ENERGY ENVIRONMENT GREEN

AUDIT REPORT

OF

All India Institute of Speech and Hearing

(An Autonomous Institute Under Ministry of Health & Family Welfare, Govt.of India)

Center of Excellence - Assessed & accredited by NAAC with "A" Grade

ISO 9001:2015 Certified Organisation

Month & Year – April 2021

Conducted By

RACHANA ENER CARE

Energy management Co

No555/I,13th cross,TK lay out ,Beside BSNL RTTC

Saraswati puram (p)Mysuru- 570009 - Ph-9449837309

www.rachanaenercare.com, Mail;

rachanaenercare@gmail.com

Acknowledgement

We appreciate the initiation taken by All India Institute of Speech & Hearing for taking interest to have energy environment & green audit . This will not only benefits institution, but society at large.

We are thankful for AIISH for giving this opportunity to us. This is a great opportunity for us to serve in our passionate area of energy & environment.

We are thankful to Director Prof Dr. M.Pushpavathi, for this initiation and giving consent to conduct detailed audit.

We are thankful to HOD Electronics , Sri.N. Manohar & *Horticulture* Officer Sri Girish for their keen interest , involvement & support.

We are thankful to electrical maintenance in charge Shivakumar for being with us in taking readings , collecting data. Thanks to all office staff & other members who supported us in audit process.

Head of NIE CREST (National Institute of Engineering) Mr. Sham sunder has provided vital information and constancy in waste management & green technologies. Thanks to him.

We need to mention our gratitude to all work force of institution, who have co operated and shared information during our frequent visit to campus.

Sustainability in Energy & Environment is every one's need & its conservation is every one's responsibility. But practicing is a challenge. We are sure that AIISH will go ahead in this regard.

Thanking you.....

For RACHANA ENER CARE

ANIL KUMAR NADIGER BE(E & E)M.I.E

(DIRECTOR & ENERGY SPECIALIST)

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3.Executive Summary

This audit has been done with intention of identifying energy & environment conservation initiative taken by institution. This report also suggests scope for improvement

Highlighted points of the report are as under.

ENERGY:

Institution needs about 6,75,000 units of energy annually.

It generates solar energy through its 472 kwp plant, which directly or indirectly ,meets almost 97% of their energy consumed by them.

Solar Capacity utilisation factor is good. (>16%) .(compared to maximum achievable of 19% in large plants)

Institution has contract demand of 700kva ,But Maximum demand recoded is with in 125 kva. Keeping solar capacity & future need in mind 100kva can be safely reduced.

Power factor maintained by system is very good . It has maintained above 0.95 through out the year

Solar power also integrated with diesel generator , thus reducing its fuel consumption up to 30%

Majority of lightings are CFL , and T5 tubes.LED share is about 25%, which needs to be improved in phased manner. Natural Day light usage is satisfactory.

Air conditioners are major connected load in the institution . It is maintained well and usage is limited .

An old water cooled chiller system of capacity 7.5 + 7.5 Kw is working in the premises. This has to be changed to air cooled system. Both as energy conservation & water saving measure

Ladies hostel is having electric heater for hot water requirement . This is 33kw total and consumes 50% of energy of hostel premise. Replacement of this heater by solar water heater and heat pump is in process.

Higher capacity pumps used in campus are inefficient. Long running pumps to be replaced immediately.

Out of eight UPS , six ups are found at working at very low power factor. Efficiency level is not up to present standard. Different option for its improvement is given in this report.

It is also suggested to optimise UPS battery size to reduce running cost and also to reduce lead waste.

Hospital has 3nos of 10kva UPS. This can be changed to 12.5 kva , 2nos parallel redundant ups . This saves energy, increases reliability & reduces battery cost also.

Automation is one of effective way to save energy. Presently no automation system noticed. We recommend installing astronomical timer for street lights, pumping automation and occupancy sensors for AC and exhausting fans.

Water TDS is high of about 700 ppm. This results in efficiency loss in pumping system , creates problem electric heaters, reduces life of solar water heaters. It is recommended to install water softener

Institution has TOD based tariff system. Best time to utilise energy is day time, when solar is generation energy, next preferred time is 10pm to 6am. After studying , we suggest to shift some load to preferred time zone. Pumping can be planned to switch on during day. Storage can be designed accordingly. In addition hostel is using electric heater 6pm to 8pm. Heaters can be switched on by 4pm & keep hot water ready . This reduces 50% of energy used in peak hour. It is also suggested to reduce night electric load by auto dimming of lights, use of SMPS based chargers for UPS, etc. It is also suggested to use heat pump after peak hour once it is installed. There are chances that ,it may switch on automatically after 8pm , once all hot water is utilised.

2000 ltr capacity solar heater is planned to install in ladies hostel in place of electric heater. It is also planned to install heat pump as back up heater. After observing student strength and usage pattern , we feel 2000 ltr is not sufficient. It is better to have 5000 ltrs, thus dependency on heat pump will be reduced .

Frequent measurement and recording will help in getting precise data on time. In this regard we suggest at least one energy monitoring system to main feeder and also energy meters to all generators, guest house and quarters main feeder.

We suggest to install hour meters to main pump. This will help to know energy consumption of pump and also to analyse water usage

ENVIRONMENT:

Greenery:

Institution has best utilised available land to maintain greenery. Lawn, gardening and decorative plants are maintained well. Greenery maintenance on walls of audiology building is appreciable.

We also appreciate leaf composting, wormy composting done by horticulture staff.

Institution campus has about 25 % of space is covered by ginnery.

Waste management:

Institution comes under bulk producer category, hence it has to follow guide lines given by corporation and pollution control board

Hazardous medical waste is handed over to authorised agency.

Lead waste (batteries) are given to authorised dealer on buy back basis till date. But recently , batteries have been purchased by GEM portal ,which does not have buy back facility. Now it has to be given to authorised battery recycler or their agents.

Institution produces e waste such as computer spares, electrical fittings ,etc. Its quantity is low, of about 100 kgs per year. This also being handed over to regular scrap dealers. We insist that this has to be handed over to authorised e waste recycler, with category wise listing

CFL & florescent lamps has to stored separately . These contain mercury. This has to be handed over only after proper packing to avoid transit damage.

Dust bins have been kept at strategic locations. We suggest to keep separate dust bins for dry & wet waste, but together with clear marking in all the places. Pubic awareness has to be increased by putting boards.

During audit it is observed that dry & wet waste (food waste) is not dumped properly by students. It is better to educate them .

It is proposed in this report to have bio gas plant for both hostel and canteen as better waste management option.

Water conservation:

Institution has made a huge ground level tank to collect rain water. It is commendable. This will help in increase of ground water source. Institution has two bore wells for their water needs . In this connection we recommend to have proper rainwater harvesting for all buildings.

STP: Including quarters, hostel and all other occupants, about 60,000 to 1,00,000 liter of sewage per day is now flowing to corporation UGD. As per PCB norms it is mandatory to have STP in the premises. Construction of 2lakh LPD sewage treatment plant is in progress. We insist on testing treated water quality once STP is completed.

Awareness activities :

We did not find any boards or displays , which creates awareness to save energy & environment. Institution should stress on plastic free environment & use of proper dust bins to public . Hostilities and all office should be educated to save energy and water.

OVERVIEW OF ENERGY CONSERVATION OPTIONS SUGGESTED

Over view of Energy conservation measures recommended	Aproximate investment	Cost benefit (rs)	Remark
Changing UPS batteries from 26ahX32nos to 42ah 16nos	During next cycle	93000	(for every three years)500kgs lead waste reduction
Replacing old 10kva ups 5nos by new with more efficient UPS	3,75,000	1,21,800/-	improves PF also
Merger of two UPS to one at knowledge park or replace by 6kva	80,000	79800/-	savings in batteries + electricity savings extra benefit
Switch off inverter section during non working hours (2ups)	nil	63644	
Reducing capacity of 100 ah batteries to 65ah	During next cycle	1,95,000/-	(for every three years)812 kgs lead waste reduction
Replacing present 10kva 3nos UPS at hospital by 12.5 kva 2nos parallel redundant UPS	1,00,000/-*	1,00,000/-	*Considering savings in battery cost
Replacing present electricity heater by min 5000 ltr solar heater	presently 2000 ltrs planned	2,80,000/-	(about 40,000 units per annum)
Automation of street light, occupancy sensor to AC & exhaust, pumps	50,000/-	17500/-	Mentioned in NAAC observations also
Contract demand reduction by 100kva	nil	2,14,000/-	After studying MD, solar & future need
Reduction of LT bill in HT Apr,May,June 2020		15952/-	As observed in these bills (previous bills are not available)
Solar CUF (90kw) improvement from 3.35 to 3.77 (as compared to others)	installer scope	53808	13797 units @ 3.90rs

Replacing three pumps (2 pumps of hostel & one of bore well	58000	80000	
Energy usage & reduction based on TOD; Pump usage, Electric heater usage, Heat pump usage, SMPS charger ,etc	nil	12,000/-	about 3750 units
Replacing server room AC EER 2.6 to EER 4.0		15,000/-	about 2200 units
Use of fans along with ACs used for comfort & set temp to 25C	5% reduction		(as per BEE guidelines)
Replacing old 7.5kw X 2nos water cooled system to air cooled	For energy savings, Reliability & Water savings		

Note;

Energy conservation measures with about 3 years pay back period, and which have other benefits are considered

Energy cost depends on TOD, future energy need, export etc. For calculation purpose Rs7/- considered.

Some measures mentioned above are different option for same case & may be inter related to each other.

Above calculations are based on measurements and usage information taken from staff. It may vary on actual working condition

It is recommended to contact us and have interaction before implementing any change in system

4.INTRODUCTION

About AIISH:

The All India Institute of Speech and Hearing was established in the year 1966 as an autonomous institute fully funded by the Ministry of Health and Family Welfare, Government of India.

It has clean & green campus , which comprises Education related buildings ,library, COE, clinical, administration, hostel , staff quarters, etc

AIISH has been recognized as a center of excellence in the area of deafness by World Health Organization (WHO). It has also received recognition from the University Grants Commission (UGC) as a center for advanced research and from the Department of Science & Technology (DST) as a Science and Technology InstituteThe major objectives of the institute are to impart professional training, render clinical services, conduct research and educate the public on issues related to communication disorders such as hearing impairment, mental retardation, voice, fluency and phonological and language disorders.

Institution has shown its concern for energy & environment too by installing solar power generation, maintenance of greenery, parks, lawns . Two lakh LPD capacity STP plant is also in progress.

About Rachana Ener Care

Rachana ener care headed by Mr.Anil kumar Nadiger, is team of experience and qualified engineers, BEE certified energy manager and auditors. Its team members have under gone many trainings and certification programs. Such as ECBC, ASHRAE standards, Green buildings ,etc conducted by NPC- National Productivity Council, KREDL – Karnataka Renewable Energy development ltd, ISHRAE – Indian Society for Heating Refrigeration & Air conditioning engineers, SEEM – Society for energy engineers & managers, etc It has conducted many audits to reputed clients like South Western Railways, Karnataka Urban water supply & drainage board, Central work shop, Police training centre, Teresian college, NIE, Institution of engineers India & many more. They also conduct training & work shops.

We are backed by consultancy support of NIE CREST , headed by sri Sham sunder for green technologies such as bio gas, composters, rain water harvesting, sustainable energy etc.

ABOUT NIE CREST

NIE-Centre for Renewable Energy and Sustainable Technologies (NIE-CREST) is a renowned Green technology promoting centre at the premises of The National Institute of Engineering (NIE), Mysore. The centre promotes eco- friendly energy systems, Renewable energy and sustainable technologies. The Centre itself has successfully implemented numerous projects on eco friendly and - renewable energy systems and sustainable technologies at International & National Level. NIE -CREST provides technology for , Design & Implementation of Renewable Energy Systems, Design & project execution of Solar, Biomas & Other RE Devices, Design & Implementation of Sustainable Technologies, Design & implementation of Technologies for Green Building, Design and implementation Of Rainwater Harvesting Systems and many more.

5.Scope of Energy Environment Green Audit

This gives an over view of scope of audit .

ENERGY:

- Study present energy consumption scenario & analyse energy sources
- Record power, load ,voltage variation from grid
- Study major energy consuming loads
- Identify present energy conservation measures taken by institute
- Identify options to save energy & evaluate

ENVIRONMENT;

- Handling of of waste (Dry ,wet Hazardous waste)
- Lead waste generation and management
- Water conservation – Rain water harvesting & STP
- Proposal to implement green technologies

GREEN:

- Green cover
- Type of vegetation

GENERAL;

- Awareness activities done
- Plastic free environment initiatives

Report

- Comprehensive report covering all above.
- Annexure ; Reference books & photos

6.ENERGY SCENARIO

6.1 Energy Scenario:

Main source:	
CHESCOM	RRno-
Contract demand	700kva
Type of supply	HT 11KV
Tariff	TOD
Fixed charges	220Rs /kva for 595kva

Other sources:

Solar (SPVRT)	472 kwp
DG sets	250kva,125kva 500kva (since sept 2020)

Transformer centre:

Capacity	1000kva
Make	VMC
Volts pri /sec	11kv / 433 v
Current pri /sec	52.5 / 1333.4
winding	Copper
year	2015
IS	IS2026
Star rating / IEC	Not found on transformer label

Energy share of each source:

Based on the data collected and calculation, Energy requirement of institution campus including all buildings, hostel, quarters, guest house and sub meter is accessed as 6,84,500 units.

