ENERGY AUDIT – 2020

SRI C. ACHUTHA MENON GOVERNMENT COLLEGE
KUTTANELLUR, THRISSUR
Kerala

EXECUTED BY

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We express our sincere gratitude to the Sri C Achutha Menon Government College Thrissur for giving us an opportunity to carry out the project of Energy Audit. We are extremely thankful to all the staffs for their support to carry out the studies and for input data, and measurements related to the project of Energy audit.

College Team Members

1	Mrs Ambika PV	Principal
2	Mr. PK Vijayan	IQAC Coordinator

Also congratulating our Energy audit team members for successfully completing the assignment in time and making their best efforts to add value.

ELECTRICAL SAFETY & ENERGY AUDIT TEAM

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ATHUL ENERGY CONSULTANTS PVT LTD. THRISSUR 680 020

Yours faithfully

Managing Director
Athul Energy Consultants Pvt Ltd

1. ENERGY SAVING PROPOSALS

The following table shows the energy saving proposals

Sl No:	Particulars	Annual energy Savings (kWh)	Annual Financial Savings (Rs.)	Investment (Rs)	Simple payback Period (Months)
1	Replacement of ceiling fans with BLDC /BEE star rated fans -50 No each	4375 or 1875	28438 or 12188	135000 or 80,000	57 or 79
2	Replacement of existing Tube fitting with LED. T-12-7, T-8 -6 and T-5 - 110	2232	14508	36900	30.5
3	Installation of 20kw solar on grid system	24000	156000	1200000	77

TABLE 1: ENERGY SAVING PROPOSALS

2. AUDIT SUMMARY - ACTIONS

The actionable summary of the audit report is given in the table below.

Sl No:	Particulars	Location	Action to be taken	Remarks
1	Replacement of ceiling fans with BLDC fans	Classrooms, Staff rooms	Change the existing old ceiling fans with BLDC fans	Energy consumption will come down
2	Replacement of old split AC with New 5 star rated ones	Computer Labs, Office Rooms	Change the old existing ACs with 5 star ACs.	Energy consumption will come down
3	Replacement of Fluorescent lights with LED	Class rooms, Staff rooms	Replace with LED lights.	Energy consumption will come down

TABLE 2: ENERGY AUDIT SUMMARY – ACTIONS

3. ENERGY AUDIT SUMMARY & RECOMMENDATIONS

The summary of the report with respect to each section is as follows.

1. **Electricity consumption analysis:**

- Presently 4 LT connections in the college premises. Which we suggested to change into single HT connection. This is useful for college for overall billing and for reliability in supply from KSEB.
- College is benefitted with space in its roof top hence they can go for more solar installations in their facility and go for zero billing and claimed as solar powered college or Green college.
- **Air conditioners:** Replacement of old AC's with new energy efficient star rated AC's.
- **Light loads:** Majority of the lighting fixtures are fluorescent type (T12). By replacing these loads with LED light fittings will reduce the overall power consumption.
- **Ceiling fan loads:** Ceiling fans are installed in majority of the areas by replacing it with Brushless DC fans which consumes in the range of 25 to 30W at full speed, instead of 70W in normal fans, will reduce the power consumption considerably. Also while purchasing new fans priority should be given for BLDC

4. GENERAL DETAILS

The general details of the College are given below in table.

Sl.No:	Particulars	Details
1	Name of the College	Sri C Achutha Menon Government College
2	Address	Kuttanellur
		Thrissur -680014
3	Contact Person	Prof: PK Vijayan
4	Contact Phone numbers & Fax	0487-2353022
5	E-mail ID	govtcollegetcr@yahoo.co.in, scamgovtcollege@gmail.com
6	Type of Building	Educational Institution
7	Total area of college	25 Acre
8	Total Built Up area of college	7971m2
9	No: of electricity connections	04
10	No: of teachers	59
11	No: of non-teaching staff	24
12	No: of students	1324
13	No of departments	12
14	Annual Working Days	210
15	No: of Shifts	Day Shift (One) (9AM -4PM)

TABLE 3: GENERAL DETAILS

ENERGY AUDIT

OBJECTIVES

An energy audit is a key to assessing the energy performance of facility and for developing an energy management program. The typical steps of an energy audit are:

