Electrical Energy & Safety Audit Report

of

Mangaldai College, Mangaldai, Assam

Audit Period: 08/11/2023-22/11/2023

Audited by: MRINMOY BORUAH ENGINEERING
Audit team led by: Mr. Mrinmoy Boruah,
Chief Energy Auditor and Electrical Consultant
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A C K N O W L E D G E M E N T

We sincerely thank Dr. Kamal Kanta Bora, Principal, Mangaldai College, as well as Mr. Santosh Borkakati, Coordinator, IQAC, and Dr. Pranjit Sarma; and the electricians of the college for their facilitation and support in conducting the data collection and measurement for this Electrical Energy & Safety audit conducted on 08 and 09/11/2023.

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

There is scope for optimizing the energy usage by some necessary tweaking of the power distribution system.

Also, 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 Mangaldai College.

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F O R E W O R D

This audit was carried out as per the work order of office of the Principal, Mangaldai College (dated 07/11/2023) for the Electrical Energy & Safety Audit of Mangaldai College, Mangaldai, 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 Mangaldai 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 08 and 09/11/2023.

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 (Mangaldai College) will be considered fully safe after rectification of the discrepancies. Regular maintenance and upkeep are utmost essential for optimal and safe use of electricity.

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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	4+ years
3.	Mr. Madan Prasad	Technical Assistant	10+ years

Instruments for conducting audit: The following **i**nstruments 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.

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EXECUTIVE SUMMARY

1) There is scope for significant reduction in the monthly electricity bills. The Contracted Demand of 141KVA can be lowered to 30KVA (which is closer to the actual Maximum Demand recorded in the monthly electricity bills) by entering into a new power supply agreement with the APDCL. This change will amount to a saving of approx. **Rs. 15,540/- per month,** i.e., **Rs. 1,86,480/- per year.** (Elaborated below in **Section 4.1**)

2) The billing arrangement was found to be ambiguous. The KWH figures shown in the electricity bills do not tally with the actual meter readings. The billing scenario needs to be investigated at the electricity provider's end. (Elaborated below in **Section 4.1**)

3) 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)**)

4) Only one of the two 30KVA DG sets is sufficient to cater to the loads connected to both the DG sets. Some changes in the electric circuitry may be done so that either of the two DGs can be used as the primary backup supply; and the other DG be kept as a standby. Additionally, there is scope for the loads in the Science Block (New) building to be put on the DG supply as well. (Elaborated below in **Section 4.2 (b)**)

5) The existing power distribution arrangement is such that the solar power is being generated only when grid supply is available. From the powerlog data, it is seen that the load demand during DG operation can effectively be met by solar generation. Necessary changes of electric circuitry may be made for the solar power generator to work on DG supply too to effectively lower the loading on the DG set(s). (Elaborated below in **Section 4.2 (c)**)

6) The protection switchgear arrangement in the power distribution system is not adequate. A distribution board (DB) should be installed major load centres in the college campus. The DBs 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**)

7) A complete revamping of the earth 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**)

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Audit observations

of

Electrical installations

and

Power Distribution System

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4.1 Analysis of electricity bill records

Scope for reduction of fixed charge in monthly electricity bills:

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

Month	Billing period		Maximum Demand (KVA)	Contract Demand (KVA)	MD/CD
Jan'21	01-01-2021	31-01-2021	6.960	141.000	5%
Feb'21	01-02-2021	28-02-2021	24.000	141.000	17%
Jun'21	01-06-2021	30-06-2021	5.200	141.000	4%
Jul'21	01-07-2021	31-07-2021	4.000	141.000	3%
Aug'21	01-08-2021	31-08-2021	2.400	141.000	2%
Sep'21	01-09-2021	30-09-2021	2.400	141.000	2%
Oct'21	01-10-2021	31-10-2021	11.600	141.000	8%
Nov'21	01-11-2021	30-11-2021	6.800	141.000	5%
Dec'21	01-12-2021	31-12-2021	4.400	141.000	3%
Feb'22	01-02-2022	28-02-2022	8.400	141.000	6%
Mar'22	01-03-2022	31-03-2022	44.400	141.000	31%
Jul'22	01-07-2022	31-07-2022	20.800	141.000	15%
Aug'22	01-08-2022	31-08-2022	44.400	141.000	31%
Sep'22	01-09-2022	30-09-2022	38.800	141.000	28%
Oct'22	01-10-2022	31-10-2022	20.800	141.000	15%
Nov'22	01-11-2022	30-11-2022	14.400	141.000	10%
Dec'22	01-12-2022	31-12-2022	7.200	141.000	5%
Jan'23	01-01-2023	31-01-2023	10.000	141.000	7%
Feb'23	01-02-2023	28-02-2023	12.000	141.000	9%
Mar'23	01-03-2023	31-03-2023	14.000	141.000	10%
Apr'23	01-04-2023	30-04-2023	15.600	141.000	11%
May'23	01-05-2023	31-05-2023	18.400	141.000	13%
Jun'23	01-06-2023	30-06-2023	29.200	141.000	21%
Jul'23	01-07-2023	31-07-2023	18.000	141.000	13%
Sep'23	01-09-2023	30-09-2023	50.400	141.000	36%
		Average=	**16.007**	**141.000**	**11%**

Table: Electricity bill records of past few years (January 2021 to September 2023)

From the table above, it is seen that the average maximum demand (MD) in a month is about 16KVA only. The maximum MD was found to be only 50.4KVA in the month of September 2023. The MD is significantly lower than the contracted demand of 141KVA.

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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 30KVA 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 141KVA to 30KVA, the saving on the monthly electricity bills will be approximately 111 x 140 = **Rs. 15,540/-.** The yearly savings will amount to approximately **Rs. 1,86,480/-.**

Note: A penalty will be levied on the months where the Maximum Demand exceeds this lowered Contracted Demand of 30KVA at three times the normal fixed charge rate (i.e. @ Rs. 420/- per KVA). For example, the maximum MD recorded in the past 2.5 years was in the month of September 2023 (50.4KVA). The MD of 50.4KVA would have exceeded this new CD of 30KVA by (50.4 - 30=) 20.4KVA. Hence the penalty levied on this bill will be (20.4 x 420=) **Rs. 8,568/-.** in the bill records of the past 2.5 years, the MD was seen to have been higher than 30KVA in only 3-4 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 141 to 30KVA.

Ambiguous billing arrangement:

There are 2 energy meters installed- one at the substation for total metering (with CT ratio of 200/5A), and the other for recording the solar generation (with CT ratio 50/5).

As per the billing arrangement, the billing is done on the Net metering – solar rebate on solar generation or total metering (whichever is less). However the energy meter at the substation is not a Net or EXIM meter.

The total metering is done on the KWH difference recording x MF of 40. For solar generation component, the actual figures on the bills should have been the actual difference reading on the solar generation meter x MF of 10 (50/5A ratio).

However this component shown in the billing is much lower than the actual meter readings. In the bill some different figures are shown for this component (which are multiplied with MF 40). These figures do not tally with the solar generation meter's actual reading x MF of 10.

The billing scenario needs to be investigated at the electricity provider's end.

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4.2 Sources of power supply

a) Primary source of power supply:

The primary source of power supply for the Mangaldai College campus is from a 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.

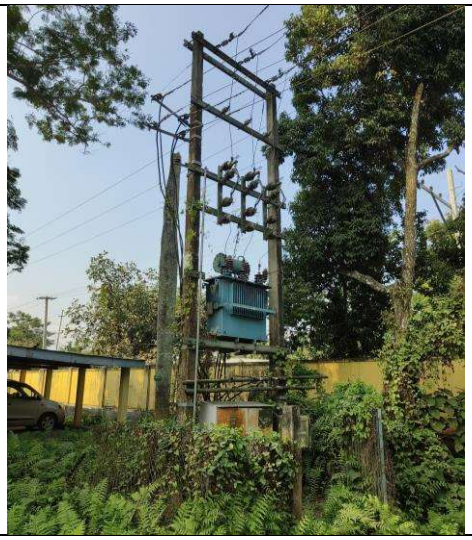

Photo: 11/0.433KV pole-mounted transformer for power supply to the college campus

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 barrel.	

Sl. No.	Observation	Photo
3.	Line type lighting arresters are mounted on the Transformer's body. The transformer is vulnerable to falling of lightning strikes.	
5.	The transformer's LT output cables are shorted with the outgoing cables using wires. Thus, there is no proper protection for the Transformer's LT output. The power receiver panel (PRP) installed at the substation area is kept disconnected. The PRP has two nos. of 200A FP MCCBs and a 63A DP MCCB. One of the 200A MCCBs is defective. The other 200A MCCB is only missing its metal link rod for manual operation. Otherwise, this MCCB switch seems to be in working condition. This switch should be used for protection of the transformer's LT output.	

Loading:

From the powerlog taken during active hours, the total load demand was found to be varying between **18** to **33KW**. The variation is found to be due to the solar source. With the solar generator (15KW) on, the load on transformer comes down from 33KW to 18KW.

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

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

(i) DG-1: for backup power supply to the Science Block (Old), Zoology and Botany Dept. (Old), and Botany Dept. (New)

(ii) DG-2: for backup power supply to the Admin building, Science Gallery, Biotech Hub and Central Library.

(iii) There is a third DG set placed in the DG area which is kept uninstalled.

i. DG set-1 :

The DG set-1 is kept idle and rarely used. Its battery has become dead. To evaluate the functioning of the DG set, the DG-2's battery was temporarily used to start the DG-1.