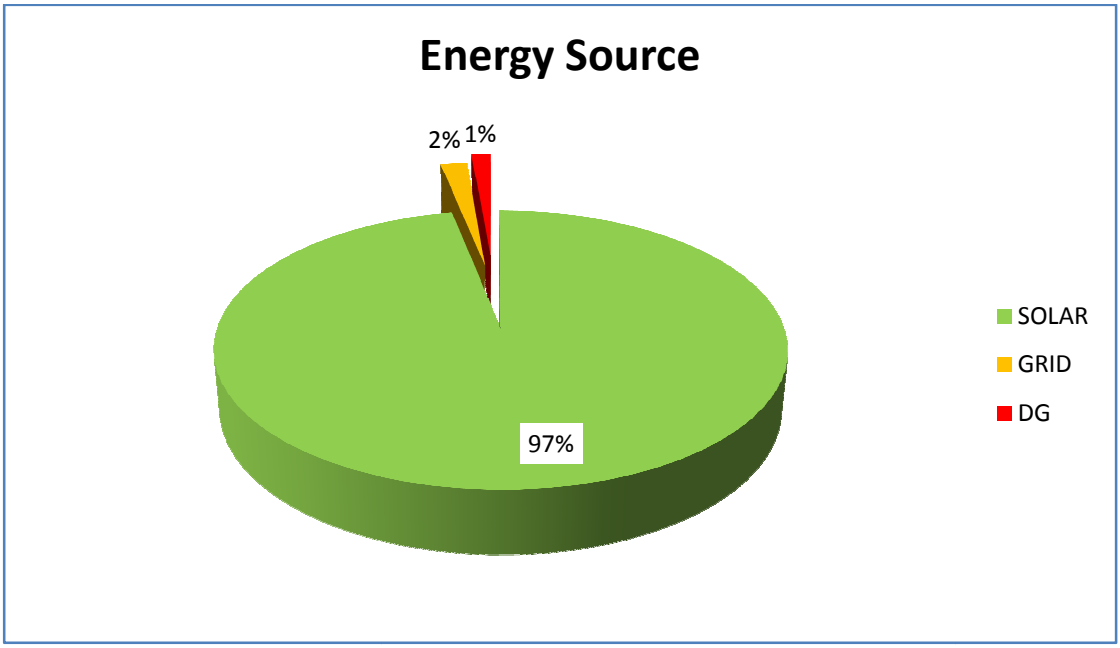
This energy is sourced from sources – CHESCOM , Solar and Diesel Generator . Solar roof top system of capacity 472 kwp serves as main source of energy. Even though solar is synchronised with grid supply on 'Net Metering ' system , institution is not compensated fully due to 'TOD' billing system. In other words solar energy exported in day time can not be compensated with energy import during night.

But considering over all impact on environment & benefit of society, we have considered energy imported during night to excess energy exported in day time . In this context institution has exported 331550 units and imported 344040 units during Apr 2020 to mar 2021. In other words institution has utilised only 12490 units (12500)of energy from chescom during that period.

Based on Solar energy generated, utilisation from grid and solar generation, energy source can be over viewed as below

SOURCE	UNITS	% share	REMARK *
SOLAR	672000	97%	At 3.9 units/ kwp /day average
GRID	12500	2%	Total import - export
DG	9000	1%	Based on 150 hours power cut and 20% average loading
Total	693500	100%	All sources

(*Details and calculations provided in preceding chapters)

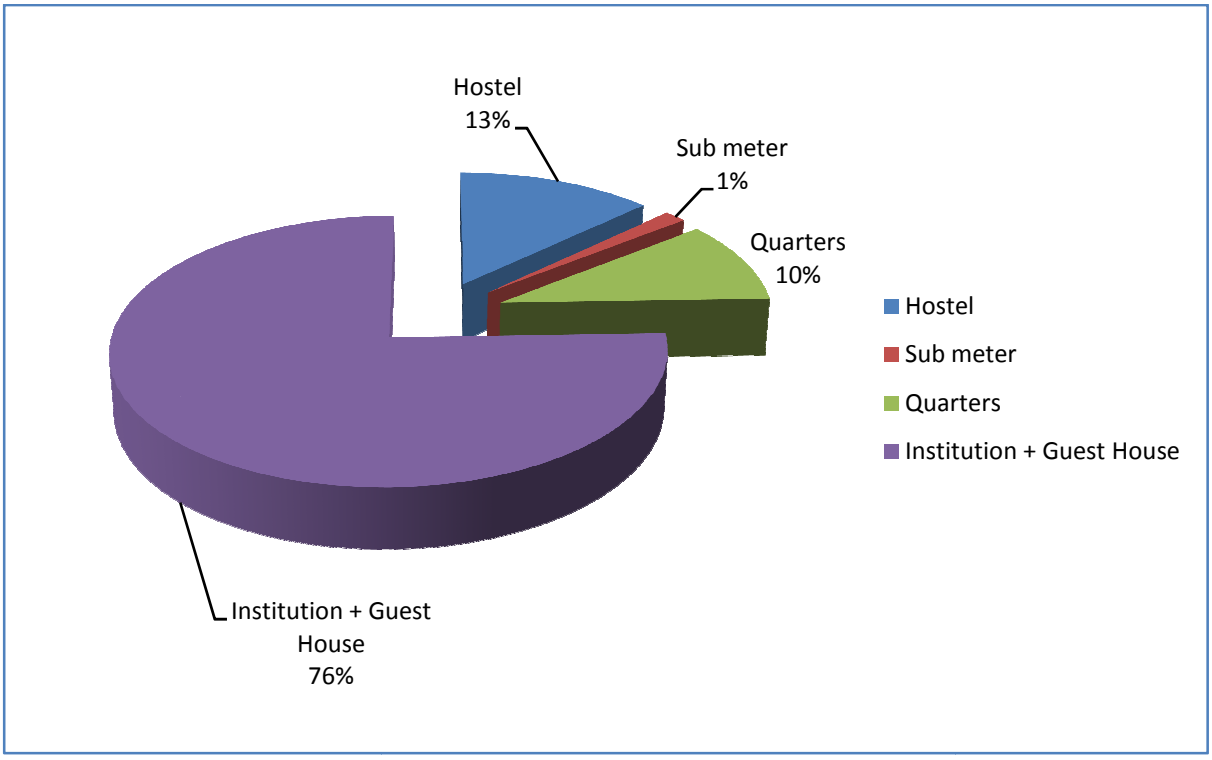


Energy Utilisation:

Energy utilisation is analysed as below. All sub meters , hostel and quarters reading is done regularly. Guest house consumption is not recorded on regular basis.

USAGE	UNITS PER ANNUM	% SHARE
Hostel	90000	13%
Sub meter	10000	1%
Quarters	70000	10%
Institution + Guest House	523500	76%
TOTAL	693500	100%

GRAPH:



Electricity bill analysis

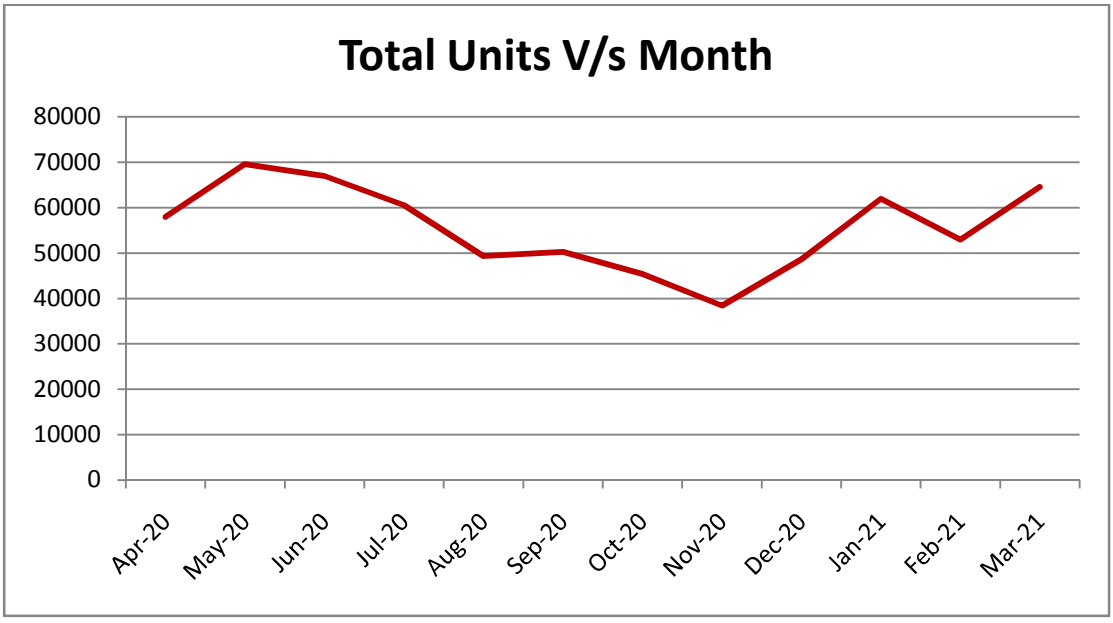
Month	import units	export units	sub meter	Chescom billed for	Checom paid for	PF	Import - Export	MD Kva
Apr-20	31840	41200	721	27560	36920	0.96	-9360	120
May-20	31800	29840	938	26760	24800	0.97	1960	134
Jun-20	29360	21720	687	23720	16080	0.96	7640	114
Jul-20	27000	20640	587	21613	15840	0.96	6360	104
Aug-20	26760	22840	595	21445	18120	0.97	3920	103
Sep-20	25000	22000	500	20000	18000	0.96	3000	105
Oct-20	24920	29280	679	19281	24320	0.97	-4360	107
Nov-20	23280	29230	732	17668	24440	0.97	-5950	108
Dec-20	29200	28280	708	20772	20560	0.96	920	122
Jan-21	31320	26440	640	23520	19280	0.96	4880	134
Feb-21	28440	28080	715	21485	21840	0.95	360	133
Mar-21	35120	32000	1159	26561	24600	0.96	3120	146
Total	344040	331550	8661	270385	264800	0.96	12490	119.17

Monthly energy consumption variation:

Monthly total energy consumption variation is recorded as below.This includes energy net consumed Energy consumption by Chescom and energy generated by Solar, based on kwp/day/kw recorded . Energy generated by the DG set is not added, since there is no practice of recording energy meter reading on DG side. But its contribution is assumed as negligible, because of less power cut and DG synchronisation with solar.

Lowest energy consumption is recorded in Nov 2020 , with 38370 units and highest energy consumption is recorded in month of 69559. Variation mainly depending on hostel occupancy and air conditioner usage. All other loads seems to be constant throughout the year.

MONTH	EB (Import- export)	Solar	Total units
Apr-20	-9360	67260	57900
May-20	1960	67599.84	69559.84
Jun-20	7640	59330.4	66970.4
Jul-20	6360	54138.4	60498.4
Aug-20	3920	45359.2	49279.2
Sep-20	3000	47209.44	50209.44
Oct-20	-4360	49748.8	45388.8
Nov-20	-5950	44320.8	38370.8
Dec-20	920	47700.32	48620.32
Jan-21	4880	57064.8	61944.8
Feb-21	360	52533.6	52893.6
Mar-21	3120	61454.4	64574.4



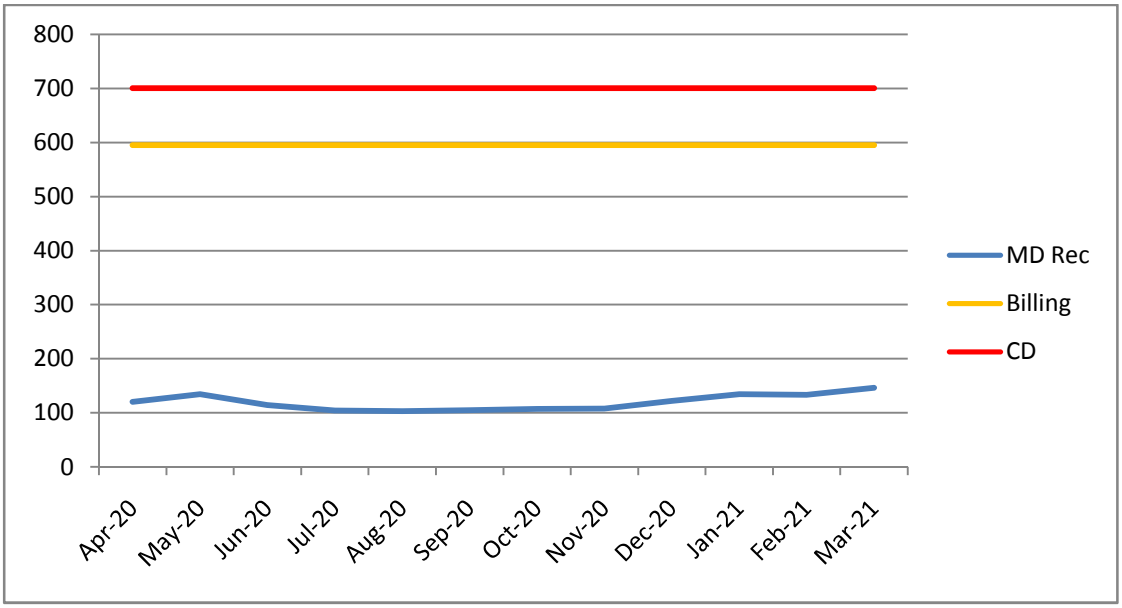
Maximum demand;

Institution has Contract demand of 700kav and billing demand of 595 kva at 85% of contract demand But actual utilisation is recorded as below. Need of more contract demand, its necessity and other related aspects are discussed in preceding chapters.