- Preparation and planning
- Data collection and review
- Plant surveys and system measurements
- Observation and review of operating practices
- Data documentation and analysis
- Reporting of the results and recommendations

1.1. Definition of energy auditing

In the Indian Energy Conservation Act of 2001 **(BEE 2008)**, an energy audit is defined as: **"The verification, monitoring and analysis of the use of energy and submission of technical report containing recommendations for improving energy efficiency with cost-benefit analysis and an action plan to reduce energyconsumption."**

1.2. Objectives of Energy Auditing

The objectives of an energy audit can vary from one plant to another. However, an energy audit is usually conducted to understand how energy issued within the plant and to find opportunities for improvement and energy saving. Sometimes, energy audits are conducted to evaluate the effectiveness of an energy efficiency project or program. In BCM College as per the request, we have assessed the energy consumption and saving opportunities at present scenario.

Methodology for the study

The methodology adopted for energy audit starts from historical energy data analysis, power quality analysis, monitoring of operational practices, system evaluation, cost benefit analysis of the energy conservation opportunities, and prepare plan for implementation. The proposals given in the report includes economical energy efficiency measures to reduce facilities unnecessary energy consumption and cost. The energy conservation options, recommendations and cost benefit ratio, indicating payback period are included in this report.

Details Work

The Scope of Work includes:

1. Historical energy data analysis.
2. Electrical, Mechanical and Thermal energy analysis.
3. Power Quality Analysis.
4. Identification of Energy saving opportunities.
5. Cost Benefit Analysis.

ABOUT COLLEGE

Sri. C. Achutha Menon Government College, Thrissur is an educational institution which draws inspiration from the Indian Constitutional values and the humanitarian visions imparted by it. The institution aims at helping its members realise the values and visions based on rights and duties envisioned by the constitution along with the intellectual and aesthetic development of the members to build up a society based on democratic and moral values.

Established on 14th of August, 1972 in the present IASC (then Government B Ed Training College) premises, the institution had 200 students and 9 teachers. Prof. Subbayyan T. R. was the first Principal. The College was affiliated to the University of Calicut.

In 1991 the college was shifted to its present site at Kuttanellur. The college strictly follows the Government and University rules and regulations in admission processes and day to day functions.

Ample facilities are provided to the members of the institution for developing an integrated personality. The institution maintains a library which contains more than 50000 books. The college has spacious playing fields for outdoor games. Apart from this the institution also provides Gymnasium facilities for the members. The institution provides facilities to students to participate in National Integration programmes and social awareness programmes by maintaining NCC. NSS units and various platforms like Red Ribbon Club, Nature Club, Bird Watching Club, Film Club etc. Apart from these statutory clubs and platforms, there are departmental level Inter Collegiate programmes organized by the students with the support of the faculty members of concerned departments. Annual elections to the posts of College Union are held following the norms of the Lyngdoh Committee Report and the directives and statutes issued by the University.

Vision

To mainstream the institution as a college that provides quality higher education and produces intellectually competent, emotionally balanced, morally strong and socially committed citizens

Mission

To impart and disseminate knowledge in an enabling academic environment to all sections of society with special reference to the educational, social, cultural and economic needs of the weaker sections.

College Crest and Motto

The College Motto is *Jnanam Param Jyothi,* the Sanskrit for *knowledge is the supreme light*.

The badge is pictorial representation of its vision and mission. Just beneath the name of the college is given the picture of a book kept open. Even in this era of advanced technology and scientific progress, books come handy in a big way for the dissemination of knowledge. Knowledge is power. The Sanskrit dictum *jnanam param jyothi* forms part of the insignia. Just above the name of the place where the college is situated, is given the picture of a flaming lamp which serves as a symbol of light,

dispelling darkness. That is what an educational institution does. It dispels the darkness of ignorance from the mind of everyone and transform all who enter its portals into better informed and civilized humans.

1. CONSTRUCTED AREA OF COLLEGE

The campus building is located in a center of lush greenery with ample free space. The main building and other buildings have ample ventilation. The construction of all buildings of Sri C Achutha Menon Government College Thrissur. have ample ventilation and air flow and keeping a silent atmosphere to the students.