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The ratings of this DG set is given below:

DG set's Capacity: **30 KVA**
Output: 415V (L-L), 3-phase, 50 Hz
Make: Kirloskar Oil Engines Ltd.
Model: KG30WS5

	
Photo: DG set-1	Photo: Nameplate of the DG set-1

ii. DG set-2 :

The ratings of this DG set is given below:

DG set's Capacity: **30 KVA**
Output: 415V (L-L), 3-phase, 50 Hz
Make: Kirloskar Oil Engines Ltd.
Model: KG30WS5

	
Photo: DG set-2	Photo: Nameplate of the DG set-2

Loading:

From the powerlog data, the max. load on the 30KVA DG-1 was found to be only **7.5KW**, and the max. load on DG-2 was found to be only **4.5KW**. Thus only one of these two 30KVA DGs is more than sufficient to cater to the loads connected to both the DG sets.

Some changes in the electric circuitry may be done so that either of the two DGs can be used as the primary backup supply; and the other DG be kept as a standby.

Additionally, there is scope for the loads in the Science Block (New) building (Maths, Statistics and Chemistry depts.) to be put on the DG supply as well.

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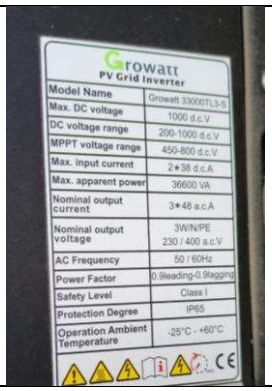
c) <u>Alternate source of power supply (On-grid solar power):</u>

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 a bus bar installed at the backside of the Admin building.

The ratings of the solar inverter is given below:

Make: Growatt
Model: 33000TL3-S
Input DC Voltage range: 200-1000V
Max. Apparent Power: 36.6KVA
Nominal Output AC Voltage: 230V (P-N)

		
<u>Photo</u>: Solar PV Grid Inverter	<u>Photo</u>: Nameplate of the solar inverter	<u>Photo</u>: Energy meter for export of solar power to grid.

<u>Observation:</u>

The existing power distribution arrangement is such that the solar power is being generated only when grid supply is available. No solar generation takes place during DG operation.

From the powerlog data, it is seen that the solar power generator is generating about **15KW** on a typical sunny day. The total load demand on the two DG sets was found to be around (7.5+4.5=) **12KW** only. Therefore, the load demand during DG operation can effectively be met by solar generation.

Necessary changes of electric circuitry may be made for the solar power generator to work on DG supply too to effectively lower the loading on the DG set(s).

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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.

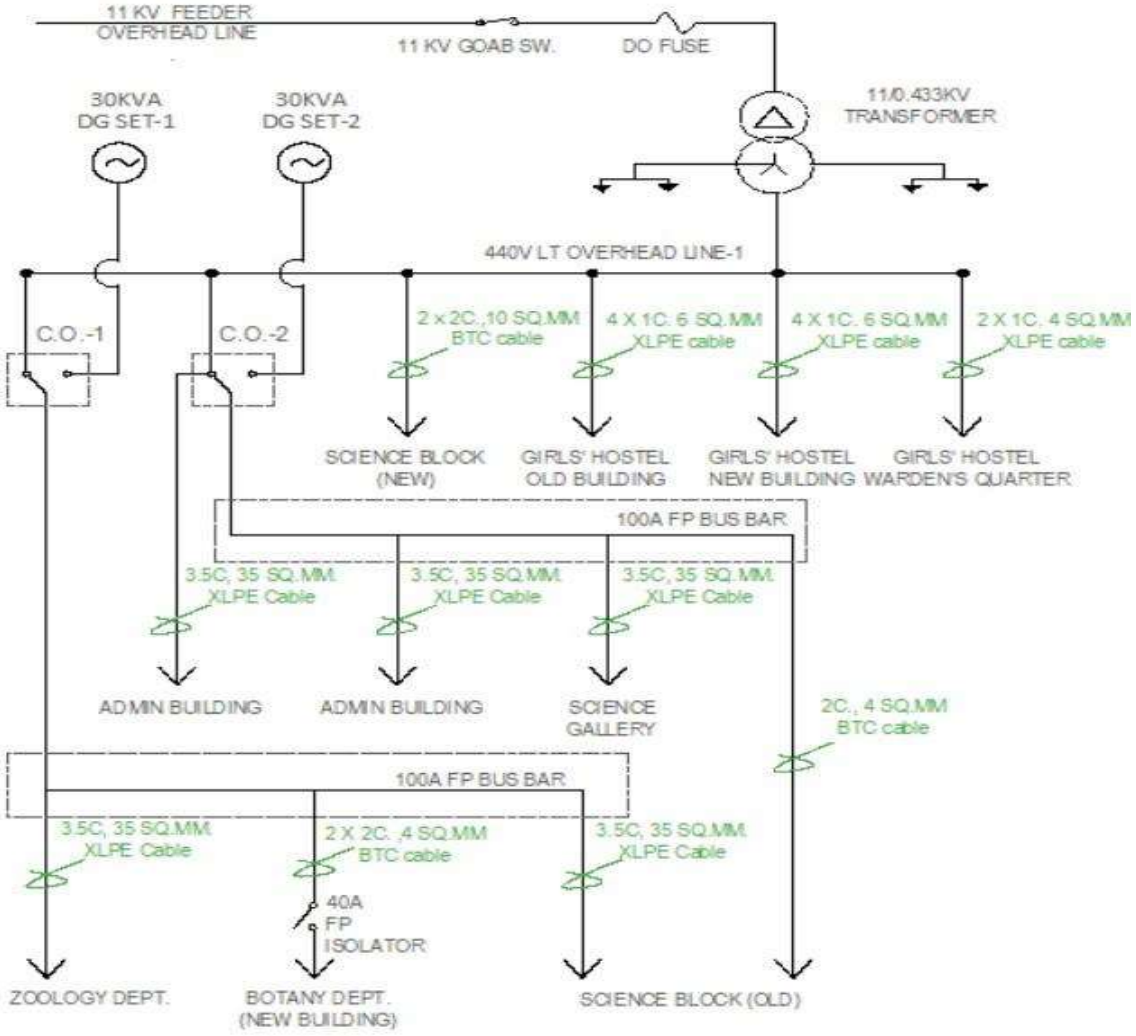

Fig: SLD of main power distribution circuit

Photo: Grid / DG-1 Changeover (C.O.-1)

Photo: Grid / DG-2 Changeover (C.O.-2)

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Science block (old):

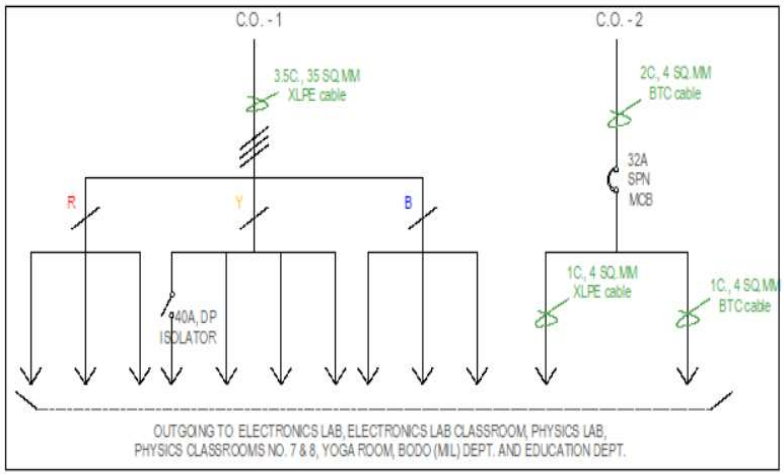

Photo: Main power distribution of the Science Block (old)

Photo: DB at Physics Lab

Photo: DB for Room 7 and 8

Photo: DB at Electronics Lab Classroom

Photo: DB at Electronics Lab

Photo: DB near Yoga Room

Zoology Dept.:

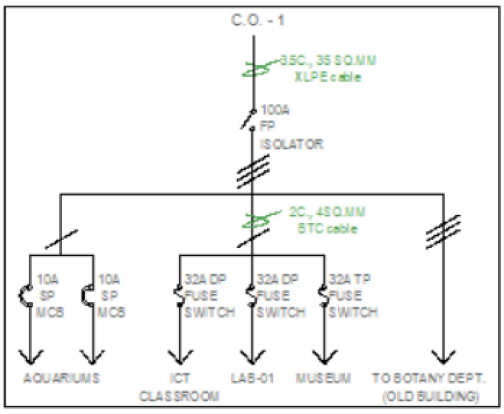

Fig: Main power distribution of the Zoology Dept.