Month	MD Rec	Billing	CD
Apr-20	120	595	700
May-20	134	595	700
Jun-20	114	595	700
Jul-20	104	595	700
Aug-20	103	595	700
Sep-20	105	595	700
Oct-20	107	595	700
Nov-20	108	595	700
Dec-20	122	595	700
Jan-21	134	595	700
Feb-21	133	595	700
Mar-21	146	595	700

(All in KVA)

Graph

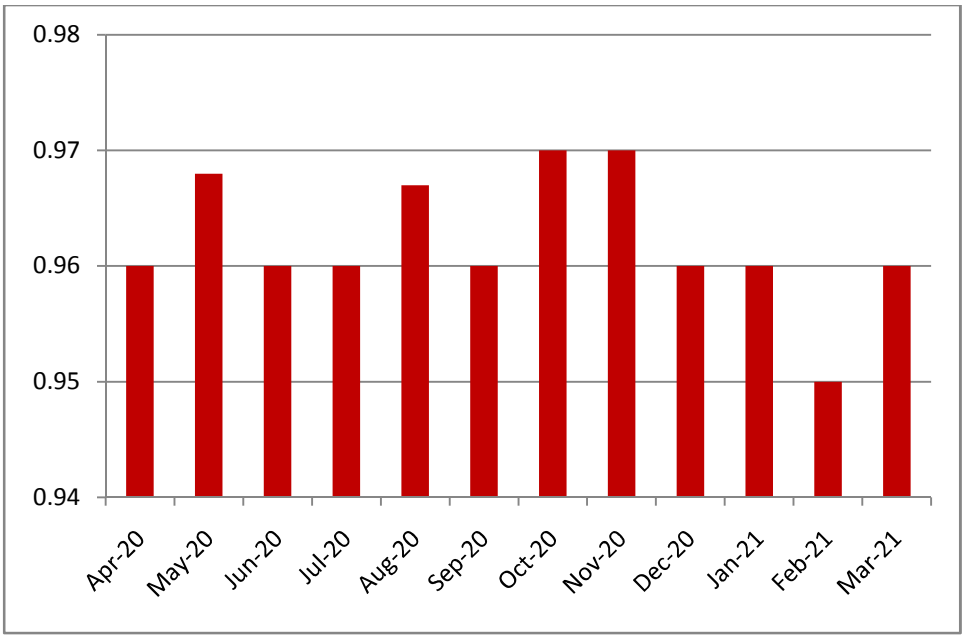


Power factor

Institution has maintained very good power factor . This indicates APFC (automatic Power Factor correction panel) is working in good condition. But during load analysis ,it is observed that many of UPS are working at very low pf of 0.4 . Pumps and Air conditioner are found working in their rated pf range of 0.75 to 0.83.

month	PF
Apr-20	0.96
May-20	0.97
Jun-20	0.96
Jul-20	0.96
Aug-20	0.97
Sep-20	0.96
Oct-20	0.97
Nov-20	0.97
Dec-20	0.96
Jan-21	0.96
Feb-21	0.95
Mar-21	0.96

Graph



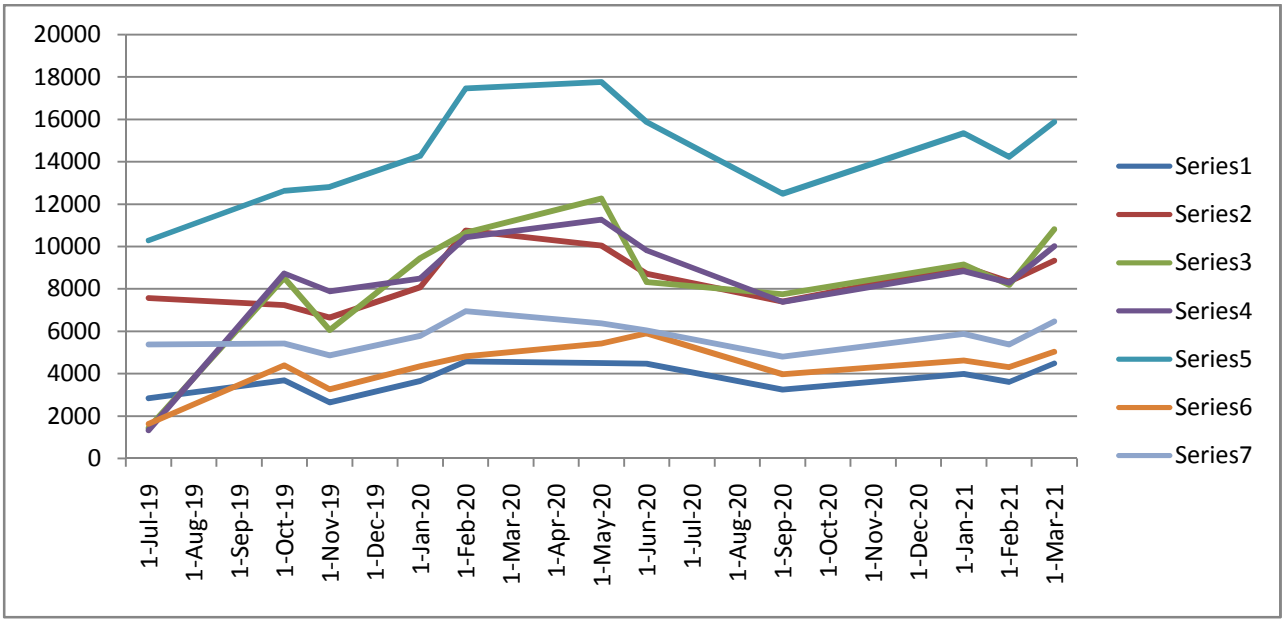
6.2 ELECTRICITY BILLS OF TWO YEARS

AWAITING FOR DATA

6.3 SOLAR PERFORMANCE ANALYSIS

CAPACITY	30KW	65KW	90KW	80KW	120KW	40KW	45 KW	472KW	
Month	**special Edu. buliding**	**Academic building**	**Audiology & admin building**	**New Audiolgy building**	**clinical building**	**Department of ENT building**	**speech and language building**	**TOTAL**	AVG KWH/DAY /KWP
5-Mar-19	4290.9	8986.6	11364.2	11399	16325.7	5133.1	6244.8		
3-May-19	4943	10381	0	0	0	0	6816		
3-Jun-19	4512	8657	0	0	0	0	6540		
2-Jul-19	2829	7565	1426	1323	10279	1636	5376	30434	2.089
4-Oct-19	3677	7225	8510	8723	12617	4399	5427	50578	3.471
1-Nov-19	2639	6638	6057	7872	12800	3265	4867	44138	3.130
2-Jan-20	3656	8079	9452	8481	14268	4352	5777	54065	3.711
3-Feb-20	4571	10747	10645	10423	17451	4812	6948	65597	4.813
4-May-20	4490	10040	12260	11260	17760	5420	6370	67600	4.640
3-Jun-20	4463	8702	8321	9804	15874	5899	6036	59099	4.191
2-Sep-20	3246	7394	7741	7378	12483	3967	4800	47009	3.334
4-Jan-21	3988	9035	9152	8835	15349	4621	5870	56850	3.902
2-Feb-21	3598	8337	8184	8280	14222	4308	5381	52310	3.975
3-Mar-21	4476	9331	10805	10014	15878	5022	6460	61986	4.254
	average				4.284911259				4.363286472
Total	472kw								

Graph



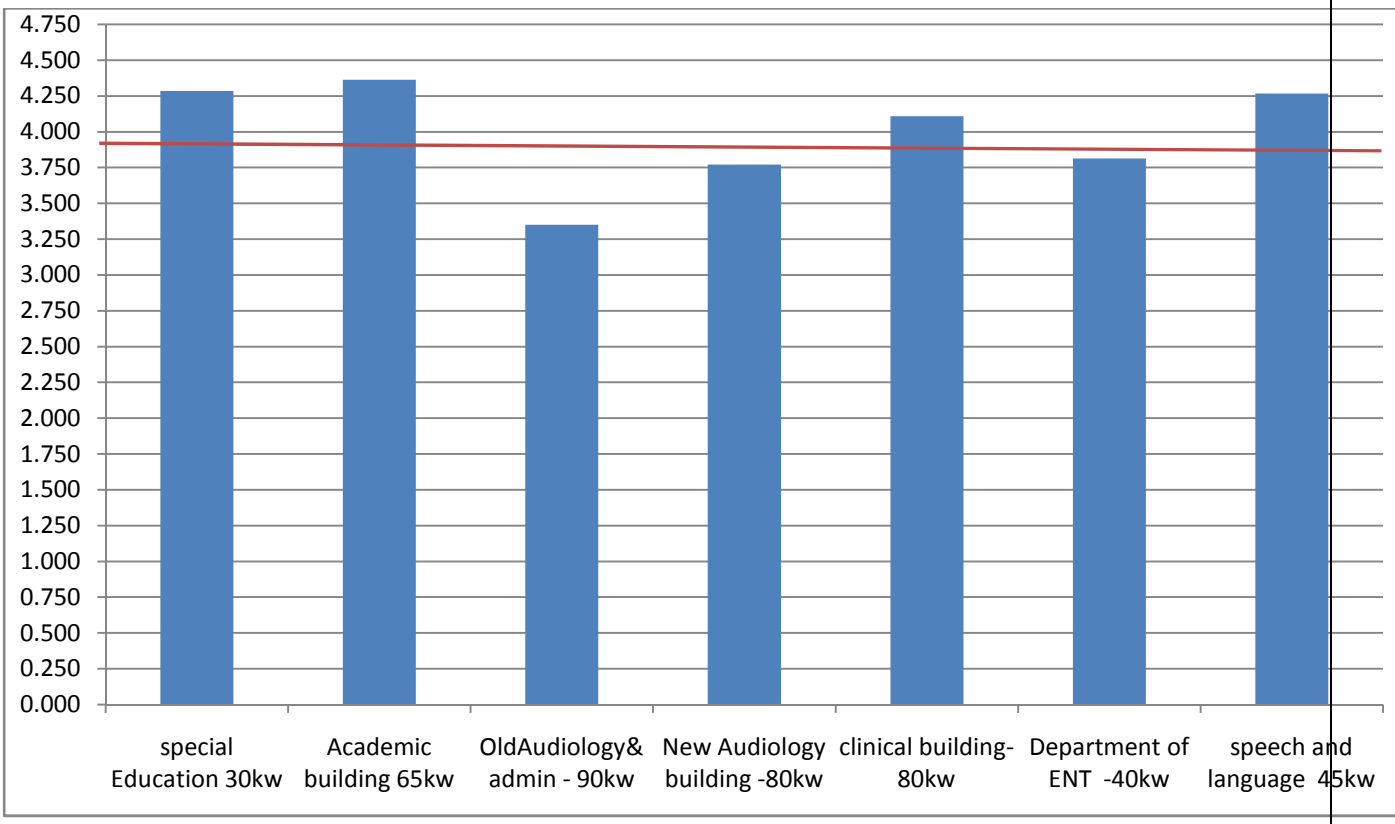
Comparison of capacity utilisation: KWH/KWP/DAY

Month	special Ed-30KW	Academic-65KW	Audiology& admin-90KW	New Audiology -80KW	clinical BLDG-120KW	Department of ENT - 40KW	Speech &language - 45KW	AVG KWH/DAY/ KWP
43742.000	3.954	3.586	3.050	3.517	3.392	3.548	3.890	3.471
43770.000	2.932	3.404	2.243	3.280	3.556	2.721	3.605	3.130
43832.000	3.931	4.009	3.388	3.420	3.835	3.510	4.141	3.711
43864.000	5.254	5.701	4.079	4.493	5.015	4.148	5.324	4.813
43955.000	4.828	4.983	4.394	4.540	4.774	4.371	4.566	4.640
43985.000	4.959	4.463	3.082	4.085	4.409	4.916	4.471	4.191
44076.000	3.607	3.792	2.867	3.074	3.468	3.306	3.556	3.334
44200.000	4.288	4.484	3.280	3.563	4.126	3.727	4.208	3.902
44229.000	4.283	4.581	3.248	3.696	4.233	3.846	4.271	3.975
44258.000	4.813	4.631	3.873	4.038	4.268	4.050	4.631	4.254
average	**4.285**	**4.363**	**3.350**	**3.771**	**4.108**	**3.814**	**4.266**	**3.942**

LOCATION	GEN KWH/KWP/DAY
special Education 30kw	4.285
Academic building 65kw	4.363
Old Audiology& admin - 90kw	3.350
New Audiology building -80kw	3.771
clinical building-80kw	4.108
Department of ENT -40kw	3.814
speech and language 45kw	4.266
average	3.994

CUF (PLF)	16.64
Industry standard	18.75

BAR GRAPH CUF COMPARISON:


4.750
4.500
4.250
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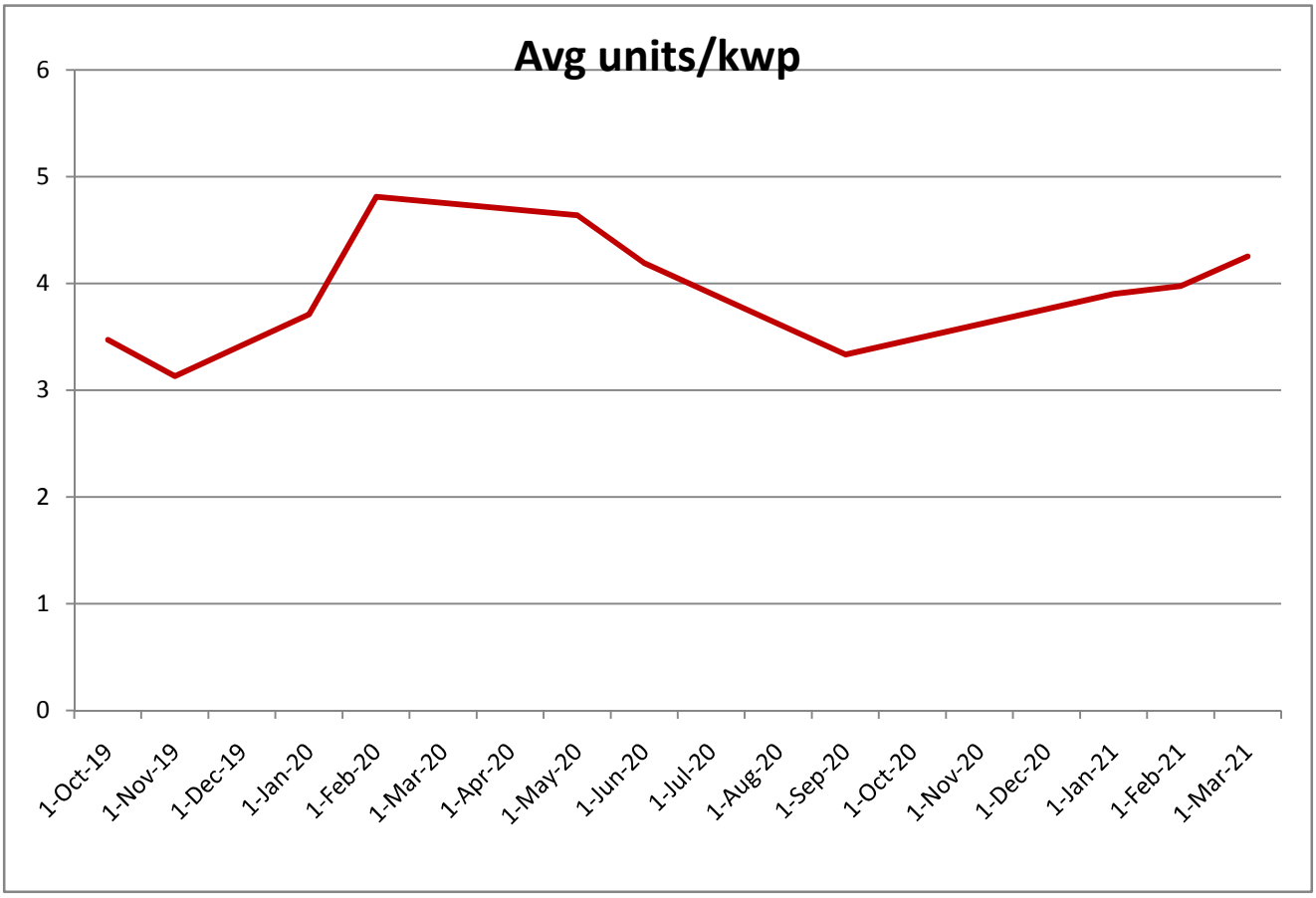
0.250
0.000
special Education 30kw
Academic building 65kw
OldAudiology& admin - 90kw
New Audiology building -80kw
clinical building- 80kw
Department of ENT -40kw
speech and language 45kw