Sri C Achutha Menon Government College Thrissur constructed the building to optimum utilisation of land and classrooms and with abundant light and natural ventilation. Maximum day light ingression and natural ventilation increases the indoor air quality and avoid the sick building syndrome. The whole facility and buildings are designed to maximum and optimum utilisation of land is done.

Sl No:	Particulars	Area in M2
1	Main Block	2470
2	Old Library block	372.4
3	Mini Auditorium	186.2
4	Old Auditorium	775
5	Science Block	1742
6	Academic Block-1	270.34
7	Academic Block-2	523.64
8	Ladies Rest Room	97.4
9	Ladies Hostel	1044.32
10	Canteen	120
11	Amenities Centre	90
12	New awaiting room	60
13	Boys wash area	70
14	Parking	100
15	Total	7971.06

'Table 4 BUILT UP AREA OF COLLEGE

ELECTRICITY CONSUMPTION ANALYSIS

2. BASELINE DATA & CONSUMPTION

Base Line Data	College Building-1	College Building -2	Hostel	Others
Connection	KSEB			
Voltage	415			
Tariff	LT-6A Three Phase	LT-6A Three Phase	LT-6B Three Phase	LT-7A Commercial
Consumer No:	1156773007612	1156774007613	1156772020464	1156777012607
Billing Period	Monthly	Monthly	Monthly	Monthly
Connected Load (kW)	34	4	18	3
Average monthly electricity consumption (kWh)	4193	1677	557	450
Average fixed charges (Rs/month)	2210	260	1440	210
Meter rent	17.65	17.65	17.65	7.14
Average monthly electricity cost (Rs)	20,000	926	1459	1210

TABLE 5 : BASELINE DATA

Inference

i. College Building Spaces major share of energy consumption.

3. ELECTRICITY BILLS ANALYSIS

The Electricity bills analysis of the college and other buildings are given below:

College Building -1

Months in year 2020	Energy Consumption	Fixed Charges Meter Rent	Electricity Charges	Electricity Duty	Total Electricity Charges
January	**4720**	**2228**	**30660**	**3066**	**35976**
February	**4450**	**2228**	**28925**	**2892**	**34045**
March	**3525**	**2228**	**22912**	**2291**	**27431**
April	**1200**	**2228**	**7800**	**780**	**10808**
May	**1100**	**2228**	**7150**	**715**	**11878**
June	**1416**	**2228**	**9504**	**950**	**12712**
July	**1006**	**2228**	**6539**	**653**	**9421**
August	1022	**2228**	6774	**677**	9679
September	**1175**	**2228**	**7638**	**764**	**10630**
October	**2965**	**2228**	**19273**	**1927**	**14344**
November	**3716**	**2228**	**24154**	**2415**	**28102**
December	**2341**	**2228**	**15216**	**1521**	**18966**

TABLE 6: EB BILLS – COLLEGE BUILDING

Note: We have not taken other bills due to Covid pandemic, the electricity is not being used in these closed areas.

ENERGY PERFORMANCE DETAILS

The objective of this subsection is to establish how the facility is performing in terms of energy consumption

MAIN INCOMER TO COLLEGE

The EB Incomer was logged by using the power quality analyzer Krykard ALM 35. Logged details are given below in the table -8

Measurement values – 433 V side				
Actual Energy for 20 Hrs	kWh	**23.33**		
Apparent Energy for 20 Hrs	kVAh	**23.93**		
Power Factor	**0.97**			
Particulars	**Units**	**Minimum**	**Maximum**	**Average**
Active Power	kW	0	21.20	11.73
Apparent Power	kVA	0	21.92	12.03
Reactive Power	kVAr	0	3.493	1.58
Voltage Line	Volts	0	424.4	393.6
Current	Amps	0	39.2	16.68
THD V	%	0.6	7.8	1.09
TDD A	%	6.2	50.7	16.05
Voltage Imbalance	%	0	1.9	0.49
Current Imbalance	%	0	88.6	21.16

CONNECTED LOAD DETAILS

LIGHTING AND FAN

Effective lighting is essential for process and utility areas to carry out their work properly, yet it is possible to achieve significant savings in this area and improve the quality of the lit environment. Good lighting design can reduce costs and have the added benefit of decreasing internal heat gains, thus reducing the need for air conditioning too. The lighting details of the Sri C Achutha Menon Government College Thrissur at various buildings are given below:

MAIN BLOCK

Area	T-12	T-8	T-5	LED TUBE	LED Bulb	CFL	Ceiling fan	Exhaust Fan
Power in Watts	40	36	28	20	9	11	70	40
Class Rooms			83	61		1	112	
Departments			16	19			15	
Lab			6	3			11	02
Common area and Facilities'			22		8		15	
Office			12		13		8	

Mini Auditorium			38				20	
Library	7	6	0	12	19		8	
Total No	7	6	177	95	40	1	189	02
Total kW	0.28	0.432	4.956	1.9	0.36	0.011	13.23	0.08
Grand Total in kW	**21.249**							

SCEINCE BLOCK

Floor/Area	LED BULB	LED tube	Ceiling fan	Exhaust Fan	Pedestal Fan
	9	20	70	40	60
Ground Floor					
Class Rooms		25	24		1
Departments	1	10	6		
Lab		10	8		
Common area		11	0		
First Floor					
Class Rooms		27	25		
Departments	1	6	4	1	
Lab		9	7		
Common area		9	0		
Second Floor					
Class Rooms		17	16		
Departments	1	8	5		
Lab		17	15		
Common area		8	0		
Total No	03	157	110	01	01
Total kW	0.027	3.140	7.7	0.004	0.006
Grand Total in kW	**10.877**				

PHYSICAL EDUCATION BLOCK

Floor	LED Bulb	T-5	Ceiling fan
Power	9	28	70
Rooms	4	27	28
Physical fitness centre		9	6
Ladies waiting room	4		4
Total No	8	36	38
Total kW	0.072	1.008	2.660
Grand Total in kW	3.74		

Ladies Hostel

Floor	LED TUBE	LED Bulb	LED	T-5	Ceiling fan	Exhaust Fan
Power	20	9	80	28	70	60
Ground Floor						
Hall					1	
Dining Hall		1		3	4	
Kitchen	1			3	4	1
Room				3	3	
Rooms	7			7	7	
Bathroom	4	1				
Toilet	4			1		
Warden room				1	1	
Office				1	1	
Veranda				2	3	
First Floor						
Toilet	4			1		
Bathroom	4	1				
Rooms	10			10	10	
Veranda		1		2	2	
Terrace			4			
Total No	34	4	4	34	36	1
Total kW	0.68	0.036	0.32	0.952	2.52	0.06
Grand Total in kW	**4.568**					

Total Computer &Printer loads

Particulars	Computer	Printer	Projector
	100	150	300
Main Block	50	11	6
Science Block	35	03	1
Total No	85	14	7
Total kW	8.5	2.1	2.1
Grand Total in kW	**12.7**		

AIR CONDITIONERS

Particulars	Rated Capacity	Star Rating	Quantity	Power consumption
Principal Office	1.5	5	01	1.452
Seminar Hall	1.5	No star	04	1.65
Total No			05	
Total kW	**8.05**			

OTHER MISCELLANEOUS LOADS

Particulars	No	Rated Load in watts	Total Load in kW
UPS	02	2000	4
Pumps	03	1250	3.75
Fridge	1	400	0.4
Grinder	1	1400	1.4
Mixer	1	1250	1.25
Induction cooker	02	1000	2
LED TV	02	200	0.4
Grand Total in kW	**13.2**		

SUMMARY OF LOADS

The details of the loads installed in the college are given below:

Sl.No:	Particulars	Total Load	In %
		kW	
1	Light Loads	14.173	19
2	Fan Loads	26.26	35.3
3	Computers & UPS loads	16.7	22.5
4	Air conditioners	8.05	10.8
5	Miscellaneous loads	9.2	12.3
	Total	**74.383**	**100**

TABLE 7: CONNECTED LOAD AS EQUIPMENTS

LUX MEASUREMENTS

According to National Lighting code-2010 BIS to determine the overall energy efficiency of lighting system using measurements and methods, which is applicable to all commercial buildings. One of the methods is Illuminance method, which is the most practicable one. Details are given in the section. Lux levels of some areas are given in the Table. The lux levels mentioned as satisfactory need to be improved.