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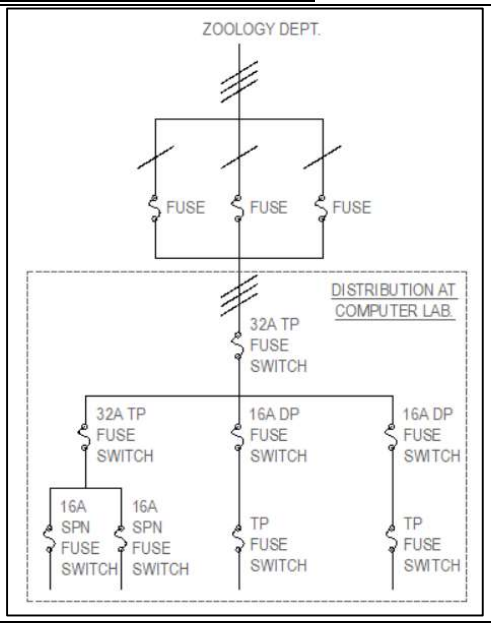
Photo: Main switch of Zoology Lab-1	Photo: Main switch of Zoology ICT Classroom	Photo: Main switch of Zoology Museum

Botany Dept. (old building):



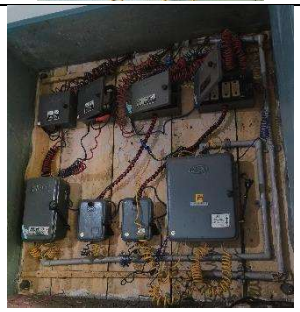


Photo: Main power distribution at the Botany Dept. (old building)

Botany Dept. (New building):

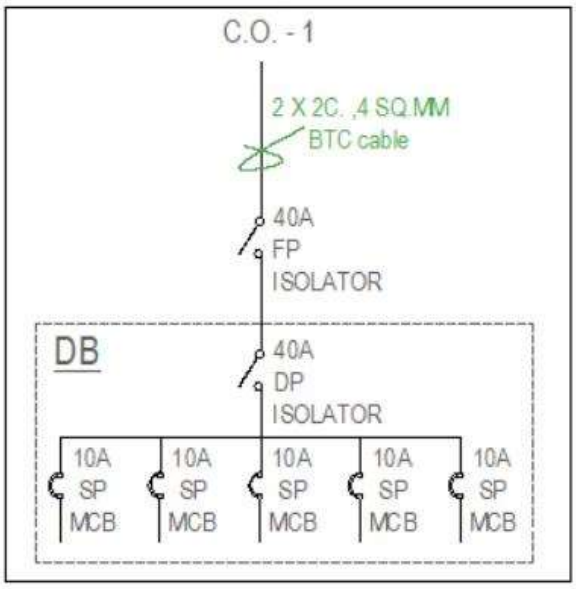
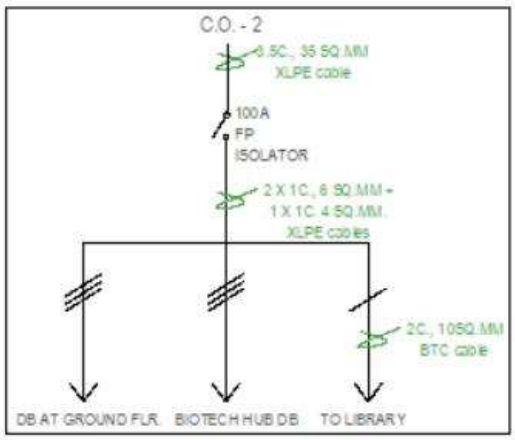


Photo: Main power distribution at the Botany Dept. (New building)

Science Gallery and Biotech Hub:



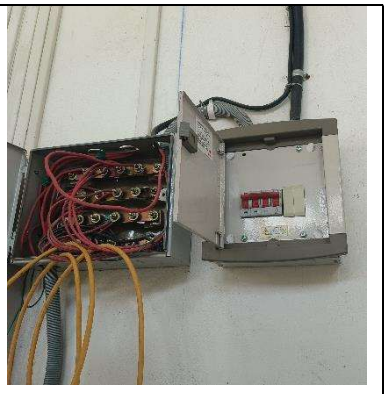


Photo: Main power distribution at Science Gallery

Photo: DB at Science Gallery (GF)

Photo: DB at Biotech Hub (1F)

Photo: DB at IBT Hub Smart Classroom (2F)

Central Library:

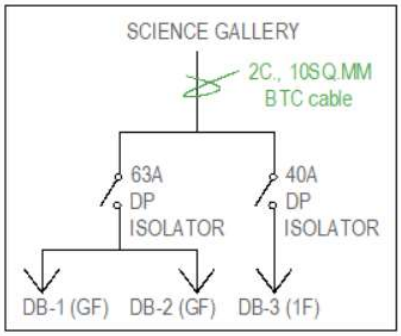


Photo: Main distribution at Central Library

Photo: Library DB-1 (GF)

Photo: Library DB-2 (GF)

Photo: Library DB-3 (1F)

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Administration Building :

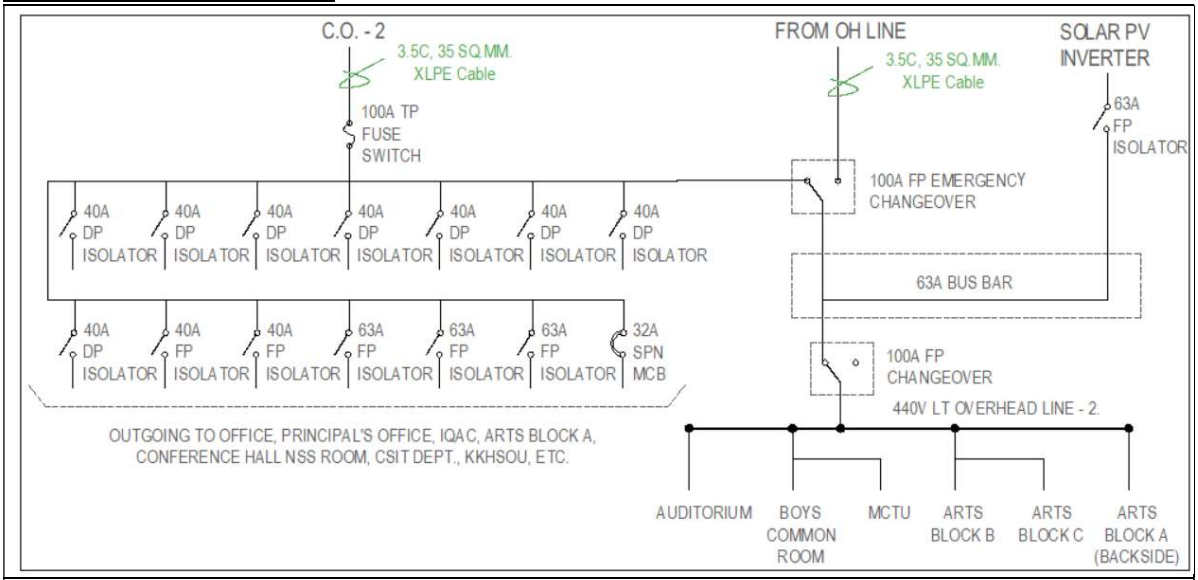

Fig: SLD of Main power distribution at the Admin building

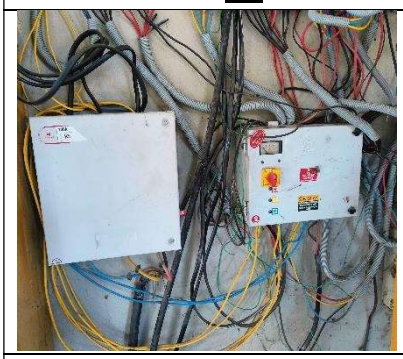

Photo: Incomer from C.O.-2

Photo: Incomer from C.O.-2 input side (direct Grid connection)

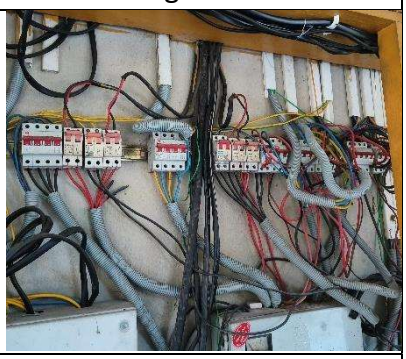

Photo: Outgoing to various DBs at the Admin building and Arts Block A.

Photo: Output switch of the Solar Inverter

Photo: Incomer from the Solar Inverter

Photo: IQAC DB (Admin Bldg. GF)

Photo: IQAC AC DB (Admin Bldg. GF)

Photos: Office DBs 1 & 2 (Admin Bldg. GF)

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Photo: DB at Principal's Office (Admin Bldg. GF)	Photo: Conference hall DB (Admin Bldg. 1F)	Photo: NSS Room DB (Admin Bldg. 1F)	Photo: DB for Room 1 & 2 of CSIT Dept. (Admin Bldg. 2F)
			
Photo: CSIT Lab-1 DB (Admin Bldg. 1F)	Photo: CSIT Lab-2 DB-1 (Admin Bldg. 1F)	Photo: CSIT Lab-2 DB-2 (Admin Bldg. 1F)	

Arts Block A (front side):

			
Photo: DB-1 Near Room 52 (Arts Block A GF)	Photo: DB-2 Pol. Sc. Dept. (Arts Block A GF)	Photo: DB-3 Pol. Sc. Dept. (Arts Block A 1F)	Photo: DB-4 Philosophy Dept. (Arts Block A 1F)
			
Photo: DB-5 KKHSOU (Arts Block A 2F)	Photo: DB-6 Geography Dept. (Arts Block A 2F)	Photo: DB-7 Sanskrit Dept. (Arts Block A 2F)	Photo: DB-8 History Dept. (Arts Block A 2F)

Arts Block A (back side):

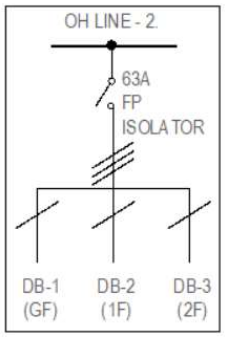

Photo: SLD of Power Distribution of Arts Block A (Backside)

Photo: Main Incomer of Arts Block A (Backside)

Photo: DB-1
English Dept.
(Arts Block A GF)

Photo: DB-2
English Dept.
(Arts Block A 1F)

Photo: DB-3
Arabic Dept.
(Arts Block A 2F)

Arts Block B:

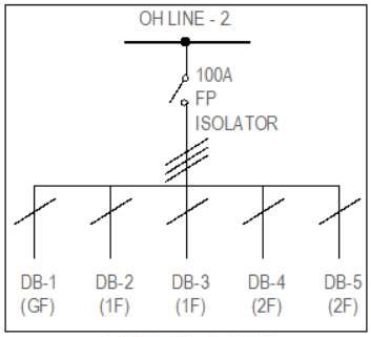

Fig: SLD of Power Distribution of Arts Block B

Photo: Main Incomer of Arts Block B

Photo: DB-1
Arts Block B (GF)

Photo: DB-2
Assamese Dept.
Arts Block B (1F)

Photo: DB-3
Arts Block B (2F)

Photo: DB-4
Arts Block B (2F)

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Arts Block C:

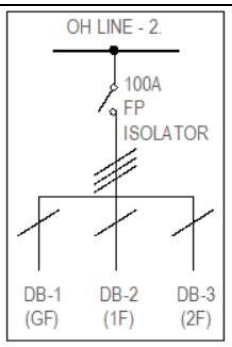

Fig: SLD of Power Distribution of Arts Block C

Photo: Main Incomer of Arts Block C

Photo: DB-1
B. Voc.
(Arts Block C GF)

Photo: DB-2
B.Voc.
(Arts Block C 1F)

Photo: DB-3
(Arts Block C 2F)

Other tappings from OH Line-2

Photo: Main switch of Boys Common Room

Photo: DB at Teachers' unit (MCTU)

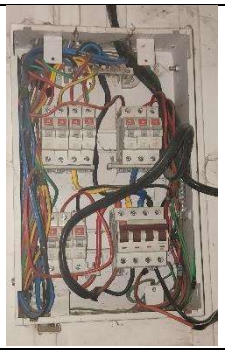

Photo: DB at the Auditorium

Science Block (New):

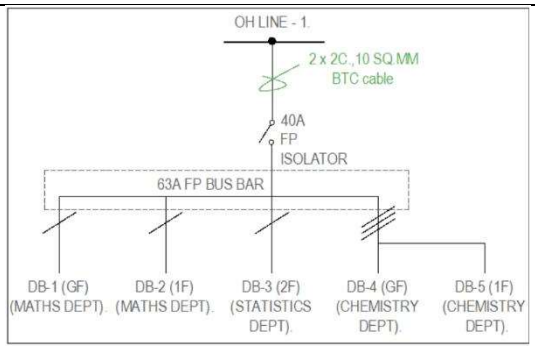

Fig: SLD of Power Distribution of Science Block (New)

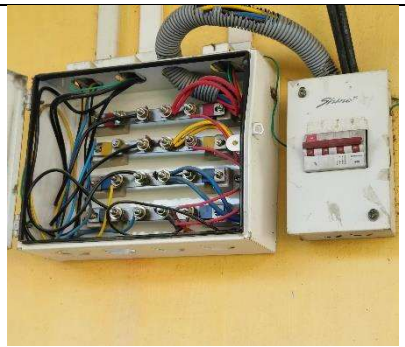

Photo: Main Incomer of Science Block (New)

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Photo: DB-1 Maths Dept. Science Block (New) GF	Photo: DB-2 Maths Dept. Science Block (New) 1F	Photo: DB-3 Statistics Dept. Science Block (New) 2F

	
Photo: DB-4 Chemistry Dept. Wet Labs Science Block (New) GF	Photo: DB-4 Chemistry Dept. Science Block (New) 1F

Girls Hostel (old building):

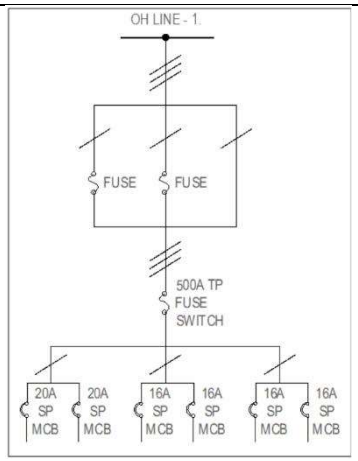	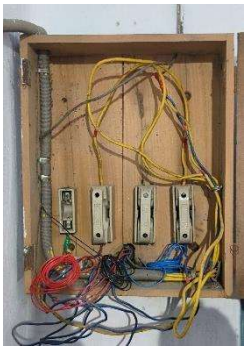	
Fig: SLD of Distribution of Girls Hostel (Old)	Photo: Main Incomer of Girls Hostel (Old)	Photo: Power distribution of Girls Hostel (Old Building)

	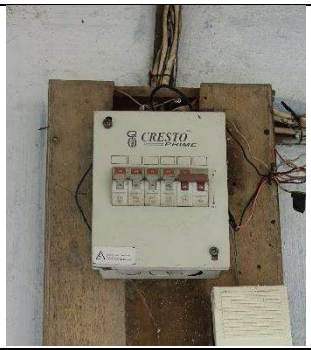	
Photo: DB-1	Photo: DB-2	Photo: DB-3

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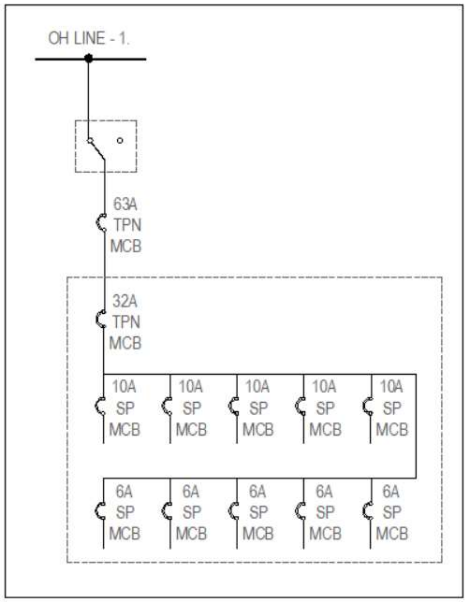
Photo: DB-4	Photo: DB-5

Girls Hostel (New building):



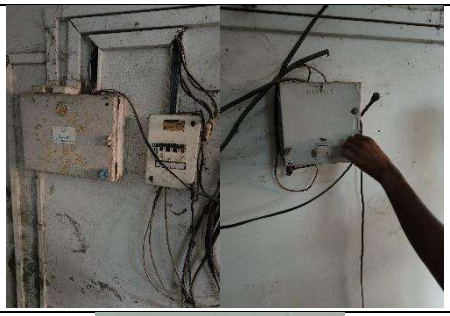


Photo: Power distribution of Girls Hostel (New Building)

Girls Hostel Warden's Quarter:

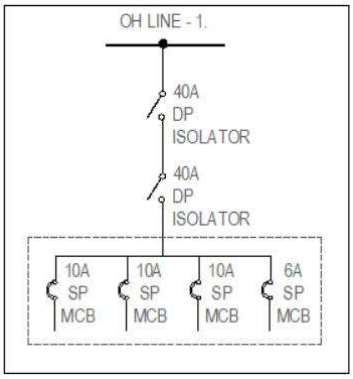


Fig: SLD of Power distribution of Girls Hostel Warden's Quarter

Photo: Main Incomer switch and DBs of Girls Hostel Warden's Quarter

Observations:

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

A distribution board (DB) should be installed for the main power distribution at the various blocks of the college campus (one each at major load centres like Admin building, Science Block (old), Science Block (New), Arts Block A (backside), Arts Blocks B, Arts Block C, Botany Dept. (old building), Girls Hostel (old building) etc.).

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.

These main distribution boards should have MCB switches of appropriate rating for each of the circuits outgoing to the different rooms of that block.

It is also seen that the DBs installed at the various rooms 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.

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4.4 Measurement and analysis of Power Quality Parameters

a) Grid supply:

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

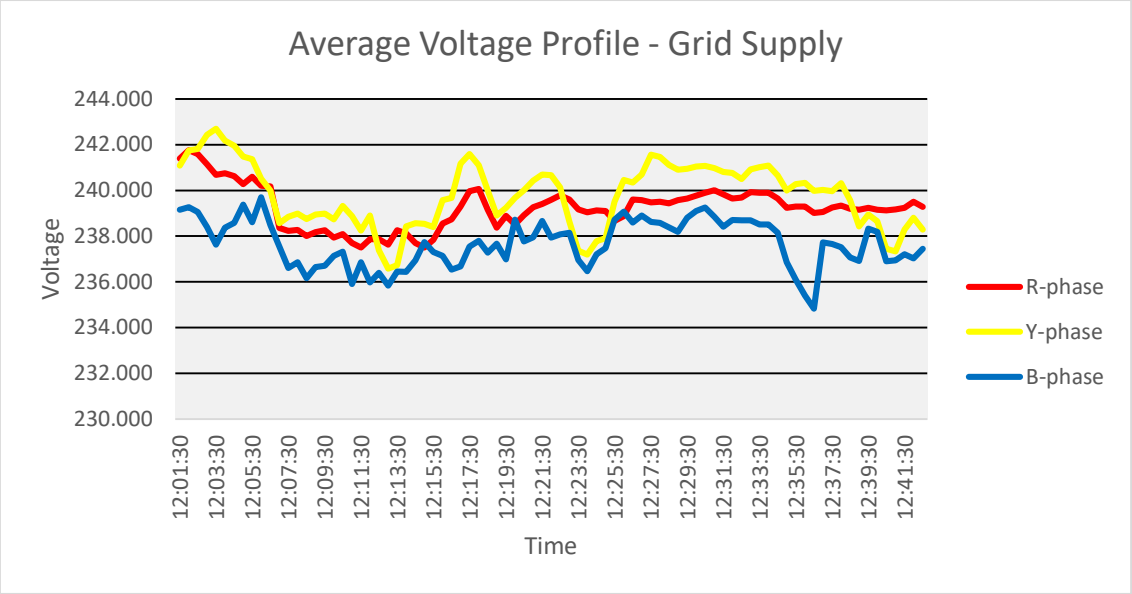

Fig: Average Voltage Profile – Grid supply

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=	241.760	242.690	239.700	0.73%	1.12%	0.13%
Average=	239.242	239.797	237.677	0.32%	0.08%	0.97%
Min=	237.500	236.580	234.830	1.04%	1.42%	2.15%