Graph


Avg units/kwp
6
5
4
3
2
1
0
1-Oct-19
1-Nov-19
1-Dec-19
1-Jan-20
1-Feb-20
1-Mar-20
1-Apr-20
1-May-20
1-Jun-20
1-Jul-20
1-Aug-20
1-Sep-20
1-Oct-20
1-Nov-20
1-Dec-20
1-Jan-21
1-Feb-21
1-Mar-21

6.4 GENERATOR

Institution has three DG sets in main campus of capacity 250kva,125kva 2units. Among 125 kva 2nos only one is in working condition. Recently another 500kva added to cater new load which is expected to add in coming days. New loads include STP, new building, COE etc.

In general 250kva and 125 kva will work in power cut during day time. During night time only one DG will work, 250kva.

Solar has stared working on full fledge from July 2019. In this 30kw of special education is synced with 125kva DG set and 65+45 total 110kva at academic and speech building synced with 250kva. This has helped in reduce fuel consumption of DG.

	250 KVA			125 KVA old			125 KVA new			125 KVA panchavati		
month	**fuel**	**hours**	**avg**	**fuel**	**hours**	**avg**	**fuel**	**hours**	**avg**	**fuel**	**hours**	**avg**
Nov-17	180	8.1	22.22	125	8	15.62	0	0	0	60	14	4.28
Dec-17	400	12.8	31.25	135	9	15	0	0	0	28	9.5	2.94
Jan-18	540	22.7	23,78	195	17	11.47	0	0	0	80	22.2	3.6
Feb-18	710	25.5	27.84	235	19	12.36	0	0	0	144	22.2	6.48
Mar-18	560	23.4	23.93	175	16	10.93	0	0	0	156	22.6	6.9
YEAR 2018-2019												
Apr-18	540	19.1	28.27	65	7	9.28	0	0	0	140	16.8	8.33
May-18	380	18	21.11	120	14	8.51	0	0	0	61	15.2	4.01
Jun-18	340	10.7	31.77	195	24	8.12	0	0	0	32	10.8	3.51
Jul-18	310	12.6	24.6	115	15	7.66	0	0	0	73	15	4.86
Aug-18	270	15	12.27	150	23	6.52	0	0	0	100	18	5.55
Sep-18	280	15	18.66	160	31	5.16	0	0	0	48	15.7	3.05
Oct-18	130	7.5	17.33	20	1	20	0	0	0	66	13.1	5.03
Nov-18	100	4.7	21.27	45	3	15	0	0	0	10	2	5
Dec-18	150	6.1	24.59	30	3	10	0	0	0	10	3.3	3.03
Jan-19	220	11.1	19.81	85	14	6.07	0	0	0	84	9.5	8.84
Feb-19	200	8.6	23.25	75	8	9.37	0	0	0	24	7.7	3.11
Mar-19	290	10	29	140	19	7.36	0	0	0	66	13.6	4.85
18-19	**3210**	**161.8**	**22.66**	**1200**	**162**	**9.42**				**714**	**140.7**	**4.93**

	500KVA (New)		
MONTH	**fuel**	hours	**Average**
Sep-20	200	6.5	30.76
Oct-20	300	11.87	25.27
Nov-20	400	22.1	18.18
Jan-20	140	4.68	29.91
Feb-20	610	24.86	24.53
Mar-20	250	9.1	27.47
TOTAL	**1900**	**79.11**	**26.02**

SEGR (SFC) & Efficiency (specific Energy Generation Ratio)(Specific fuel consumption)

SEGR is ratio of energy generated to fuel consumed or energy generated per ltr of fuel. Generator energy generation is not recorded. Hence it is not possible to analyse SEGR. Based on the fuel consumption & hours of running SEGR may be calculated.

Indicative standard consumption at different loading

capacity	ltr/hr	ltr/hr	ltr/hr	ltr/hr
kva	25%	50%	75%	100%
125	11.71	18.9	21.4	28
250	21.54	35.91	41.2	54.1
500	41.58	69.98	80	103

Calorific value/kg = 11000 kcals /kg S.G. 0.845

Calorific value /ltr = 11000 X0.845 = 9295 kcals/ltr

1)For 125 kva DG;

Consumption per hour = 9.42 ltr /hr (average)

Loading as per above table- 25% = 31.25 kva = 25kw (at 0.8PF)

Hence SEGR = 25 /9.42 = 2.65 kwh/ltr

Efficeincy

Kwh = 860 kcals

Out put = 2.65 x 860 =2279 kcals

Input = 9295 kcals /ltr

Efficiency = 2279 /9295 *100 = 24.51%

(Best achievable 30%)

2)For 250kva DG :

Consumption per hour = 22.66 ltr /hr (average)

Loading as per above table- 25% = 62.5 kva = 50kw (at 0.8PF)

Hence SEGR = 50 /22.66= 2.20 kwh/ltr

Efficiency :Out put /input = (860 x 2.20)/ 9295 X100 =20.36%

3)for 500kva DG

Consumption per hour = 26.02 ltr /hr (average)

Loading as per above table- 15% (or less) =75 kva = 60kw (at 0.8PF)

Hence SEGR = 60 /26.02= 2.30 kwh/ltr

REMARK:

1.Generator is said to be efficient only if SEGR is above 3.It also depends on generator loading. In this case loading is not possible due to generator synchronisation. Since above reading pertain to 2018-19 & solar has commissioned fully by july 2019. It is recommended to install & record energy meter for performance analysis. Efficiency is marginally low. Best efficiency is 30%.

2. DG fuel consumption at Panchavati indicates very low loading on DG. Under such condition DG capacity may be reduced.

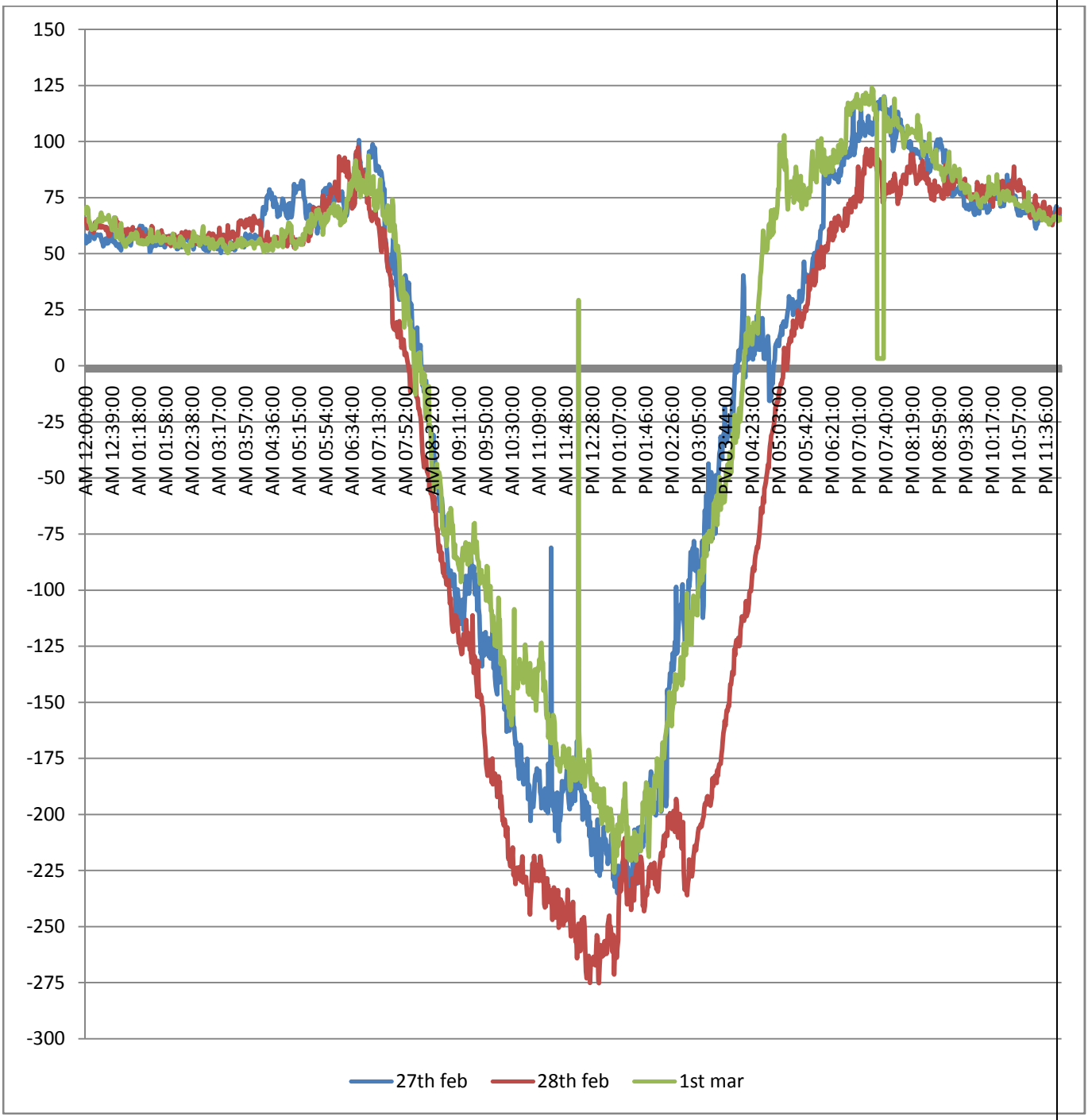
7.Power data log

To analyse and record power parameter , we installed data logger to incoming line ,LT side. It recorded voltage ,current, pf, power on each phase from 26.2.2021 to 03.3.2021. All min by min records were stored in drive and analysed .

Observations & Remark:

- About 8000 data samples collected by data logger
- Power input from grid is high during 6pm to 8pm. It will be between 80 to 100kw.
- Power consumption in night is almost stable between 50 to 60kw
- Due to solar production , there will be continuous export from 8am to 5pm
- Peak export is 275 kw from solar to grid (after internal consumption).
- Sunday peak power exported is 275kw, Saturday 245 kw and Monday 225 kw
- Energy Export will be more on Sundays, followed by Saturday and Monday. (see the curve below)
- Duration export will start from 8am all the days. But export will stop by 4.00 pm on working days, but will go up to 5.30 pm on Sundays.
- Input voltage is all three phase is almost with in limit in most of time. It is between 235 -245VAC, With occasionally going above 250vac /ph R & Y phases .
- Line current is less than 200 amps in maximum of time. Peak current is nearly 400 amps. But this is well with in safe limit.
- Transformer loading will be normally 100kva, which is 10% of its rated capacity. On peak loading it will go to 250 kva , which is 25% of its rated capacity.
- Power factor correction panel APFC panel is maintaining PF 0.95 most of time.
- Transformer centre has maintained well.
- No major problems noticed in power supply side.