Sl. No.	AREA	Measured Lux	Required Lux	Remarks
1	Economics classroom	150	150	Satisfactory
2	Language Lab	165	150	Good
3	Commerce class	170	150	Good
4	Computer lab	180	150	Good
5	Office	180	150	Good
6	Psychology class room	180	150	Good
7	Entrance	250	150	Good
8	Statistics department	145	150	Satisfactory
9	Sports centre	290	150	Good
10	Computer Science	220	150	Good
11	Hostel ladies	160	150	Good
12	Amenity centre	170	150	Good
13	Library	190	150	Good

Table 8: LUX MEASUREMENT

ANNEXURE-1

ENERGY SAVING PROPOSALS - 1

REPLACEMENT OF CEILING FANS IN THE OFFICE WITH ENERGY EFFICIENT BLDC FANS

Background

A BLDC fan takes in AC voltage and internally converts it into DC using SMPS. The main difference between BLDC and ordinary DC fans is the commutation method. A commutation is basically the technique of changing the direction of current in the motor for the rotational movement. In a BLDC motor, as there are no brushes, so the commutation is done by the driving algorithm in the Electronics. The main advantage is that over a period, due to mechanical contact in a brushed motor the commutators can undergo wear and tear, this thing is eliminated in BLDC Motor making the motor more rugged for long-term use. To explain, BLDC technology in simpler terms, BLDC uses a combination of Permanent Magnets and Electronics to achieve the kind of efficiency and performance, it delivers. A BLDC fan composes of 3 main components: - 1. Stator 2. Rotor 3. Electronics

Proposal

Replace the ceiling fans with BLDC in the as per preference of operating hours as office areas., staff rooms and in security cabin and in hostels the calculation for the savings is given in the table.

Particulars	Units	BLDC fan	With BEE star rated
Existing Ceiling Fans	Watts	70	70
Proposed BLDC Fans	Watts	35	55
Difference in Wattage	Watts	35	15
Avg No: of working hours/day	Hrs	10	10
No: of working days per year (Average)	Days	250	250
No: of working hours per annum	Hrs	2500	2500
Number of Fans operating	Nos	50	50
Energy Saving per Annum	**kWh**	4375	**1875**
Cost per kWh	Rs	6.5	6.5
Annual Financial Savings	**Rs**	**28438**	**12188**
Cost of BLDC Fans	Rs	3000	1900
Salvage value of fan	Rs	300	300
Investment for Fans	Rs	135000	80,000
Simple Payback period	Months	57	79

TABLE 9: EC PROPOSAL 1

ENERGY SAVING PROPOSALS – 2

REPLACEMENT OF FLUORESCENT TUBES WITH ENERGY EFFICIENT LED LIGHTS

At present LED lights are used in very few areas. Replacement of Fluorescent lights to be done in phase manner with LED lights.

Particulars		T-12	T8	T-5
Existing Fluorescent lights	Watts	40	36	28
Proposed LED light	Watts	20	20	20
Difference in Wattage	Watts	20	16	8
Avg No: of working hours/day	Hrs	8	8	8
No: of working days per year (Average)	Nos	250	250	250
No: of working hours per annum	Hrs	2000	2000	2000
Number of Lights operating for change	Nos	7	6	110
Energy Saving per Annum	**kWh**	**280**	**192**	**1760**
Cost per kWh (Average)	Rs	6.5	6.5	6.5
Annual Financial Savings	**Rs**	**1820**	**1248**	**11440**
Cost of LED light	Rs	300	300	300
Investment for LED lights	Rs	2100	1800	33000
Simple Payback period	Months	14	17	35

Summary

Annual Energy Savings	kWh	2232
Total Financial Savings	Rs	14508
Total investment	Rs	36900
Payback period	Months	30.5