The average voltage of the Grid Supply as can be seen in the graph above is 238.91V (L-N). The voltage variation was found to be within 234.83 to 242.69 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

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Parameters		Value	Variation (%)	Limit	Remarks
Voltage	R-Phase to N	239.242	0.32%	**6%**	OK
	Y-Phase to N	239.797	0.08%		OK
	B-Phase to N	237.677	0.97%		OK
Frequency		49.981	0.04%	**3%**	OK
THD-V	R-Phase to N	2.23%		**3%**	OK
	Y-Phase to N	1.64%			OK
	B-Phase to N	1.73%			OK
THD-I	R-Phase to N	21.59%		**15%**	Marginally high
	Y-Phase to N	65.99%			**Very High**
	B-Phase to N	23.27%			Marginally high
Neutral to Ground Voltage		5 V		**3V**	**High**

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 high. The earthing arrangement needs to be improved.

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b) Diesel Generator (DG) set-1:

The standby diesel generator (DG-1) was tested during the audit for evaluating its functional operation.

The graph below is a representation of the voltages recorded at the DG output.

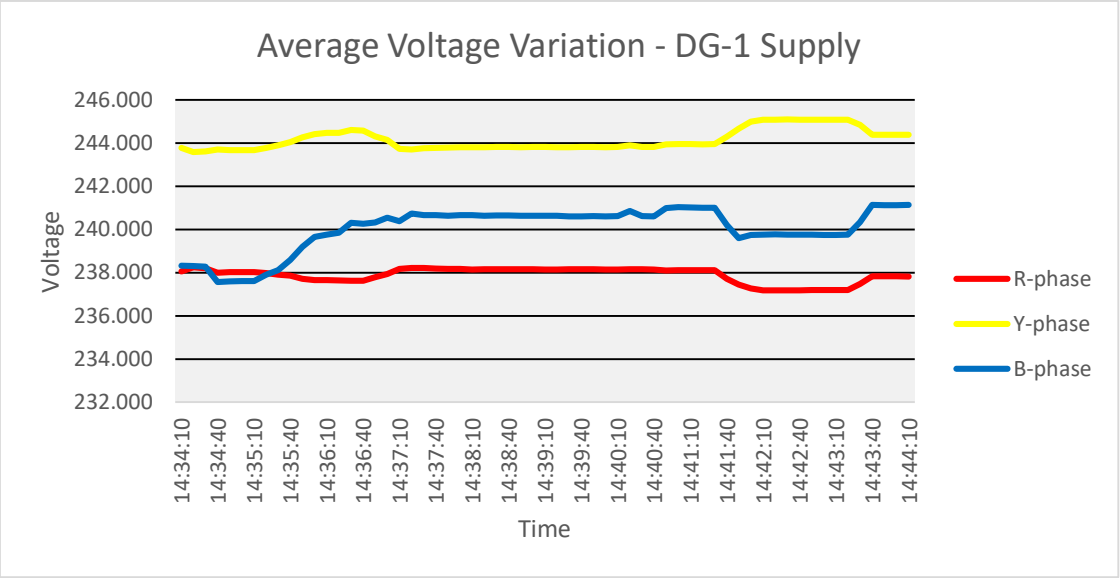

Fig: Average Voltage Profile – DG set-1 supply

The average voltage of the DG 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=	238.240	245.100	241.140	0.73%	2.13%	0.47%
Average=	237.883	244.151	240.023	0.88%	1.73%	0.01%
Min=	237.180	243.580	237.570	1.18%	1.49%	1.01%

The average voltage at the DG set's output as can be seen in the graph above is 240.69V (L-N). The voltage variation was found to be within 237.18 to 245.1 V. The DG set-1's supply can be considered safe for operation.

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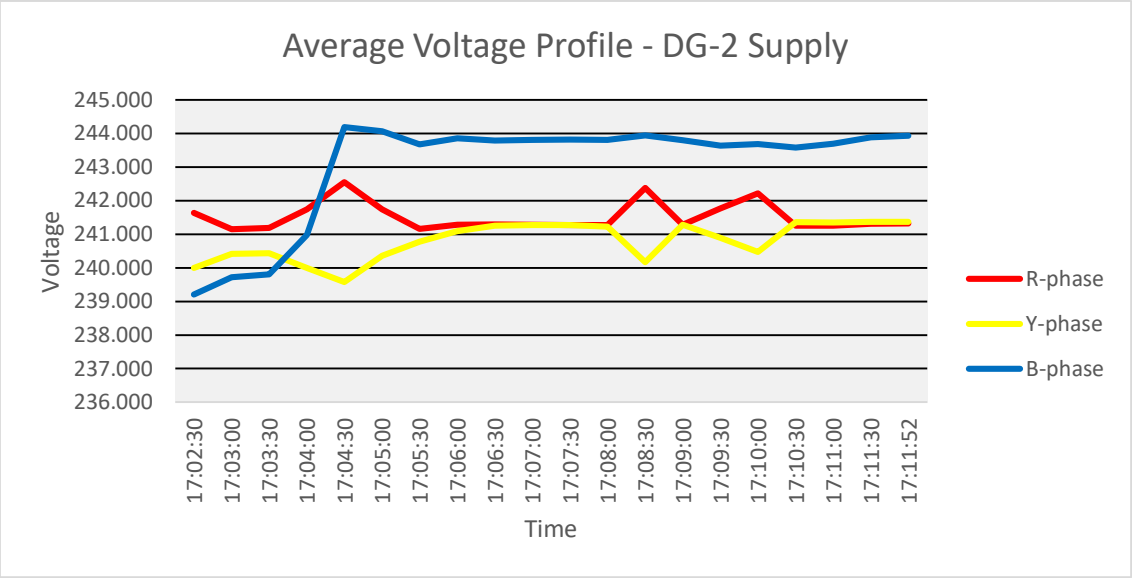
c) Diesel Generator (DG) set-2:

The standby diesel generator (DG-2) was tested during the audit for evaluating its functional operation.

The graph below is a representation of the voltages recorded at the DG output.



The average voltage of the DG 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=	242.550	241.370	244.190	1.06%	0.57%	1.75%
Average=	241.518	240.798	243.046	0.63%	0.33%	1.27%
Min=	241.150	239.580	239.210	0.48%	0.17%	0.33%

The average voltage at the DG set's output as can be seen in the graph above is 241.78 V (L-N). The voltage variation was found to be within 239.21 to 244.19 V. The DG set-2's supply is varying but may be considered safe for operation.

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4.5 Study/findings on Earthing System

Observations:

- The transformer substation's earth-pits could not be traced out as the transformer substation area is fully covered by weeds & creepers.
- The earth-pits for the DG set-1's body and neutral earthing are untraceable as they have been buried under concrete cover.
- The earth-pits for the DG set-2's body and neutral earthing are untraceable as they have been buried under concrete cover.
- There are no earthing connections for any of the DBs and switch boxes in the college campus.
- None of the earth-pits (if any) could be traced out during the audit.
- The Neutral to Earth voltage was found to be high at certain switchboards.

A complete revamping of the earth arrangement is necessary.

New earth-pits should be constructed at easily accessible locations in the college campus. Concrete earth-pit protection chambers having a hinged CI cover should be constructed for these earth-pits.

Earthing connections should be provided for each of the switchboards and DBs at each room of the college campus.

The two 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.

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.

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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 significant reduction in the monthly electricity bills by adjusting the contracted demand in accordance with the actual requirement.
- Some tweaking in the electricity distribution arrangement can be done 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.

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 Mangaldai College campus will be considered completely safe for its continued operation after completion of rectification of each of the observed discrepancies.