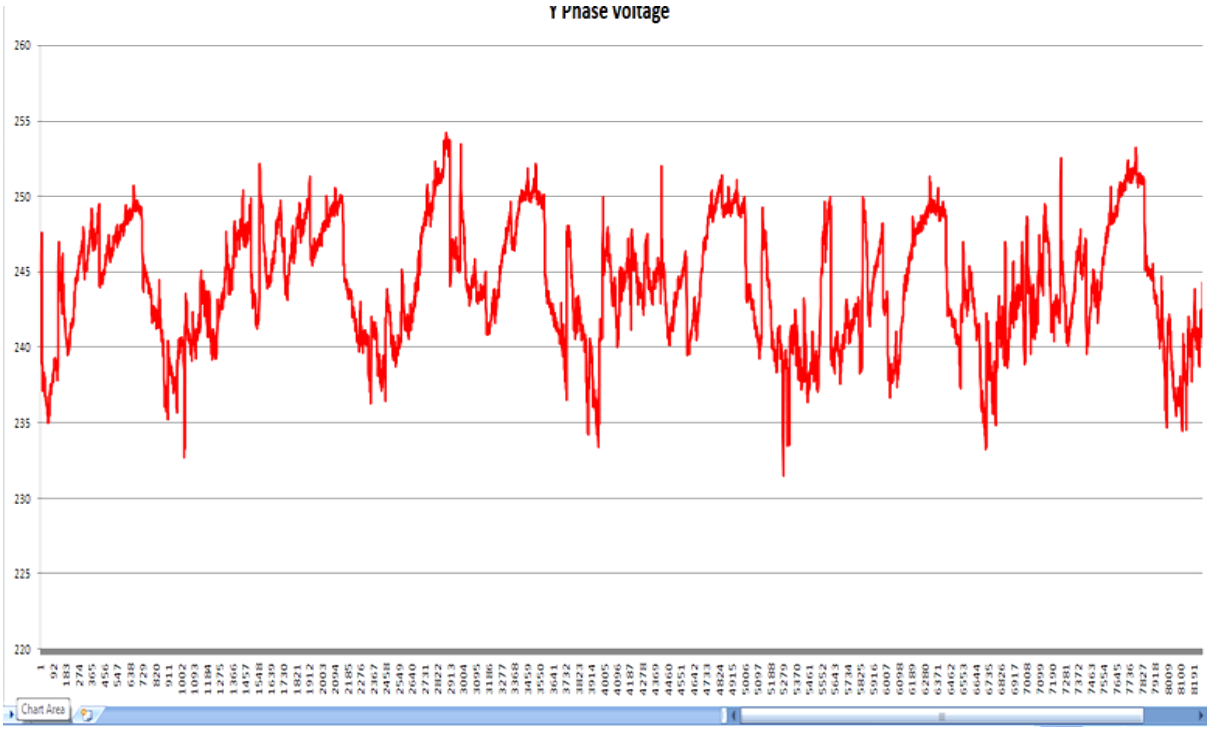
POWER GRAPH:


150
125
100
75
50
25
0
-25
-50
-75
-100
-125
-150
-175
-200
-225
-250
-275
-300
AM 12:00:00
AM 12:39:00
AM 01:18:00
AM 01:58:00
AM 02:38:00
AM 03:17:00
AM 03:57:00
AM 04:36:00
AM 05:15:00
AM 05:54:00
AM 06:34:00
AM 07:13:00
AM 07:52:00
AM 08:32:00
AM 09:11:00
AM 09:50:00
AM 10:30:00
AM 11:09:00
AM 11:48:00
PM 12:28:00
PM 01:07:00
PM 01:46:00
PM 02:26:00
PM 03:05:00
PM 03:44:00
PM 04:23:00
PM 05:03:00
PM 05:42:00
PM 06:21:00
PM 07:01:00
PM 07:40:00
PM 08:19:00
PM 08:59:00
PM 09:38:00
PM 10:17:00
PM 10:57:00
PM 11:36:00
27th feb
28th feb
1st mar

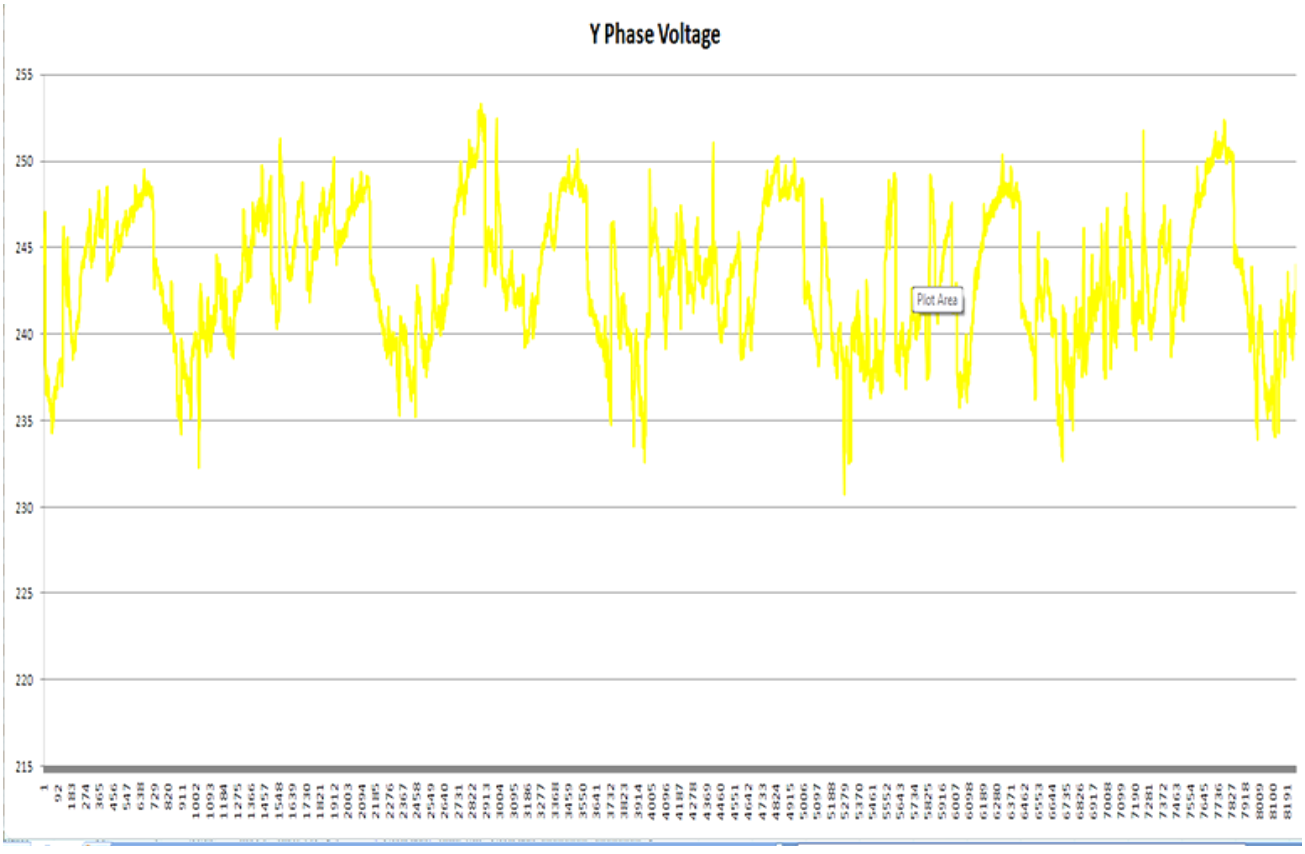
Hourly extract from datalog

Time	27th feb2021 (Sat)	28thfeb 2021 (Sun)	1st mar 2021(Mon)
AM 12:00:00	57.94881	64.69121	68.03168
AM 01:00:00	58.06988	58.90917	56.03352
AM 2:20:00	51.04984	54.48122	56.46294
AM 03:02:00	57.08145	58.24076	182.00
AM 04:03:00	67.93216	65.69621	56.096
AM 05:03:00	77.776	56.99604	62.78986
AM 06:03:00	98.69064	78.98016	68.24902
AM 07:04:00	15.34078	67.05446	79.86055
AM 08:05:00	-99.08661	-1.43764	6.64127
AM 09:05:00	-142.70345	-111.2717	-79.58235
AM 10:05:00	-179.55456	-183.58694	-121.6798
AM 11:06:00	-176.1261	-224.11844	-145.0697
PM 12:06:00	-232.23678	-252.53238	-179.84247
PM 01:07:00	-184.93444	-241.58672	-212.995
PM 02:07:00	-184.93444	-222.24233	-181.32703
PM 03:08:00	-90.48491	-204.4259	-91.8365
PM 04:08:00	16.18838	-111.72828	-11.63003
PM 05:09:00	18.84579	-5.3785	96.45495
PM 06:09:00	83.68006	50.44749	96.35016
PM 07:10:00	102.51402	93.56547	116.8309
PM 08:10:00	98.4207	81.0239	101.47197
PM 09:11:00	88.78468	77.02077	88.42283
PM 10:11:00	68.45041	76.87232	76.64923
PM 11:12:00	72.40727	67.83522	70.20324

