.600
21.03.2023	12:20:30	7.070	1.920	7.330
21.03.2023	12:21:00	7.000	1.920	7.260
21.03.2023	12:21:30	7.120	1.930	7.380
21.03.2023	12:22:00	6.980	1.920	7.240
21.03.2023	12:22:30	6.930	1.910	7.190
21.03.2023	12:23:00	6.830	1.930	7.090
21.03.2023	12:23:30	6.780	1.940	7.050
21.03.2023	12:24:00	6.730	1.940	7.000
21.03.2023	12:24:30	6.700	1.950	6.970
21.03.2023	12:25:00	6.680	1.940	6.950
21.03.2023	12:25:30	6.670	1.930	6.940
21.03.2023	12:26:00	6.710	1.950	6.980
21.03.2023	12:26:30	6.730	1.950	7.010
21.03.2023	12:27:00	6.770	1.970	7.050
21.03.2023	12:27:30	7.120	1.970	7.390
	Max=	**7.950**	**3.900**	**8.350**
	Average=	**5.457**	**2.258**	**6.070**
	Min=	**0.210**	**1.570**	**3.330**

Annexure-3: THD-log of the Grid Supply

Date	Time	THD-V (%)			THD-I (%)		
		R-phase	Y-phase	B-phase	R-phase	Y-phase	B-phase
21.03.2023	12:05:30	1.980	2.070	2.220	27.140	19.190	21.570
21.03.2023	12:06:00	1.970	2.090	2.220	27.590	19.300	21.500
21.03.2023	12:06:30	2.020	2.090	2.240	23.380	19.420	21.990
21.03.2023	12:07:00	2.010	2.090	2.210	26.290	19.570	22.140
21.03.2023	12:07:30	2.000	2.090	2.210	25.550	19.900	22.070
21.03.2023	12:08:00	2.030	2.120	2.240	28.230	19.940	22.790
21.03.2023	12:08:30	2.020	2.110	2.250	28.860	20.140	22.980
21.03.2023	12:09:00	2.030	2.120	2.260	29.580	20.230	23.060
21.03.2023	12:09:30	2.030	2.110	2.250	30.310	20.380	23.200
21.03.2023	12:10:00	2.020	2.100	2.250	30.430	20.300	23.340
21.03.2023	12:10:30	2.000	2.100	2.250	30.410	20.240	23.390
21.03.2023	12:11:00	2.010	2.120	2.290	30.290	20.240	23.520
21.03.2023	12:11:30	2.020	2.130	2.280	29.870	20.190	23.350
21.03.2023	12:12:00	2.050	2.150	2.300	29.510	20.080	23.510
21.03.2023	12:12:30	2.050	2.150	2.270	21.210	20.030	23.370
21.03.2023	12:13:00	2.060	2.150	2.270	25.760	20.030	23.130
21.03.2023	12:13:30	2.070	2.150	2.270	27.860	20.050	23.340
21.03.2023	12:14:00	2.070	2.150	2.270	29.220	20.060	23.320
21.03.2023	12:14:30	2.070	2.140	2.260	29.130	19.920	23.170
21.03.2023	12:15:00	2.060	2.140	2.270	29.370	19.970	23.000
21.03.2023	12:15:30	2.040	2.120	2.230	29.830	20.030	22.570
21.03.2023	12:16:00	2.050	2.150	2.240	31.130	18.660	23.060
21.03.2023	12:16:30	2.070	2.150	2.250	31.670	19.080	23.050
21.03.2023	12:17:00	2.070	2.170	2.260	32.080	19.640	23.030
21.03.2023	12:17:30	2.060	2.150	2.240	43.030	19.990	23.040
21.03.2023	12:18:00	2.090	2.170	2.270	44.670	20.870	23.310
21.03.2023	12:18:30	2.080	2.160	2.250	46.100	19.210	23.460
21.03.2023	12:19:00	2.090	2.160	2.270	46.830	21.020	23.760
21.03.2023	12:19:30	2.090	2.150	2.280	47.930	21.100	23.810
21.03.2023	12:20:00	2.090	2.170	2.280	49.120	21.140	23.930
21.03.2023	12:20:30	2.100	2.200	2.270	50.960	21.120	17.830
21.03.2023	12:21:00	2.060	2.180	2.260	53.470	21.500	16.470
21.03.2023	12:21:30	2.050	2.160	2.250	55.460	21.750	16.580
21.03.2023	12:22:00	2.060	2.160	2.260	56.760	21.770	23.010
21.03.2023	12:22:30	2.030	2.150	2.220	57.020	22.100	24.930
21.03.2023	12:23:00	2.000	2.130	2.200	59.370	22.210	25.100
21.03.2023	12:23:30	2.000	2.150	2.210	61.730	22.290	25.340
21.03.2023	12:24:00	2.000	2.130	2.220	65.450	22.580	25.410
21.03.2023	12:24:30	2.020	2.180	2.250	68.000	22.730	25.590
21.03.2023	12:25:00	2.020	2.170	2.230	-----	23.060	25.940
21.03.2023	12:25:30	2.010	2.160	2.210	104.670	23.590	26.030
21.03.2023	12:26:00	2.020	2.190	2.230	-----	23.900	29.000
21.03.2023	12:26:30	2.030	2.180	2.240	-----	24.540	29.510
21.03.2023	12:27:00	2.130	2.250	2.270	-----	25.430	28.330
21.03.2023	12:27:30	2.080	2.230	2.230	-----	26.010	31.340
	Max=	**2.130**	**2.280**	**2.360**	**104.670**	**56.130**	**88.270**
	Average=	**1.999**	**2.114**	**2.229**	**37.903**	**25.560**	**32.790**
	Min=	**1.810**	**1.860**	**2.070**	**17.650**	**15.730**	**16.470**

Phone & Fax : 03713 255583

OFFICE OF THE PRINCIPAL

KHARUPETIA COLLEGE

P.O.: KHARUPETIA, PIN: 784115
DIST.: DARRANG (ASSAM)
Website : www.kharupetiacollege.in
e-mail: kharupetiacollege@gmail.com
Accredited with 'B' Grade by NAAC

Memo No. : KC/2023/ Date: 13/03/2023

From

Dr. Mausumi Saha Kalita, *M.A., Ph.D., LL.B.*
Principal
e-mail: mskalita09@gmail.com

To
Mr. Mrinmoy Boruah
CEO & Chief Energy Auditor
MONADITYA

Date: 13.03.2023

Subject: Carryout of Electrical Energy and Safety Audit of Kharupetia College.

Dear Sir,

With reference to your aforesaid letter on 09.03.2023, I would like to request you, to carry out the electrical energy and safety audit of Kharupetia College as early as possible. Dr. Pranjit Kumar Sarma, Associate Professor, Department of Geography, Bhattadev University, Bajali, Pathsala will be the liaison officer for the aforesaid task. For any further information and support please keep in touch with Dr. Pranjit Kumar Sarma.

Thanking you

13/03/2023
Principal
Kharupetia College
Kharupetia, Assam

Principal
Kharupetia College

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