--END OF REPORT--

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ANNEXURES

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Annexure-1: Voltage variation log of Grid supply

Date	Time	R-phase Voltage, V	Y-phase Voltage, V	B-phase Voltage, V
09-11-2023	12:01:30	241.400	241.090	239.150
09-11-2023	12:02:00	241.760	241.740	239.270
09-11-2023	12:02:30	241.590	241.810	239.050
09-11-2023	12:03:00	241.140	242.430	238.390
09-11-2023	12:03:30	240.680	242.690	237.620
09-11-2023	12:04:00	240.750	242.180	238.370
09-11-2023	12:04:30	240.620	241.950	238.580
09-11-2023	12:05:00	240.270	241.480	239.380
09-11-2023	12:05:30	240.590	241.360	238.610
09-11-2023	12:06:00	240.200	240.510	239.700
09-11-2023	12:06:30	240.170	239.990	238.480
09-11-2023	12:07:00	238.360	238.560	237.540
09-11-2023	12:07:30	238.230	238.850	236.610
09-11-2023	12:08:00	238.270	238.980	236.860
09-11-2023	12:08:30	238.010	238.750	236.150
09-11-2023	12:09:00	238.170	238.950	236.650
09-11-2023	12:09:30	238.260	238.990	236.700
09-11-2023	12:10:00	237.940	238.730	237.130
09-11-2023	12:10:30	238.090	239.320	237.320
09-11-2023	12:11:00	237.700	238.880	235.900
09-11-2023	12:11:30	237.500	238.240	236.860
09-11-2023	12:12:00	237.870	238.900	235.980
09-11-2023	12:12:30	237.870	237.370	236.400
09-11-2023	12:13:00	237.620	236.580	235.830
09-11-2023	12:13:30	238.260	236.730	236.450
09-11-2023	12:14:00	238.120	238.420	236.440
09-11-2023	12:14:30	237.690	238.570	236.940
09-11-2023	12:15:00	237.500	238.530	237.740
09-11-2023	12:15:30	237.830	238.390	237.300
09-11-2023	12:16:00	238.550	239.570	237.140
09-11-2023	12:16:30	238.740	239.670	236.530
09-11-2023	12:17:00	239.290	241.170	236.680
09-11-2023	12:17:30	239.970	241.590	237.540
09-11-2023	12:18:00	240.060	241.100	237.800
09-11-2023	12:18:30	239.150	240.000	237.270
09-11-2023	12:19:00	238.370	238.900	237.670
09-11-2023	12:19:30	238.890	239.240	236.980
09-11-2023	12:20:00	238.510	239.670	238.720
09-11-2023	12:20:30	238.920	240.010	237.760
09-11-2023	12:21:00	239.260	240.430	237.950
09-11-2023	12:21:30	239.400	240.690	238.660
09-11-2023	12:22:00	239.590	240.660	237.930
09-11-2023	12:22:30	239.780	240.140	238.080
09-11-2023	12:23:00	239.600	238.640	238.150
09-11-2023	12:23:30	239.170	237.360	236.960
	Max=	**241.760**	**242.690**	**239.700**
	Average=	**239.242**	**239.797**	**237.677**
	Min=	**237.500**	**236.580**	**234.830**

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Annexure-2: Voltage variation log of DG-1's Supply

Date	Time	R-phase Voltage, V	Y-phase Voltage, V	B-phase Voltage, V
09-11-2023	14:34:10	238.060	243.780	238.320
09-11-2023	14:34:20	238.240	243.580	238.300
09-11-2023	14:34:30	238.200	243.620	238.280
09-11-2023	14:34:40	237.990	243.700	237.570
09-11-2023	14:34:50	238.020	243.680	237.600
09-11-2023	14:35:00	238.030	243.670	237.610
09-11-2023	14:35:10	238.030	243.670	237.610
09-11-2023	14:35:20	237.980	243.780	237.900
09-11-2023	14:35:30	237.910	243.890	238.120
09-11-2023	14:35:40	237.860	244.050	238.590
09-11-2023	14:35:50	237.720	244.260	239.190
09-11-2023	14:36:00	237.660	244.420	239.650
09-11-2023	14:36:10	237.650	244.470	239.760
09-11-2023	14:36:20	237.640	244.480	239.850
09-11-2023	14:36:30	237.630	244.610	240.310
09-11-2023	14:36:40	237.620	244.580	240.270
09-11-2023	14:36:50	237.790	244.310	240.330
09-11-2023	14:37:00	237.940	244.150	240.540
09-11-2023	14:37:10	238.170	243.740	240.380
09-11-2023	14:37:20	238.220	243.710	240.740
09-11-2023	14:37:30	238.220	243.760	240.670
09-11-2023	14:37:40	238.190	243.780	240.660
09-11-2023	14:37:50	238.170	243.790	240.640
09-11-2023	14:38:00	238.170	243.810	240.660
09-11-2023	14:38:10	238.150	243.810	240.660
09-11-2023	14:38:20	238.160	243.810	240.640
09-11-2023	14:38:30	238.160	243.820	240.650
09-11-2023	14:38:40	238.160	243.820	240.650
09-11-2023	14:38:50	238.160	243.810	240.630
09-11-2023	14:39:00	238.160	243.830	240.640
09-11-2023	14:39:10	238.150	243.820	240.640
09-11-2023	14:39:20	238.150	243.810	240.630
09-11-2023	14:39:30	238.160	243.810	240.610
09-11-2023	14:39:40	238.160	243.820	240.610
09-11-2023	14:39:50	238.160	243.820	240.620
09-11-2023	14:40:00	238.150	243.810	240.610
09-11-2023	14:40:10	238.150	243.820	240.620
09-11-2023	14:40:20	238.160	243.890	240.860
09-11-2023	14:40:30	238.160	243.820	240.620
09-11-2023	14:40:40	238.150	243.820	240.610
09-11-2023	14:40:50	238.100	243.940	240.990
09-11-2023	14:41:00	238.110	243.950	241.030
09-11-2023	14:41:10	238.110	243.950	241.020
09-11-2023	14:41:20	238.110	243.940	241.000
09-11-2023	14:41:30	238.110	243.960	241.000
	Max=	**238.240**	**245.100**	**241.140**
	Average=	**237.883**	**244.151**	**240.023**
	Min=	**237.180**	**243.580**	**237.570**

Annexure-3: Voltage variation log of DG-2's Supply

Date	Time	R-phase Voltage, V	Y-phase Voltage, V	B-phase Voltage, V
08-11-2023	17:02:30	241.640	240.000	239.210
08-11-2023	17:03:00	241.150	240.420	239.720
08-11-2023	17:03:30	241.190	240.440	239.810
08-11-2023	17:04:00	241.740	240.000	240.980
08-11-2023	17:04:30	242.550	239.580	244.190
08-11-2023	17:05:00	241.740	240.360	244.070
08-11-2023	17:05:30	241.160	240.780	243.680
08-11-2023	17:06:00	241.280	241.090	243.860
08-11-2023	17:06:30	241.290	241.260	243.790
08-11-2023	17:07:00	241.280	241.270	243.810
08-11-2023	17:07:30	241.270	241.270	243.820
08-11-2023	17:08:00	241.270	241.230	243.810
08-11-2023	17:08:30	242.380	240.170	243.940
08-11-2023	17:09:00	241.280	241.280	243.800
08-11-2023	17:09:30	241.770	240.890	243.640
08-11-2023	17:10:00	242.220	240.470	243.690
08-11-2023	17:10:30	241.260	241.360	243.580
08-11-2023	17:11:00	241.260	241.350	243.700
08-11-2023	17:11:30	241.310	241.370	243.890
08-11-2023	17:11:52	241.320	241.370	243.930
08-11-2023	17:02:30	241.640	240.000	239.210
08-11-2023	17:03:00	241.150	240.420	239.720
08-11-2023	17:03:30	241.190	240.440	239.810
08-11-2023	17:04:00	241.740	240.000	240.980
08-11-2023	17:04:30	242.550	239.580	244.190
08-11-2023	17:05:00	241.740	240.360	244.070
08-11-2023	17:05:30	241.160	240.780	243.680
08-11-2023	17:06:00	241.280	241.090	243.860
08-11-2023	17:06:30	241.290	241.260	243.790
08-11-2023	17:07:00	241.280	241.270	243.810
08-11-2023	17:07:30	241.270	241.270	243.820
08-11-2023	17:08:00	241.270	241.230	243.810
08-11-2023	17:08:30	242.380	240.170	243.940
08-11-2023	17:09:00	241.280	241.280	243.800
08-11-2023	17:09:30	241.770	240.890	243.640
08-11-2023	17:10:00	242.220	240.470	243.690
08-11-2023	17:10:30	241.260	241.360	243.580
08-11-2023	17:11:00	241.260	241.350	243.700
08-11-2023	17:11:30	241.310	241.370	243.890
08-11-2023	17:11:52	241.320	241.370	243.930
	Max=	**241.920**	**243.000**	**244.980**
	Average=	**237.077**	**238.184**	**242.000**
	Min=	**232.070**	**229.000**	**238.320**

Annexure-4: Power-log of the Transformer

Date	Time	KW	KVAR	KVA
09-11-2023	12:01:30	6.026	1.965	6.339
09-11-2023	12:02:00	3.675	2.461	4.423
09-11-2023	12:02:30	6.697	2.623	7.193
09-11-2023	12:03:00	8.798	1.993	9.021
09-11-2023	12:03:30	9.615	2.314	9.889
09-11-2023	12:04:00	9.384	2.370	9.679
09-11-2023	12:04:30	11.534	2.550	11.813
09-11-2023	12:05:00	14.009	2.232	14.186
09-11-2023	12:05:30	13.890	2.218	14.066
09-11-2023	12:06:00	12.877	2.207	13.065
09-11-2023	12:06:30	12.573	2.182	12.761
09-11-2023	12:07:00	10.906	2.516	11.193
09-11-2023	12:07:30	11.056	2.600	11.358
09-11-2023	12:08:00	8.729	2.322	9.032
09-11-2023	12:08:30	9.592	2.396	9.887
09-11-2023	12:09:00	8.712	2.354	9.024
09-11-2023	12:09:30	8.340	2.321	8.657
09-11-2023	12:10:00	8.853	2.356	9.161
09-11-2023	12:10:30	9.837	2.401	10.125
09-11-2023	12:11:00	13.118	2.426	13.341
09-11-2023	12:11:30	14.090	2.229	14.266
09-11-2023	12:12:00	13.901	2.270	14.085
09-11-2023	12:12:30	15.554	2.186	15.707
09-11-2023	12:13:00	17.076	2.039	17.198
09-11-2023	12:13:30	10.483	2.669	10.818
09-11-2023	12:14:00	12.218	2.272	12.428
09-11-2023	12:14:30	16.368	2.262	16.524
09-11-2023	12:15:00	16.836	2.108	16.967
09-11-2023	12:15:30	14.595	2.652	14.834
09-11-2023	12:16:00	4.627	4.615	6.535
09-11-2023	12:16:30	1.666	5.427	5.677
09-11-2023	12:17:00	4.604	4.516	6.449
09-11-2023	12:17:30	8.364	2.556	8.746
09-11-2023	12:18:00	6.257	3.538	7.188
09-11-2023	12:18:30	9.603	3.079	10.085
09-11-2023	12:19:00	9.513	2.478	9.831
09-11-2023	12:19:30	8.098	2.540	8.487
09-11-2023	12:20:00	8.004	2.645	8.430
09-11-2023	12:20:30	8.423	2.565	8.805
09-11-2023	12:21:00	6.098	3.117	6.848
09-11-2023	12:21:30	4.694	2.489	5.313
09-11-2023	12:22:00	5.964	2.378	6.420
09-11-2023	12:22:30	4.013	2.859	4.927
09-11-2023	12:23:00	1.329	3.285	3.544
09-11-2023	12:23:30	1.145	3.719	3.891
	Max=	**17.076**	**5.427**	**17.198**
	Average=	**7.676**	**2.918**	**8.534**
	Min=	**1.145**	**1.965**	**3.544**