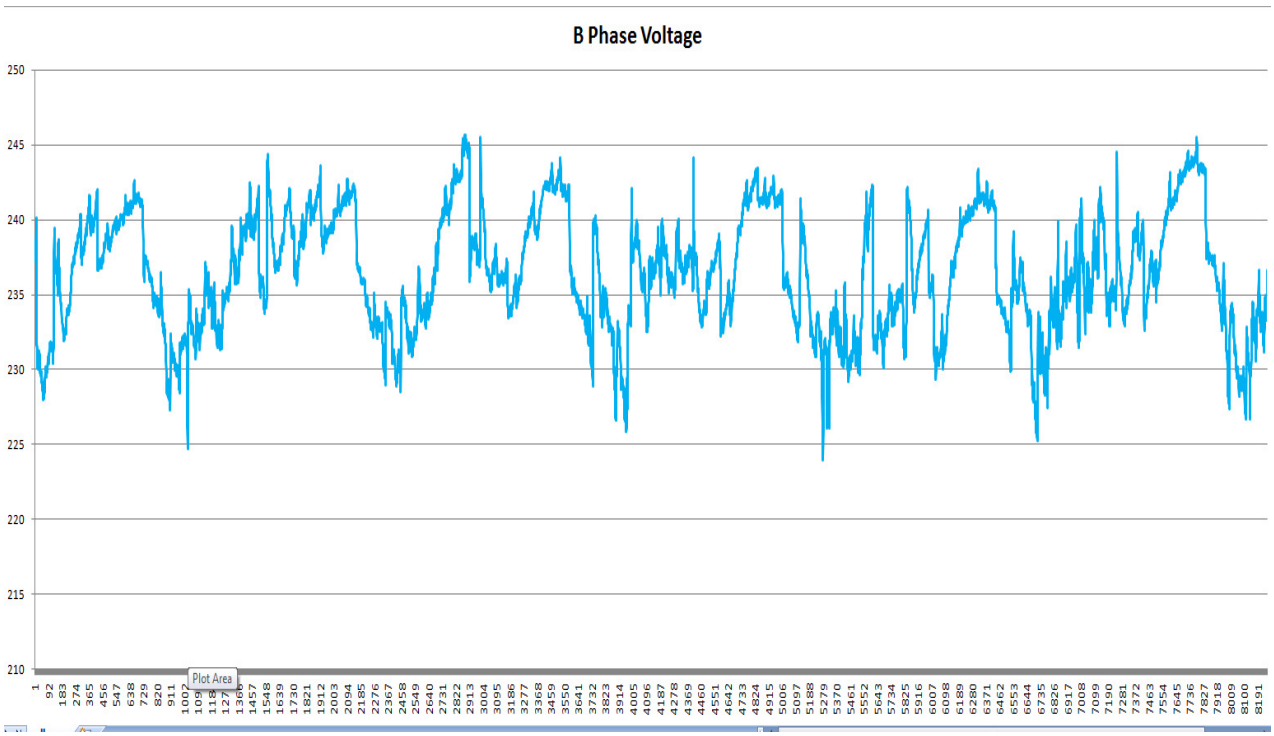
R Phase voltage



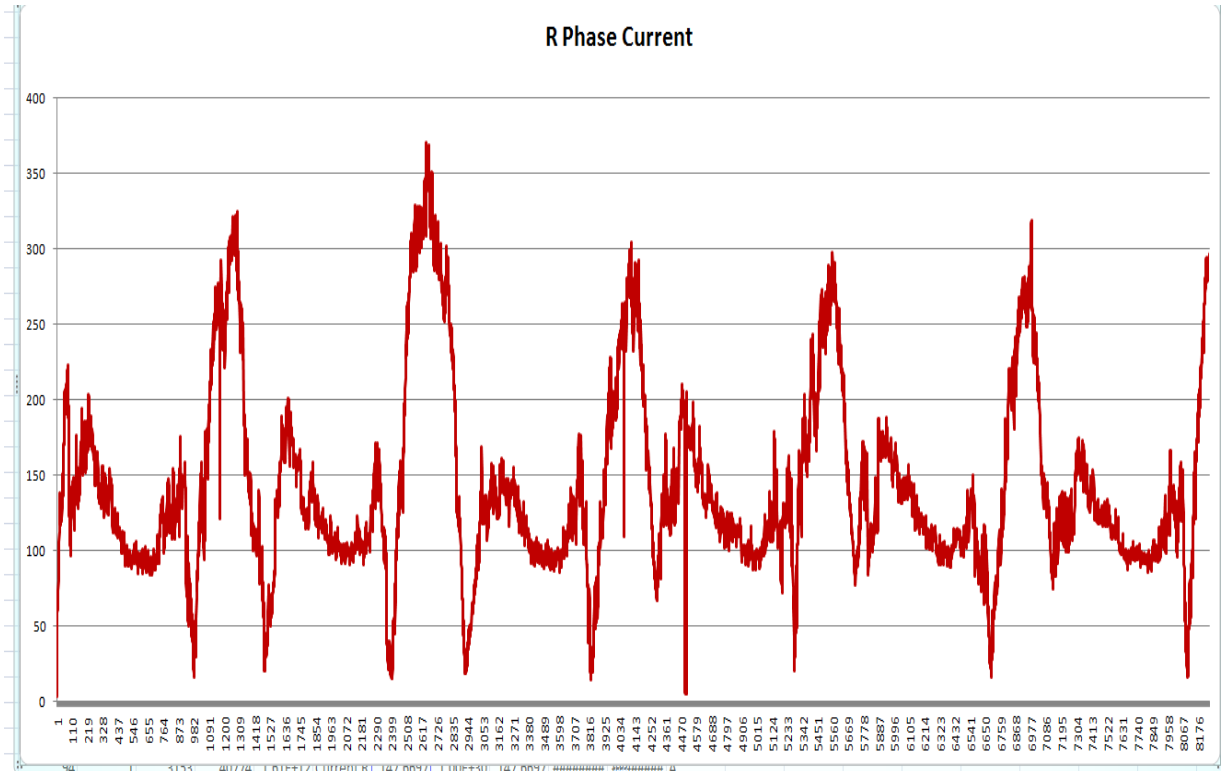
Y phase voltage



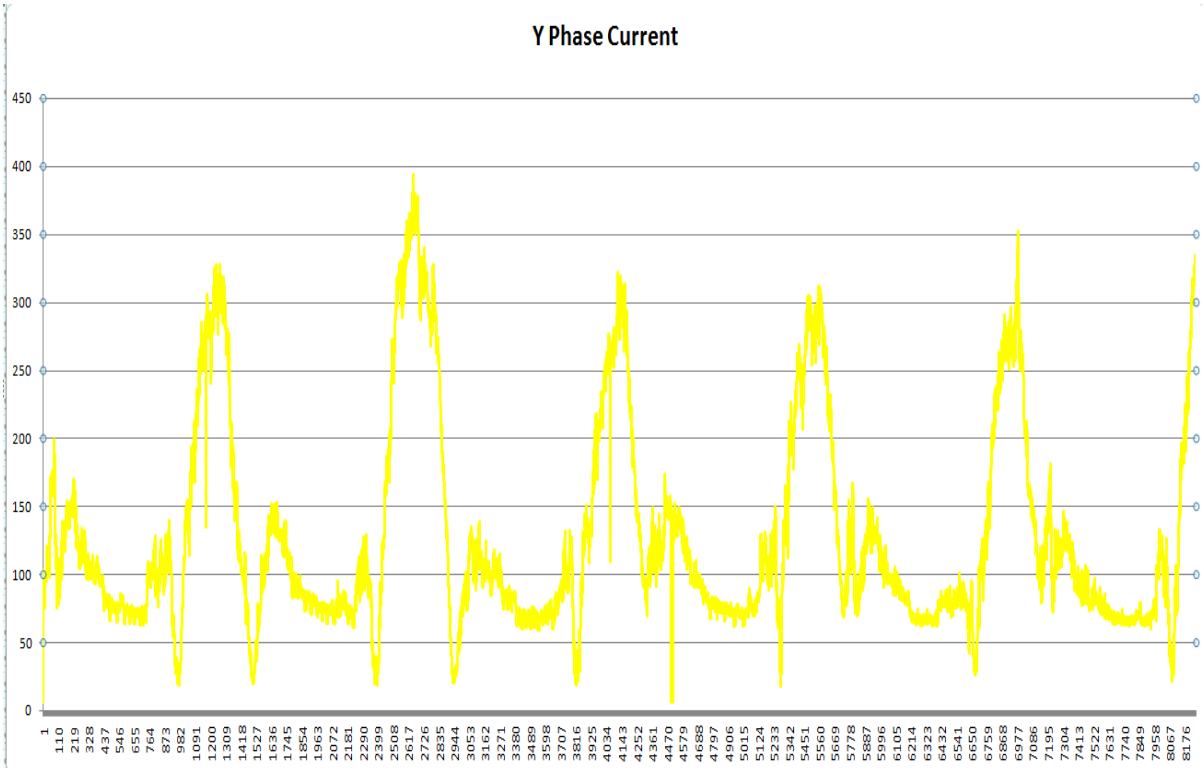
Bphase



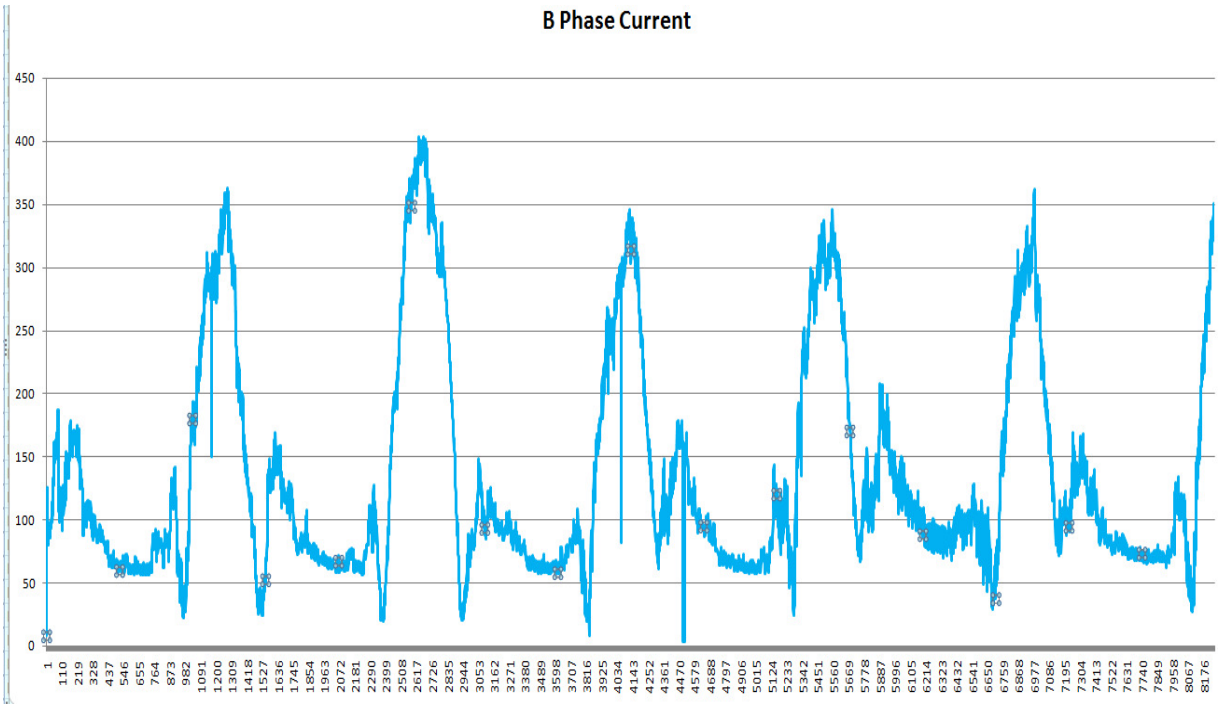
R ph current



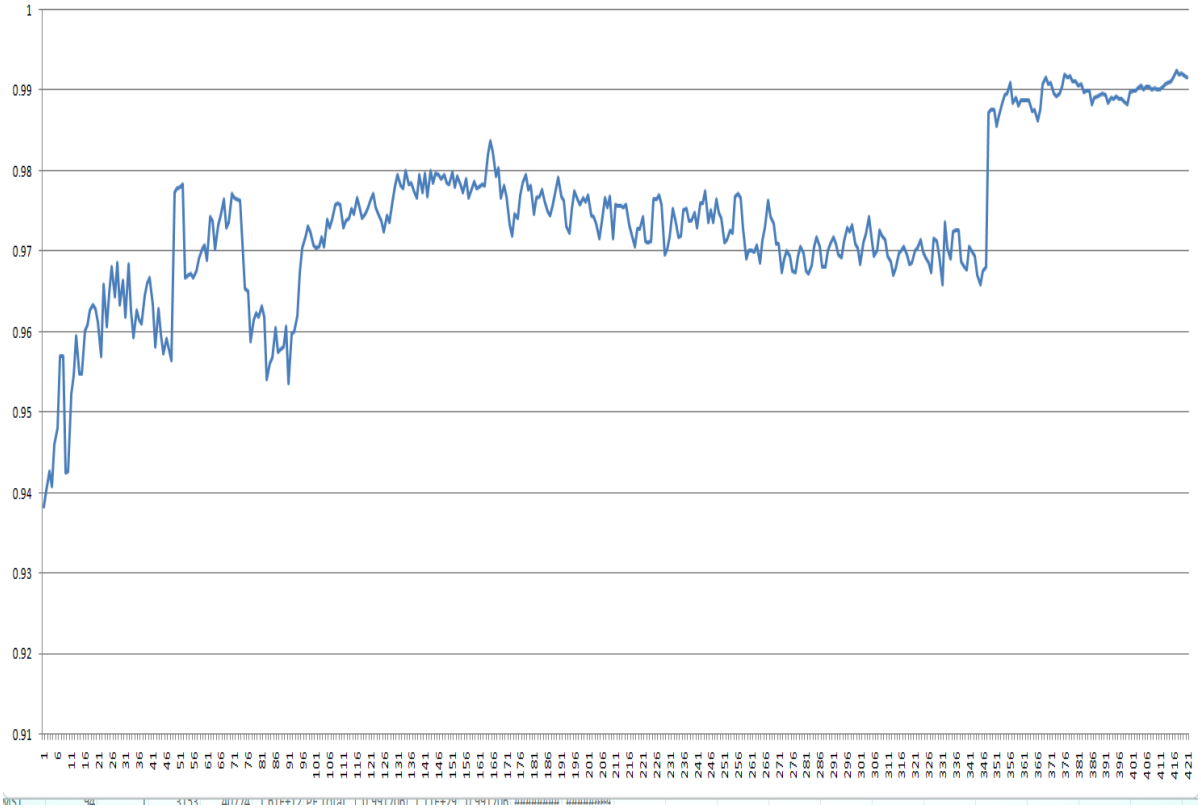
Y phase current



B phase current



Power factor



8.0 DSM

Demand Side Management

Study of loads , power measurement ,efficiency level,

energy consumption

8.1 UPS SYSTEMS

UPS are used for critical loads for purpose of voltage stabilisation & also for immediate back up on power fail. Institution has 8 nos of UPS .All are ONLINE UPS with double conversion and has in built isolation transformer. Total installed capacity is 76kva. All UPS (except 6kvaups) have 3phase in put & single phase out put. Its details are given below.

UPSMAKE	CAPACITY	BATTERY CAPACITY SMF	QTY IN EACH SET	SET
SILICON	10KVA /192VDC	26AH/12V	32NOS	5
EMERSION	10KVA /312VDC	100AH/12V	26NOS	1
EMERSION	6KVA /192VDC	100AH/12V	16NOS	1
EMERSION	10KVA /312VDC	100AH/12V	26NOS	1
TOTAL	76KVA			8

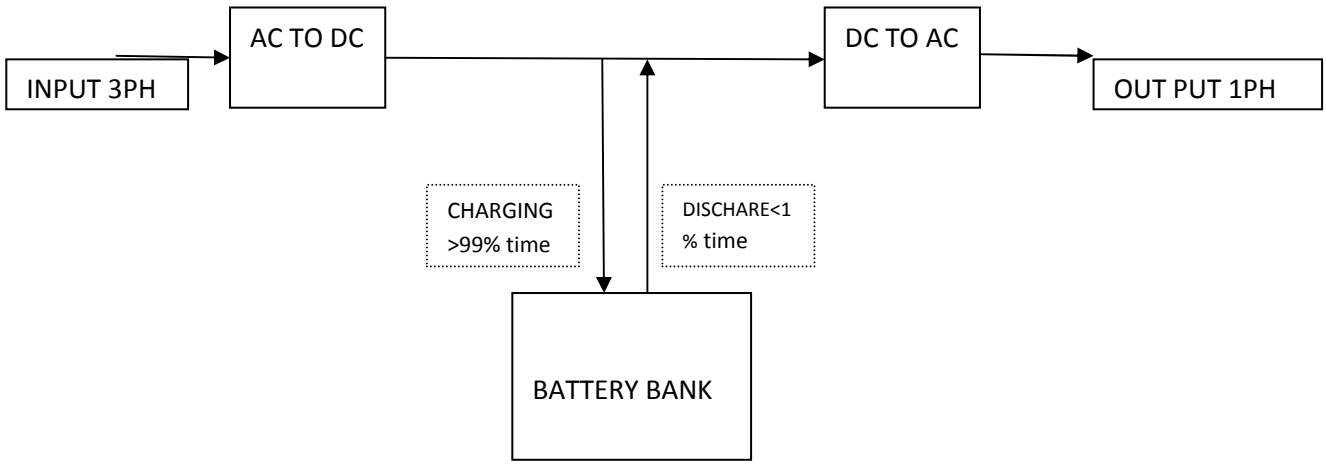
Since all the UPS are continuously converting AC to DC and also DC to AC , its efficiency loss will happen in both stages. UPS are used in 24 x7 mode, its efficiency contributes major savings in energy. Efficiency loss indicates loss in UPS parts & transformer. This will be converted to heat and eventually system or battery failure many times.

In addition to efficiency, many UPS will work on poor power factor , because of rectifier design. Even though this poor factor is corrected by APF panel at incoming mains, this leads to stress on APF and also loading on internal cable.

Batteries are other critical part of UPS. Institution is using SMF VRLA (sealed maintenance free valve regulated lead acid batteries). This has advantages like no distil water maintenance, No fumes, etc. But usually has less life than Tubular technology batteries. Since institution needs low capacity batteries & in door usage, SMF is most suited. Apart from Lab UPS , all UPS have low capacity batteries of 26ah. But lab ups (2nos) & library has higher capacity of 100ah

Keeping in mind load criticality, percentage of normal loading, power factor , battery charging , UPS performance is evaluated in different criteria.

Working diagram;



EFFICIENCY OVER VIEW

EFFICIENCY	UPS1	UPS2	UPS3	UPS4	UPS5	UPS6	UPS7	UPS8
Efficiency =w (ac+dc)/w	73.84%	48.22%	72.41%	75.24%	74.94%	70.23%	94.43%	78.84%
Efficiency = usefulw/ input w	47.30%	31.45%	37..52%	38.49%	35.24%	54.68%	34.33%	46.01%
Efficiency = total va/input va	**39.42%**	**23.80%**	**35.50%**	**34.82%**	**31.98%**	**97.20%**	**56.25%**	**89.82%**
Efficiency= useful va out/ va input	25.21%	15.41%	21.03%	17.85%	17.47%	74.93%	20.00%	61.96%

INDEX;

Major Observation & Remarks:

- UPS NO 1,2,3,4,5,7 are less efficient
- Power factor of UPS 1,2,3,4,5 is very poor at 0.4 and UPS 7 is at O.5. This is design constraint.
- Power factor of UPS 5 is poor in one phase at 0.41 and loading is this phase is low. But other two phase has good power factor at 0.98. This indicates this UPS needs service.
- UPS 2 is having 3 phase input , but taking load on only one phase. This resulted in low efficiency apart from low power factor.
- Load on all ups is very less. It varies between 25 to 40% in majority of times.
- Loading on UPS 7 will be very less about 300w in most of times. But is kept for use of lab equipments when needed.
- UPS 2,4,5 not getting sufficient cooling ,due to cooling fan fail. This needs to be addressed immediately. Otherwise excess heat may result in IGBT device failure.