TABLE 10: EC PROPOSAL 2

Reason for change in the lighting system

- Lighting quality can have a dramatic influence on the attitude and performance of working persons, if they have an environment that with proper uniform lighting.
- In addition to the lumens per watt which is a lighting quantity calculation lighting quality and life of lighting system is also to be considered.
- Lighting quality can be divided into Uniformity, Glare, Colour rendering Index, coordinated colour temperature.
- In case of consistency and in uniformity, the life time of LED is far better than CFL s and FTLs.
- Deterioration of lumens or lux level in FTLs and CFL are more as compared with LED which is consistent during in its life time.
- Considering VCP (Visual Comfort Probability) LED is better option than FTLs and CFL because the glare value is lesser.
- The LED are whitish in colour than FTLs which is giving a better feeling of brightness to the persons occupied or working
- CCT of LED is 5000k which is white as compared with lesser CCT for FTLS of 4500 k
- There is no mercury content in the LED as compared with CFL and FTL s hence it is environmentally supportive.
- The life cycle data of tube lights with LED is given in the table below.

Type of lamp	Typical life in Hours	Cost per lamp	No: of lamps required during LED lifetime (led 60,000 Hours)	Replacement cost per lamp	Approximate maintenance expense for replacement	Total cost per lamp
T12	5000	45	12	540	500	1040
T8	5000	45	12	540	500	1040
T5	5000	100	12	1200	500	1700
LED	60000	800	1	800	0	800

Table 11: Lifecycle data of light types

ENERGY SAVING PROPOSAL-3

INSTALLATION OF 20 kW SOLAR ON GRID SYSTEM

The Sun is an inexhaustible, reliable and non-polluting source of power. Since the inception of life on earth, the only energy that was available came from the sun. The time is now approaching when mankind will again depend upon the sun as dominant energy source. We are aware that fossil fuels are not going to last forever. A growing worldwide concern for conservation of energy has reignited our interest in ecologically sustainable materials, processes and sources of energy.

Of the numerous renewable sources of energy known to mankind, Solar Photo Voltaic or SPV is one that has the potential to supply power for our future needs. The advantages of solar power are:

- The solar energy is more evenly distributed in the world than wind or biomass.
- It is well proven and demonstrated technology
- It promises to be most cost-effective renewable power at high volumes.
- The solar energy potential in India is immense due to its convenient location near the Equator. India receives nearly 3000 hours of sunshine every year, which is equivalent to 5000 trillion kWh of energy.

Solar Grid Tie mode system of **20 kW as rooftop**, can be installed at Sri . C Achuthamenon Govt. College, Kuttanellur without any modification in the electrical system.

Summary:

Particulars	Unit	Values
Proposed system	kW	20
Average Energy Consumption	kWh/day	80
Average Energy Consumption	kWh/year	24000
Average utility electricity cost	Rs	6.5
Annual Financial Savings	Rs	156000
Investment (subsidized & in grid tied mode)	Rs	12,00000
Simple payback period	Months	77

Table 12: ECPROPOSAL3

ANNEXURE-2

1. LED specification

The Department of Electronics and information technology issued "Electronics and information Technology goods order 2012" on 3rd October 2012 the following standards for LED lamps are covered.

1. IS 15885 (Part -2/section 13)
2. IS 16102 (Part-1): 2012

As per this order LED manufactures to get their product tested from BIS recognised labs.

Thus, the following electrical parameters and standards should ensure while purchasing LED in future based on the BIS standards. These are the minimum technical requirements for the acceptance of LED. Also, the LED test certificates as per the various standards mentioned below should be examined while purchasing.

Sl no	Parameters	Requirements	Applicable IS
1	Light source	SMD LED chip	LM 80/IS 16106
2	System Efficacy	>= 110 lumen /watt	IS 16106:2012
3	LED Driver Efficiency	Minimum 85%	
4	**Harmonics**	**Maximum 10%**	**IS 16102-2-2012**
5	**Power factor**	**Minimum 0.95**	**IS 16102-2**
6	Frequency	50 Hz ±3%	LM-79 report
7	Operating voltage	110V – 320V	LM 79 report
8	Surge voltage	>4 kV	LM 79 report
9	Ambient temp	-10 to 50 deg C	LM 79 report
10	Degree of protection	IP 66	IS 10322
11	CRI	Minimum 70	IS 16102 - 2

TABLE 13: LED SPECIFICATION

2. BLDC SPECIFICATION

Normal trend of one ceiling fan working hours with present cost while replacing with BLDC fan and the payback period is given in below table.