Annexure-5: Power-log of the DG-1

Date	Time	KW	KVAR	KVA
09-11-2023	14:34:10	4.330	0.617	4.373
09-11-2023	14:34:20	4.445	0.669	4.495
09-11-2023	14:34:30	4.421	0.633	4.466
09-11-2023	14:34:40	4.555	0.669	4.603
09-11-2023	14:34:50	4.525	0.636	4.569
09-11-2023	14:35:00	4.519	0.644	4.565
09-11-2023	14:35:10	4.515	0.641	4.560
09-11-2023	14:35:20	4.612	0.648	4.657
09-11-2023	14:35:30	4.683	0.684	4.733
09-11-2023	14:35:40	4.856	0.692	4.905
09-11-2023	14:35:50	5.092	0.751	5.147
09-11-2023	14:36:00	5.272	0.788	5.330
09-11-2023	14:36:10	5.309	0.794	5.368
09-11-2023	14:36:20	5.351	0.789	5.408
09-11-2023	14:36:30	5.535	0.778	5.589
09-11-2023	14:36:40	5.523	0.773	5.576
09-11-2023	14:36:50	5.790	0.792	5.844
09-11-2023	14:37:00	6.054	0.812	6.108
09-11-2023	14:37:10	6.270	0.849	6.327
09-11-2023	14:37:20	6.551	0.871	6.609
09-11-2023	14:37:30	6.559	0.844	6.613
09-11-2023	14:37:40	6.544	0.827	6.596
09-11-2023	14:37:50	6.531	0.822	6.582
09-11-2023	14:38:00	6.532	0.812	6.582
09-11-2023	14:38:10	6.537	0.809	6.587
09-11-2023	14:38:20	6.534	0.808	6.584
09-11-2023	14:38:30	6.526	0.802	6.575
09-11-2023	14:38:40	6.537	0.794	6.585
09-11-2023	14:38:50	6.525	0.797	6.573
09-11-2023	14:39:00	6.527	0.795	6.575
09-11-2023	14:39:10	6.534	0.790	6.582
09-11-2023	14:39:20	6.527	0.789	6.575
09-11-2023	14:39:30	6.519	0.788	6.567
09-11-2023	14:39:40	6.518	0.784	6.565
09-11-2023	14:39:50	6.521	0.780	6.568
09-11-2023	14:40:00	6.521	0.779	6.568
09-11-2023	14:40:10	6.528	0.781	6.574
09-11-2023	14:40:20	6.626	0.790	6.673
09-11-2023	14:40:30	6.528	0.777	6.574
09-11-2023	14:40:40	6.520	0.780	6.567
09-11-2023	14:40:50	6.681	0.789	6.728
09-11-2023	14:41:00	6.689	0.785	6.735
09-11-2023	14:41:10	6.689	0.781	6.735
09-11-2023	14:41:20	6.688	0.779	6.733
09-11-2023	14:41:30	6.689	0.777	6.734
	Max=	**7.384**	**0.871**	**7.429**
	Average=	**6.190**	**0.769**	**6.238**
	Min=	**4.330**	**0.617**	**4.373**

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Annexure-6: Power-log of the DG-2

Date	Time	KW	KVAR	KVA
08-11-2023	17:02:30	2.844	-1.206	3.089
08-11-2023	17:03:00	2.657	-1.18	2.907
08-11-2023	17:03:30	2.696	-1.181	2.944
08-11-2023	17:04:00	3.077	-1.215	3.308
08-11-2023	17:04:30	4.309	-1.128	4.454
08-11-2023	17:05:00	3.957	-1.18	4.129
08-11-2023	17:05:30	3.634	-1.135	3.807
08-11-2023	17:06:00	3.088	-1.109	3.281
08-11-2023	17:06:30	2.935	-1.101	3.135
08-11-2023	17:07:00	2.939	-1.099	3.138
08-11-2023	17:07:30	2.941	-1.098	3.139
08-11-2023	17:08:00	2.953	-1.114	3.156
08-11-2023	17:08:30	3.516	-1.04	3.667
08-11-2023	17:09:00	2.933	-1.097	3.131
08-11-2023	17:09:30	3.062	-1.048	3.236
08-11-2023	17:10:00	3.279	-1.001	3.429
08-11-2023	17:10:30	2.807	-1.056	2.999
08-11-2023	17:11:00	2.747	-1.086	2.954
08-11-2023	17:11:30	2.669	-1.098	2.886
08-11-2023	17:11:52	2.641	-1.068	2.849
08-11-2023	17:02:30	2.844	-1.206	3.089
08-11-2023	17:03:00	2.657	-1.18	2.907
08-11-2023	17:03:30	2.696	-1.181	2.944
08-11-2023	17:04:00	3.077	-1.215	3.308
08-11-2023	17:04:30	4.309	-1.128	4.454
08-11-2023	17:05:00	3.957	-1.18	4.129
08-11-2023	17:05:30	3.634	-1.135	3.807
08-11-2023	17:06:00	3.088	-1.109	3.281
08-11-2023	17:06:30	2.935	-1.101	3.135
08-11-2023	17:07:00	2.939	-1.099	3.138
08-11-2023	17:07:30	2.941	-1.098	3.139
08-11-2023	17:08:00	2.953	-1.114	3.156
08-11-2023	17:08:30	3.516	-1.04	3.667
08-11-2023	17:09:00	2.933	-1.097	3.131
08-11-2023	17:09:30	3.062	-1.048	3.236
08-11-2023	17:10:00	3.279	-1.001	3.429
08-11-2023	17:10:30	2.807	-1.056	2.999
08-11-2023	17:11:00	2.747	-1.086	2.954
08-11-2023	17:11:30	2.669	-1.098	2.886
08-11-2023	17:11:52	2.641	-1.068	2.849
08-11-2023	17:02:30	2.844	-1.206	3.089
08-11-2023	17:03:00	2.657	-1.18	2.907
08-11-2023	17:03:30	2.696	-1.181	2.944
08-11-2023	17:04:00	3.077	-1.215	3.308
08-11-2023	17:04:30	4.309	-1.128	4.454
	Max=	**4.309**	**-1.001**	**4.454**
	Average=	**3.084**	**-1.112**	**3.282**
	Min=	**2.641**	**-1.215**	**2.849**

Annexure-7: Power-log of Solar generation

Date	Time	KW	KVAR	KVA
09-11-2023	11:10:30	15.507	15.551	1.168
09-11-2023	11:11:00	15.419	15.463	1.165
09-11-2023	11:11:30	15.446	15.490	1.167
09-11-2023	11:12:00	13.870	13.919	1.174
09-11-2023	11:12:30	12.714	12.766	1.152
09-11-2023	11:13:00	12.887	12.940	1.171
09-11-2023	11:13:30	15.206	15.252	1.191
09-11-2023	11:14:00	13.657	13.708	1.185
09-11-2023	11:14:30	14.856	14.905	1.203
09-11-2023	11:15:00	15.667	15.711	1.171
09-11-2023	11:15:30	15.740	15.783	1.164
09-11-2023	11:16:00	15.649	15.692	1.161
09-11-2023	11:16:30	15.495	15.539	1.170
09-11-2023	11:17:00	15.460	15.503	1.155
09-11-2023	11:17:30	15.407	15.450	1.155
09-11-2023	11:18:00	15.407	15.450	1.150
09-11-2023	11:18:30	15.427	15.469	1.149
09-11-2023	11:19:00	15.386	15.429	1.151
09-11-2023	11:19:30	15.281	15.323	1.141
09-11-2023	11:20:00	15.243	15.286	1.148
09-11-2023	11:20:30	15.278	15.321	1.145
09-11-2023	11:21:00	10.434	14.338	9.834
09-11-2023	11:21:30	6.229	14.250	12.817
09-11-2023	11:22:00	13.856	14.104	2.635
09-11-2023	11:22:30	10.468	14.256	9.677
09-11-2023	11:23:00	5.872	14.591	13.358
09-11-2023	11:23:30	5.855	14.544	13.314
09-11-2023	11:24:00	5.636	14.485	13.343
09-11-2023	11:24:30	14.441	14.668	2.569
09-11-2023	11:25:00	14.870	14.919	1.214
09-11-2023	11:25:30	14.693	14.745	1.237
09-11-2023	11:26:00	14.503	14.555	1.232
09-11-2023	11:26:30	14.316	14.368	1.222
09-11-2023	11:27:00	14.125	14.175	1.187
09-11-2023	11:27:30	13.974	14.025	1.198
09-11-2023	11:28:00	13.881	13.932	1.190
09-11-2023	11:28:30	13.833	13.885	1.198
09-11-2023	11:29:00	13.813	13.864	1.183
09-11-2023	11:29:30	13.819	13.870	1.189
09-11-2023	11:30:00	13.905	13.957	1.202
09-11-2023	11:30:30	14.114	14.165	1.201
09-11-2023	11:31:00	14.324	14.373	1.177
09-11-2023	11:31:30	14.381	14.429	1.167
09-11-2023	11:32:00	14.467	14.514	1.164
09-11-2023	11:32:30	14.561	14.608	1.181
	Max=	**15.740**	**15.783**	**13.358**
	Average=	**13.693**	**14.655**	**2.659**
	Min=	**5.636**	**12.766**	**1.141**