(Please see other recommendations in view energy conservation & environment in coming chapter)

8.1 UPS EVALUATION

equipment details	
Location	knowledge park(ground floor near window)
UPS TYPE	online with transformer
Capacity	10 kva
DC voltage	192 vdc
input	3ph
out put	1ph
make	silicon
slno	214i071-fd3

Battey ah	26 ah
No of batteries	16*2 set
Battery Type	SMF
Battery make	exide

Under Regular working			
input	**R**	**Y**	**B**
voltage	228.6	223	228.8
Current	6.3-6.4	6.6	5.9-6.5
PF	0.38	0.4	0.4

out put	**parameter**
voltage	231.8
current	6.6
PF	0.75-0.8

DC	
voltage	220.7 vdc
current	2.3-2.46

No load consumption			
current with inv on	1.9	1.7	1.5
current with inverter off	0.18	0.3	0.11

other informations	
remark	Fan fail

calculations:			o/p	i/p
efficeincy =w (ac+dc)/w		73.84%	1395	1889
efficeincy = usefulw/ input w		47.30%	895	1889
efficiency = total va/input va		39.42%	1.86	4.72
efficiency= useful va out/ va input		25.21%	1.19	4.72

Ups2

equipment details

Location	Knowledge park (First floor)		
UPS TYPE	online with transformer		
Capacity		10 kva	
DC voltage		192 vdc	
input	3ph		
out put	1ph		
make		silicon	
slno		214i070-fd5	

Battey ah		26 ah
No of batteries		16*2 set
Battery Type		SMF
Battery make		exide

normal working			
input	R	Y	B
voltage	228.6	227	225
Current	1.1	11.86	0.6
PF	0.3-0.4	0.4-0.44	0.28-0.34

out put	
voltage	230.9
current	4.5-4.68
PF	0.71

DC	
voltage	218 vdc
current	1.34 amps

No load consumption			
current with inv on	0	4.4	0
current with inverter off	0	0.5	0

other informations

Remark : Fan fail, working on single phase
Recommended : 42 ah*16 number
Note : 2 UPS can be merged to 1

calculations:	o/p	i/p	%eff			
efficeincy =w (ac+dc)/w	1129	2340.83	48.22%			
efficeincy = usefulw/ input w	737	2340.83	31.45%			
efficiency = total va/input va	1.59	6.68	23.80%			
efficiency= useful va out/ va input	1.03	6.68	15.41%			

UPS3

equipment details			
Location		hospital	
UPS TYPE	online with transformer		
Capacity		10kva	
DC voltage		192vdc	
input	3ph		
out put	1ph		
make		silicon	
slno		214i068-fd5	

Battey ah		26
No of batteries		16*2 set
Battery Type		SMF
Battery make		exide

	test under normal load		
normal working			
input	R	Y	B
voltage	235.9	234.9	237
Current	2.9-3.4	2.8-3.7	2.8-3.6

PF	0.33	0.34	0.33

out put	
voltage	231.4
current	2.1-2.38
PF	0.69

DC	
voltage	219.6
current	2.39

No load consumption			
current with inv on			not tested
current with inverter off			not tested

other informations

calculations:	o/p	i/p	% eff			
efficeincy =w (ac+dc)/w	714	986	72.41%			
efficeincy = usefulw/ input w	370	986	37..52%			
efficiency = total va/input va	1.03	2.9	35.50%			
efficiency= useful va out/ va input	0.61	2.9	21.03%			

UPS4

equipment details			
Location		hospital	
UPS TYPE	online with transformer		
Capacity		10kva	
DC voltage		192vdc	
input	3ph		
out put	1ph		
make		silicon	
slno		214j072-fd5	

Battey ah		26
No of batteries		16*2 set
Battery Type		SMF
Battery make		exide

		test under normal load	
normal working			
input	R	Y	B
voltage	236.1	235.6	237.2
Current	3.4-3.8	3.2-3.75	3.7-3.9
PF	0.31	0.34	0.34

out put	
voltage	231.5
current	2.6
PF	0.73

DC	
voltage	219.5vdc
current	2.76

No load consumption			
current with inv on			not tested
current with inverter off			not tested

other informations	
remark	fan fail

calculations:	o/p	i/p	%eff			
efficiency =w (ac+dc)/w	860	1143	75.24%			
efficiency = useful w/ input w	440	1143	38.49%			
efficiency = total va /input va	1.17	3.36	34.82%			
efficiency= useful va out/ va input	0.6	3.36	17.85%			

UPS5

equipment details			
Location		hostipal	
UPS TYPE	online with transformer		
Capacity		10kva	
DC voltage		192vdc	
input	3ph		
out put	1ph		
make		silicon	
slno		214i067-fd5	

Battey ah		26
No of batteries		16*2 set
Battery Type		SMF
Battery make		exide

		test under normal load		
normal working				
input	R	Y	B	
voltage	236.8	236	237.9	
Current	3.1-4.06	3.36	3.6-4.05	
PF	0.3-0.4	0.3-0.4	0.3-0.4	

out put	
voltage	231.3
current	2.84
PF	0.88

DC	
voltage	219.8vdc
current	3.9-4.01

No load consumption			
current with inv on			not tested
current with inverter off			not tested

other informations	
remark	fan fail

calculations:				o/p	i/p	% eff	
efficeincy =w (ac+dc)/w				1116.3	1489.5	74.94%	
efficeincy = usefulw/ input w				525	1489.5	35.24%	
efficiency = total va/input va				1.19	3.72	31.98%	
efficiency= useful va out/ va input				0.65	3.72	17.47%	

Ups6

equipment details			
Location		Lab 1	
UPS TYPE		online with transformer	
Capacity		10kva	
DC voltage			
input		3ph	
out put		1ph	
make		EMERSON	
slno		140510ES1514	

Battey ah		100ah
No of batteries		26
Battery Type		SMF
Battery make		AMARON

normal working			
input	R	Y	B
voltage	245	238	253
Current	4.8	4.7	4.6
PF	0.96	0.97	0.96

out put	
voltage	232
current	12-13 A

PF	0.7

DC	
voltage	346.9
current	1.6

No load consumption			
current with inv on			not tesetd
current with inverter off			not tesetd

other informations

calculations:			o/p	i/p	% eff
efficeincy =w (ac+dc)/w			2501.65	3562	70.23%
efficeincy = usefulw/ input w			1948	3562	54.68%
efficiency = total va /input va			3.57	3.67	97.20%
efficiency= useful va out/ va input			2.75	3.67	74.93%

UPS7

equipment details			
Location		Lab 2	
UPS TYPE		online with transformer	
Capacity		6 kva (single phase)	
DC voltage		192	
input		3ph	
out put		1ph	
make		EMERSON	
slno		140806AS3147	

Battey ah		100 ah
No of batteries		16
Battery Type		SMF
Battery make		EXCIDE

normal working	
input	R
voltage	235.7
Current	3.1-3.4
PF	0.54

out put	
voltage	221.6
current	0.74
PF	0.9

DC	
voltage	215.6
current	1.56

No load consumption

current with inv on	not tested
current with inverter off	not tested

other informations

calculations:				o/p	i/p	% eff
efficeincy =w (ac+dc)/w				407	431	94.43%
efficeincy = usefulw/ input w				148	431	34.33%
efficiency = total va/input va				0.45	0.8	56.25%
efficiency= useful va out/ va input				0.16	0.8	20.00%

UPS 8

equipment details			
Location		Library/Computer Lab	
UPS TYPE		online with transformer	
Capacity		10kva	
DC voltage		312	
input	3ph		
out put	1ph		
make		emerson	
slno		180410as7211	

Battey ah		100ah
No of batteries		26
Battery Type		smf
Battery make		exide

normal working				
input	R	Y	B	
voltage	228.6	233.4	238.5	
Current	3.7	1.56	3.05	
PF	0.97	0.41	0.98	
VA	882.82	364.1	727.42	1974.34
WATTS	818.29	149.02	712.87	1608.18

out put			
voltage	228.4		
current	5.4		
PF	?	0.4 TO 0.7	SAY 0.6
VA	1233.36		
WATTS	740.02		

DC			
voltage	352		
current	1.5	528	WATTS

No load consumption			
current with inv on			not tested
current with inverter off			not tested

other information
Equipment not found working properly with balanced input

calculations:			%	o/p	i/p	
efficeincy =w (ac+dc)/w			78.84 %	1268.01	1608.18	
efficeincy = usefulw/ input w			46.01 %	740.02	1608.18	
efficiency = total va/input va			89.82 %	1773.36	1974.34	
efficiency= useful va out/ va input			61.96 %	1233.36	1974.34	

8.2 PUMPS

Institution has total 10 pumps for their water need. Among this 5 pumps are of higher capacity, more than 5 hp. Other six are of lower capacity ,2 & 3 hp.

We also measured actual power consumption of all pumps and collected details about its usage.

Details are given below.

NO	LOCATION	RATED CAPACITY HP	POWER MEASURED KW	HOURS OF USE	ENERGY PER ANNUM KWH
1	KUTEERA	2HP	1.414	45M -1HR	516.11
2	AUDIOLOGY	3HP	2.487	45M -1HR	907.755
3	E & T	2HP	1.4	30M	258.055
4	SLP	2HP	1.89	1HR FOR 2 DAYS	344.925
5	LIBRARY	2HP	1.23	30M	224.475
6	ACADEMIC	2HP/1PH	1.92	30M	361
7	KNOWLEDGE PARK	7.5HP	6.216	1.5HRS	3394.5
8	100BACK SIDE	7.5HP	6.81	1HR FOR 2 DAYS	1225.8
9	HOSTEL	5HP	3.2	8 TO 10HRS	11834
10	HOSTEL	5HP		NOT	
TOTAL	10NOS	38HP	26.567KW		19066.62 KWH

Pump efficiency varies from 55 to 65%. In this connection we measured pump out flow & calculated efficiency of higher capacity pumps.

Location	Rated capacity	Measured Efficiency
KNOWLEDGE PARK	7.5HP	31.30%
100BACK SIDE	7.5HP	26.24%
HOSTEL	5HP	19%
HOSTEL	5HP	not in use

Reason for low efficiency:

Hardness in water ,resulting in more head loss in pipe

Pump working away from BEP

Inefficient induction motor (not IE3 rated)

8.2a PUMP EVALUATION

LOCATION		Hostel	
capacity		5 HP	
type		open	
make/model			
year of use		3	
stage(sub pump)			
repairs/rebound			
water flow from/to		GLR to tank	
suction head		10 ft	
delivery head		50 ft	
length of pipe		35 ft	
type of pipe		soil pipe	
diameter of pipe		4 inch	
usage per day		9-10 hrs	
current - R		6.86	
current - Y		6.26	
current - B		7.89	
PF		0.83	
Voltage - R		237.6	
voltage - Y		234.6	
Voltage - B		238.4	
Voltage - RY		394.6	
voltage - YB		398.4	
voltage - BR		395.3	
discharge			
water TDS		719 ppm	
Power input((3^0.5)VICOSϴ		3.2 kw	
Energy/year (power input/day * 365)		11834.75 kwhr	
output power	(Q*H)/367	0.6	
efficiency[(O/P)/(I/P]		19%	

PUMP2

LOCATION		100 Backside	
capacity		7.5 HP	
type		borewell	
make/model			
year of use		1	
stage(sub pump)		single	
repairs/rebound			
water flow from/to		bore to sump	
suction head			
delivery head		240 ft - 73.2 m	
length of pipe		200 m	
type of pipe		CPC	
diameter of pipe		2 inch	
usage per day		I hour for 2 days	
current - R		12.01	
current - Y		11.81	
current - B		11.68	
PF		0.84	
Voltage - R		228	
voltage - Y		225	
Voltage - B		229	
Voltage - RY		397.8	
voltage - YB		397.6	
voltage - BR		394.6	
discharge			
water TDS		619 ppm	
Power input		6.827 kw	
Energy/day		6.827 kwhr for 2 days	
output power	(Q*H)/367	1.79 kw	
efficiency[(O/P)/(I/P]		26.24%	

PUMP3

LOCATION		Knowledge Park	
capacity		7.5 HP	
type		Borewell	
make/model			
year of use			
stage(sub pump)		single	
repairs/rebound			
water flow from/to		Bore to GLR+sump	
suction head		0	
delivery head		250ft - 79.24m	
length of pipe		250 m	
type of pipe		DI	
diameter of pipe		2 inch	
usage per day		1.5 hr	
current - R		11.81	
current - Y		11.83	
current - B		11.75	
PF		0.6	
Voltage - R		228	
voltage - Y		225	
Voltage - B		229	
Voltage - RY		393	
voltage - YB		395	
voltage - BR		396	
discharge m^3/hr		9003.56	
water TDS			
Power input((3^0.5)VICOSϴ		6.2 kw	
Energy/year (power input/day * 365)		2628 kwhr	
output power	(Q*H)/367	1.944kw	
efficiency[(O/P)/(I/P]		31.29%	

PUMP4

LOCATION		Academic	
capacity		2 HP	
type		open	
make/model			
year of use		6 months back motor change	
stage(sub pump)		single	
repairs/rebound			
water flow from/to			
suction head			
delivery head			
length of pipe			
type of pipe			
diameter of pipe			
usage per day		30 mins	
current - R		11.88	
current - Y			
current - B			
PF			
Voltage - R		232.9	
voltage - Y			
Voltage - B			
Voltage - RY			
voltage - YB			
voltage - BR			
discharge			
water TDS			
Power input		1.92 kw	
Energy/day		0.961 kwhr	

PUMP5

LOCATION		Library	
capacity			
type		open	
make/model			
year of use		5	
stage(sub pump)		single	
repairs/rebound			
water flow from/to			
suction head			
delivery head			
length of pipe			
type of pipe			
diameter of pipe			
usage per day		30 mins	
current - R		2.56	
current - Y		2.46	
current - B		2.59	
PF		0.72	
Voltage - R		225	
voltage - Y		228	
Voltage - B		232	
Voltage - RY		392.1	
voltage - YB		398.8	
voltage - BR		392.7	
discharge			
water TDS			
Power input		1.23 kw	
Energy/day		0.615 kwhr	