Number of working hours/day for a single ceiling fan	**Hours**	9	10	11	12	13	14	15	16	17	18	19	More than 20
Simple payback period after replacement with BLDC	**Years**	5	5	4	4	4	3	3	3	3	3	3	2

The BLDC fan test certificates as per the various standards mentioned below should be examined while purchasing.

Sl no	Parameters	Requirements	Applicable IS
1	Air delivery	215 CMM	IS 374 - 2019
2	Harmonics	Maximum 10%	IS 374 - 2019
3	Power factor	Minimum 0.95	IS 374 - 2019
4	Frequency	50 Hz ±3%	IS 374 - 2019
5	Insulation resistance	>2 MΩ	IS 374 - 2019
6	Speed	350 rpm	IS 374 - 2019
7	Maximum temperature rise	70 deg C	IS 374 - 2019
8	Degree of protection	IP 65	IS 10322

Table 14: BLDC specification

ABBREVIATIONS

APFC	:	Automatic Power Factor controller
AVG	:	Average
BDV	:	Breakdown voltage
BEE	:	Bureau of energy efficiency
CEA	:	Central electrical authority
CFL	:	Compact fluorescent lamp
CFM	:	Feet cube per minute
DB	:	Distribution Board
DG Set	:	Diesel Generator Set
EC	:	Energy Conservation
FD	:	Forced draft
HPSV	:	High-pressure sodium vapour
HT	:	High Tension
ID	:	Induced draft
IEC	:	International electro technical commission
IEEE	:	The Institute of electrical and electronics engineers
IS	:	Indian Standard
KG	:	Kilogram
KVA	:	Kilo Volt Ampere
KVAH	:	Kilo volt Ampere Hour
KVAR	:	Kilo volt-ampere
KW	:	Kilo Watts
KWH	:	Kilowatt-hour
LED	:	Light emitting diode
MAX	:	Maximum
MH	:	Metal halide
NEMA	:	National Electrical Manufacturers Association
OLTC	:	On load tap changer
ONAN	:	Oil natural air natural
PCC	:	Point of common coupling
PSI	:	Pound square inch
RMD	:	Registered Maximum demand
SEC	:	Specific electricity consumption
SFU	:	Switch Fuse Unit
SLD	:	Single Line Diagram
TDD	:	Total demand distortion
THD	:	Total harmonics distortion
TOE	:	Tonne of oil equivalent
UPS	:	Uninterruptible power supply
VFD	:	Variable frequency drive

INSTRUMENTS USED

SL.NO	EQUIPMENT DESCRIPTION	MAKE & MODEL
1	Power energy & harmonic Analyser	Krykard ALM 35
2	Thermal Imager	FLIR E50

TABLE 15: INSTRUMENTS USED

REFERENCES

1. BEE energy audit books
2. CEA regulations of grid connectivity-2007
3. IEEE Std. 519-1992.
4. National lighting code - 2010

ENERGY IS LIFE
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BUREAU OF ENERGY EFFICIENCY

Examination Registration No.: EA- 7597

Accreditation Registration No.: AEA-0275

Certificate of Accreditation

This is to certify that Mr./Ms. Santhosh. A having its trade/registered office at Kerala has been given accreditation as accredited energy auditor. The certificate shall be effective from 2nd day of November, 2017

The certificate is subject to the provisions of the Bureau of Energy Efficiency (Qualifications for Accredited Energy Auditors and Maintenance of their List) Regulations, 2010.

This certificate shall be valid until it is cancelled under regulation 9 of the Bureau of Energy Efficiency (Qualifications for Accredited Energy Auditors and Maintenance of their List) Regulations, 2010.

On cancellation, the certificate of accreditation shall be surrendered to the Bureau within fifteen days from the date of receipt of order of cancellation.

Your name has been entered at AEA No. 0275 in the register of list of accredited energy auditors. Your name shall be liable to be struck out on the grounds specified in regulation 8 of the Bureau of Energy Efficiency (Qualifications for Accredited Energy Auditors and Maintenance of their List) Regulations, 2010.

Given under the seal of the Bureau of Energy Efficiency, Ministry of Power, this 12th day of February, 2018

Secretary,
Bureau of Energy Efficiency
New Delhi