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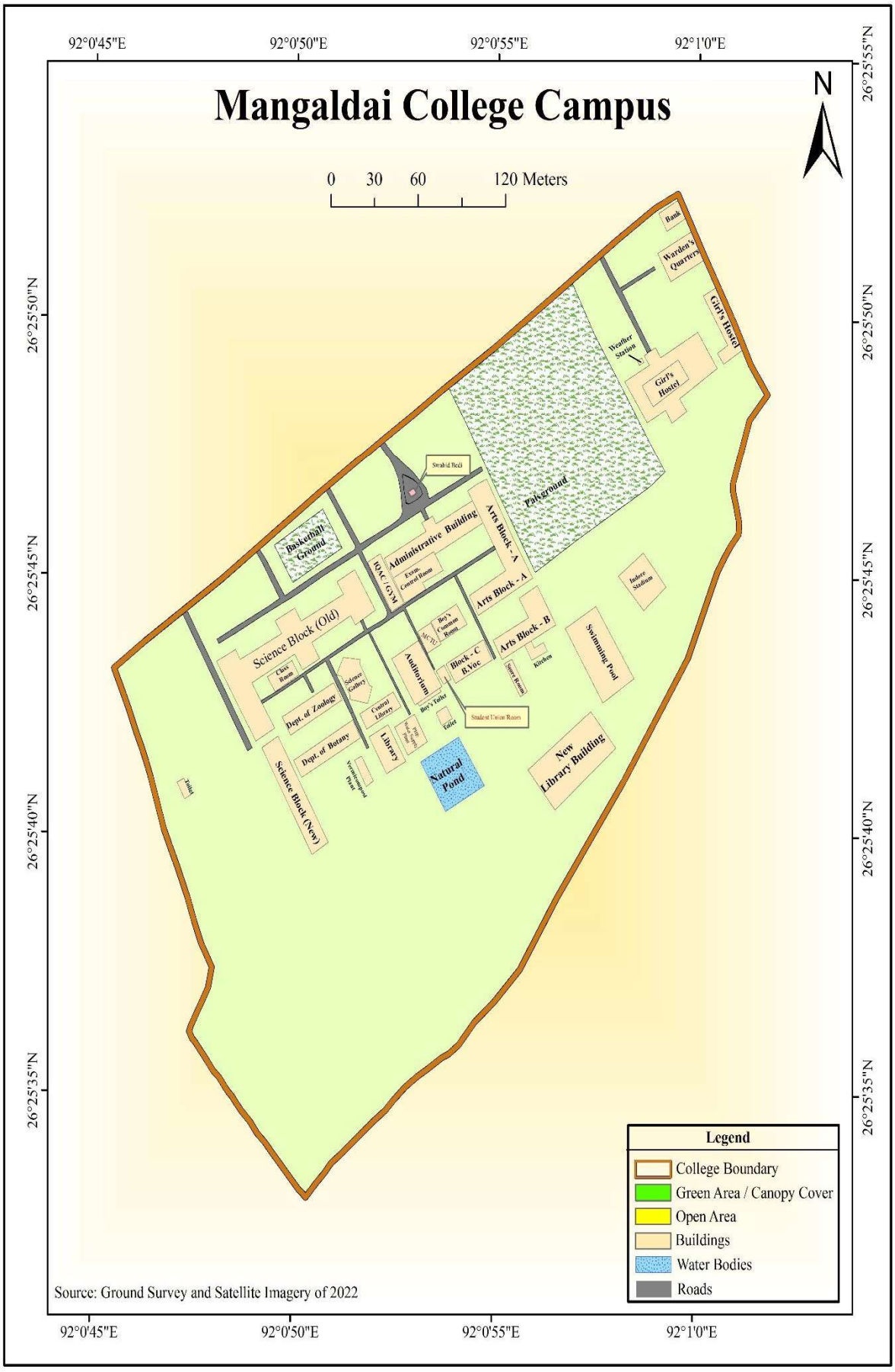
Annexure-8: Geographical layout of the Mangaldai College campus



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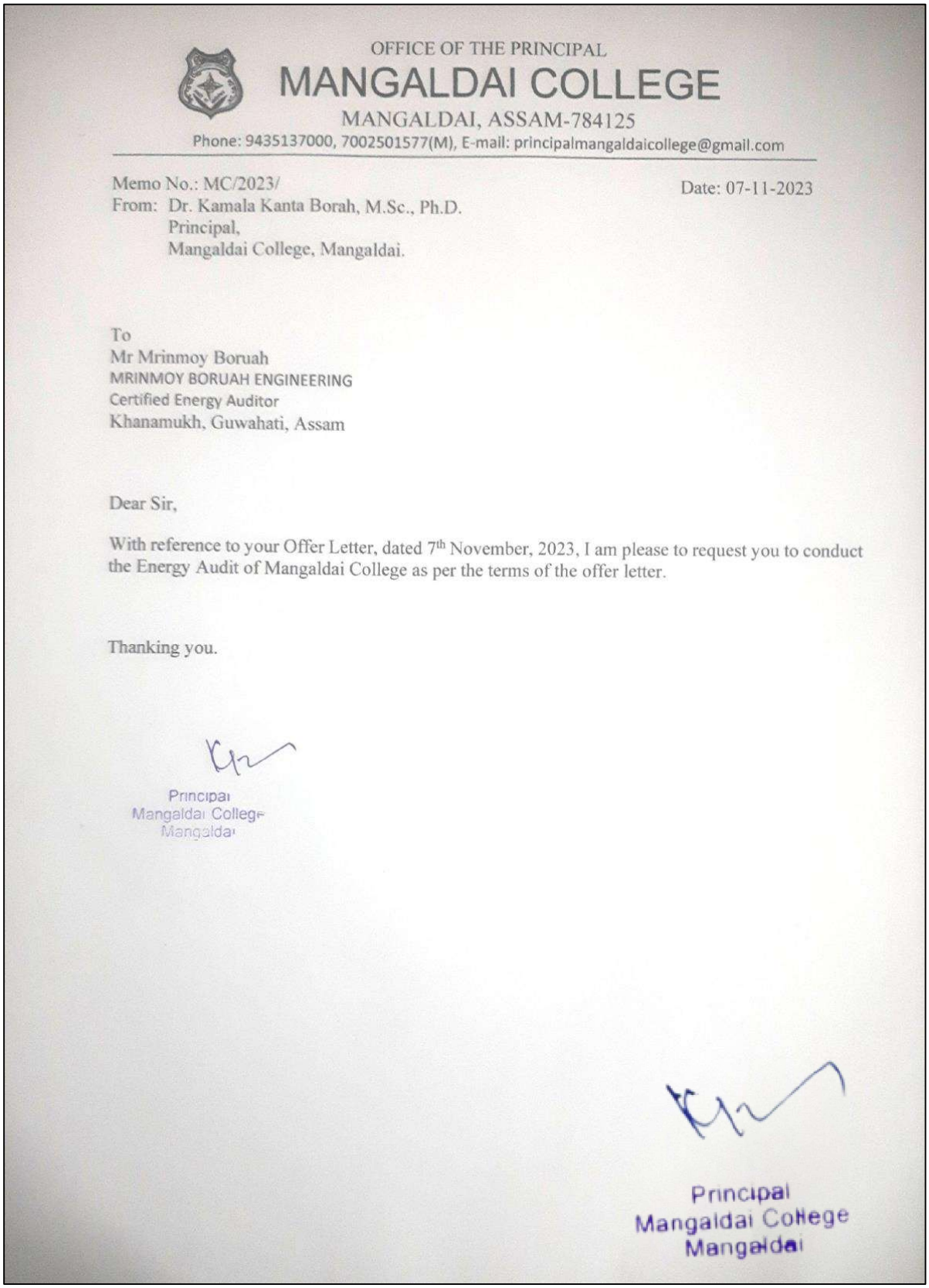
Annexure-9: Work order for conducting Electrical Energy & Safety Audit



OFFICE OF THE PRINCIPAL

MANGALDAI COLLEGE

MANGALDAI, ASSAM-784125

Phone: 9435137000, 7002501577(M), E-mail: principalmangaldaicollege@gmail.com

Memo No.: MC/2023/ Date: 07-11-2023

From: Dr. Kamala Kanta Borah, M.Sc., Ph.D.
Principal,
Mangaldai College, Mangaldai.

To
Mr Mrinmoy Boruah
MRINMOY BORUAH ENGINEERING
Certified Energy Auditor
Khanamukh, Guwahati, Assam

Dear Sir,

With reference to your Offer Letter, dated 7th November, 2023, I am please to request you to conduct the Energy Audit of Mangaldai College as per the terms of the offer letter.

Thanking you.

Principal
Mangaldai College
Mangaldai

Principal
Mangaldai College
Mangaldai

-END-