PUMP6

LOCATION		SLP		
capacity				
type		open		
make/model				
year of use		4		
stage(sub pump)		single phase		
repairs/rebound				
water flow from/to				
suction head				
delivery head				
length of pipe				
type of pipe				
diameter of pipe				
usage per day		1 hour		
current - R		3.34		
current - Y		3.44		
current - B		3.4		
PF		0.79		
Voltage - R		225		
voltage - Y		228		
Voltage - B		232		
Voltage - RY		408		
voltage - YB		407.8		
voltage - BR		406.7		
discharge				
water TDS				
Power input		1.89 kw		
Energy/day		1.89 kwhr		

PUMP7

LOCATION		ENT		
capacity		2 HP		
type		open		
make/model		Tesmo		
year of use		1.5 years		
stage(sub pump)		single phase		
repairs/rebound				
water flow from/to		ENT to RO Plant		
suction head		9 m		
delivery head				
length of pipe				
type of pipe				
diameter of pipe				
usage per day		30 minutes		
current - R		8.6		
current - Y				
current - B				
PF		0.7		
Voltage - R		234		
voltage - Y				
Voltage - B				
Voltage - RY				
voltage - YB				
voltage - BR				
discharge				
water TDS				
Power input		1.4 kw		
Energy/day		0.704 kwhr		

PUMP8

LOCATION		department of audiology		
capacity		3 HP		
type		open		
make/model				
year of use		2 years		
stage(sub pump)		single stage		
repairs/rebound				
water flow from/to		sump to dept of audiology		
suction head				
delivery head				
length of pipe				
type of pipe				
diameter of pipe				
usage per day		45 mins - 1 hour		
current - R		4.49		
current - Y		4.44		
current - B		4.42		
PF		0.817		
Voltage - R		229		
voltage - Y		224		
Voltage - B		228		
Voltage - RY		394.6		
voltage - YB		394		
voltage - BR		396		
discharge				
water TDS				
Power input		2.487 kw		
Energy/day		2.487 kwhr		

PUMP9

LOCATION		Kuteera		
capacity		2 HP		
type		open		
make/model		Kirloskar		
year of use		3 years		
stage(sub pump)		single		
repairs/rebound				
water flow from/to		Kuteera to Dharmashaala (Sump to tank)		
suction head		22.0 m		
delivery head				
length of pipe				
type of pipe				
diameter of pipe				
usage per day		40 minutes - 1 hour		
current - R		8.46		
current - Y				
current - B				
PF				
Voltage - R		238.9 (single phase)		
voltage - Y				
Voltage - B				
Voltage - RY				
voltage - YB				
voltage - BR				
discharge				
water TDS				
Power input		1.414 kw		
Energy/day		1.414 kwhr		

8.3 AIR CONDITIONERS

Air conditioners constitute major connected load in the system. It purpose of use include comfort, treatment process, acoustic & audiology needs , lab & server room.

An overview of all connected air conditioner is given below

capacity	type	qty	Total TR
5TR	Ductable	2	10
3 tr	ductable	4	12
8.5	Ductable	2	17
18	ductable	3	54
7.5	Ductable	1	7.5
2tr	Spl dutcable	3 (20 years old)	6
1.5	Spl ductable	6 (20 years old)	9
1tr	Split	20	20
1.5	split	16	24
2	split	17	34
1.5	F SAC fan coil	4	6
3 tr	cac	7	21
7.5 x2 *std by water cool)	cac	1	15
21hpx2nos 18hp X 1no	VvRf DUCTABLE	1	60

Connected load of AC is 295.5Tr , Its EER W/W varies from 2.5 to 3.2 .

Connected load in watts considering EER 2.75 = 295.5/2.75= 107.45 kw

We measured power consumption of some acs randomly. None of Acs found drawing more current than rated.

Location	**make**	**Cap Tr**	**star**	**type**	**EER**	**temp set**	**Usage hour**	**current**	**qty**
varthana parkisha kothadi	blue star	2.0	3	split	2.70	23-24	1 to 1/2	9.8 to 10.28	1no
Psychodrama unit	blue star	2.0	3	split	2.70	23-24	1 to 1/2	10.1 to 10.19	1no
dept of clinical psychology	blue star	2.0	3	split	2.76	24	weeky two times two hours	9.4 to 10	1no
Conrol room	blue star	1.0	3	split	2.78	24	weeky two times two hours	4.5 to 5.6	1no
gentic lab	blue star	1.5	3	split	3.00	20-22	24x7	6.9 to 7.2	2nos
genetic sequency lab	lloyd	1.5	3	split	3.12	18-20	24X7	6.7 to 6.9	2nos
Server room	blue star	1.5	nil	FSAC	2.64	20	24x7	9 to 10	2nos

Observation & recommendation:

Many of air conditioners are 3 star rated & few are 4 star rated

There are 30 nos 3 star split ACS & 4 nos 4 star split ACs

There is no five star rated split ACs.

Star rating is given to Split ACs only and changes according to technology change.

Institution's ACs Star rating pertains to old standard of about 10 years back. Present standards have been changed.

During audit course ,it is observed that ACs are maintained periodically and most of ACs are used an average 3-4 hours day.

EER _Energy Efficiency Ratio is 2.5 to 3.2 watts/watts. Present 5 star rated Ac will have EER > 4.5 w/w. On usage & maintenance context replacing any AC with EER less tan 3 will not result in significance energy savings, in contrary it may result in financial burden and increase in e waste. Hence it is recommended to replace only when existing AC fails. It is always replace with new 5 star ac with EER more than 4.5 in future.

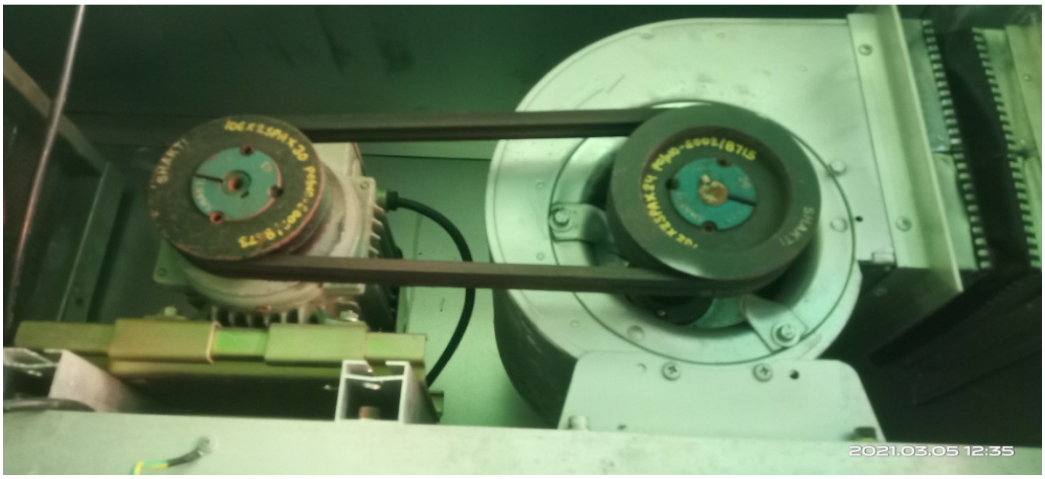
Knowledge park seminar hall has heavy cooling load of 18 Tr capacity 3 units , amounting to 54 tons. These systems are more than 15 years old. There will not be any star rating for duct Acs at present. System is accessed of having EER of about 2.5.

Places where ACs are used for 24x 7 include, 4 nos in genetic labs, 2nos in server room. AC used in server room has low EER 0f 2.64. Since server will be regularly generating heat , there is more load on this . Hence it may be replaced with new AC of higher EER .

Institution has one water cooled system of 7.5 tr with stand by 7.5 tr. This is very old system and has many inefficient motors. More over this has cooling tower , which needs water & more maintenance. All its control systems are old , many of sensors are not working properly. System is more than 20 years old . This proposal has been discussed in energy conservation measures chapter.


MORE STARS
MORE SAVINGS
POWER SAVINGS
GUIDE
ENERGY EFFICIENCY
2.70*
EER (W/W)
Appliance/Type : RAC / Split
Brand : BLUE STAR
Model/Year : 3 HW 24 YC GDU / 2012 +
Cooling Capacity (W) : 3 HW 24 YC SDU / 2012
Power Consumption (W) : 6800
Variable Speed Compressor : 2515
Heat Pump : No
: No
ENERGY IS LIFE
CONSERVE IT
*Under test conditions, when tested in accordance with IS 1391.
Actual electricity consumption will depend on how the appliance being used.
2021.03.05 11:34


MORE STARS
MORE SAVINGS
POWER SAVINGS
GUIDE
ENERGY EFFICIENCY
2.78*
EER (W/W)
Appliance/Type : RAC / Split Type
Brand : BLUE STAR
Model/Year : 3HW12VA/2011
Cooling Capacity (W) : 3470
Power Consumption (W) : 1250
Variable Speed Compressor : No
Heat Pump : No
ENERGY IS LIFE
CONSERVE IT
*Under test conditions, when tested in accordance with IS 1391.
Actual electricity consumption will depend on how the appliance being used.
SPLIT
IDU CO
RATED V
RATED F
PHASE
256
3763
2021.03.05 11:45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8.4 ELECTRIC HEATERS

Institution using electric geysers at girls hostel & quarters . Existing Solar water heater has become scrap about 6 years back. It is said that new solar water heater of 2000 ltr capacity along with heat pump (500ltr/hr) has been in process.

Mean time we inspected existing capacity ,type & usage pattern of existing system to find out its power & energy consumption.

Quarters have instant water heater of 3000 watts capacity. Which is found best option at present? Since solar water is not possible for apartment.

Hostel has occupancy of about 300 and hot water requirement is more.

Heaters	Nos	kw	ltr	Total KW	std by loss
Ground	4nos	2kw	50ltr	8kw	0.916
First	5nos	2kw	50 ltr	10kw	0.916
Second	3nos	3kw	50ltr	9kw	0.898
Third	2nos	3kw	50 ltr	6kw	0.898
Total	14nos		500ltr	33kw	

Observation & remark:

Newly installed five electric heaters have 5 star rating and old have 3 star rating.

As per the information collected, above heaters are used about 2 hours in day , usually 6am to 8am and also two hours in evening 6pm to 8pm. Totally fours per day.

It is calculated energy consumption as below:

= 33kw x 4 hours =132 units per day

This is about 48,000 units annually. This amounts to about 50% of hostel energy consumption

During evening electric heaters are used between 6pm -8pm. During this time ,there wont be any solar electricity generation and electricity tariff will be high. It would have been more logical if electric heaters were switched on by 4pm. Once heating may take one to one and half hour. This could have saved some cost on energy and indirectly using solar energy. This measure will meet 50% of evening requirement by reduced cost.

Since hot water is needed both day & night , 2000 ltr capacity solar water may not meet the requirement. Additionally planned, heat pump need to be used regularly to meet the requirement. Hence additional capacity of solar heater may need to be added in future.

Water TDS is found 750 ppm. Solar water heater along with heat pump will be normally designed with flat plate solar technology. Flat plat collectors are more susceptible to hard water and tanks will get corroded. Best recommended TDS level is 150ppm. It is recommended to use water softner for effective and long term use.

Hard water will also damage electric heaters coil also.

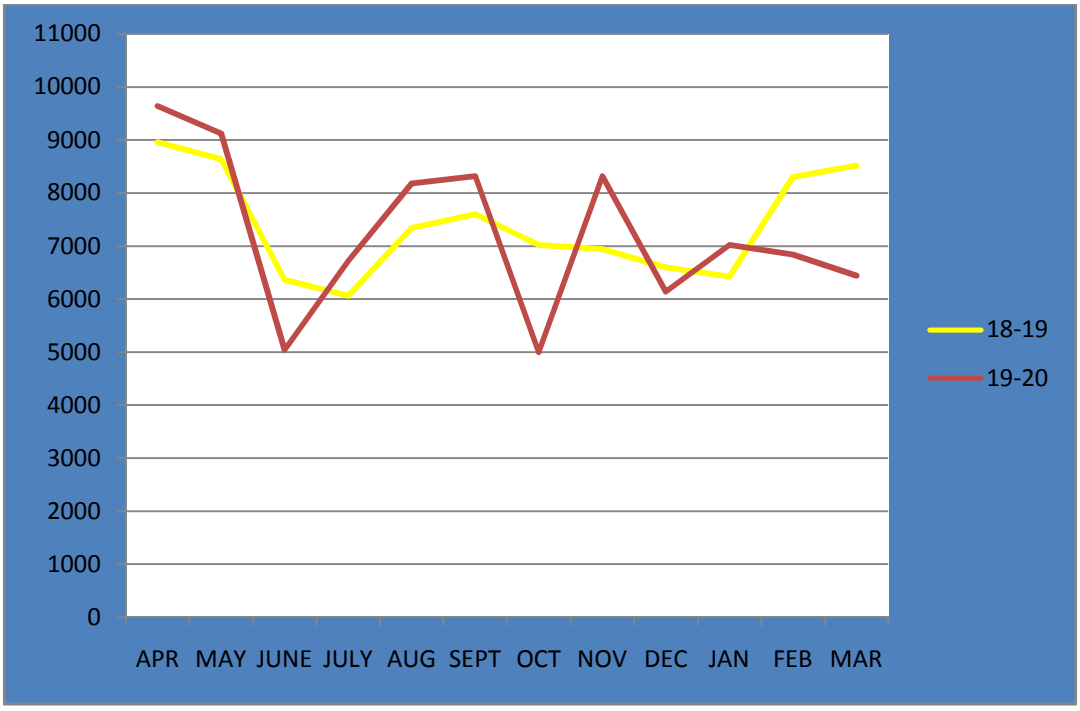
8.5 LADIES HOSTEL- EPI

This analysis made to find out present energy usage pattern and possible corrections .

Present energy consumption pattern as below

Month	18-19 (units)	19-20 (units)
APR	8960	9640
MAY	8640	9120
JUNE	6360	5040
JULY	6060	6720
AUG	7340	8180
SEPT	7600	8320
OCT	7020	5000
NOV	6940	8320
DEC	6600	6140
JAN	6420	7020
FEB	8300	6840
MAR	8520	6440
TOTAL	88760	86780

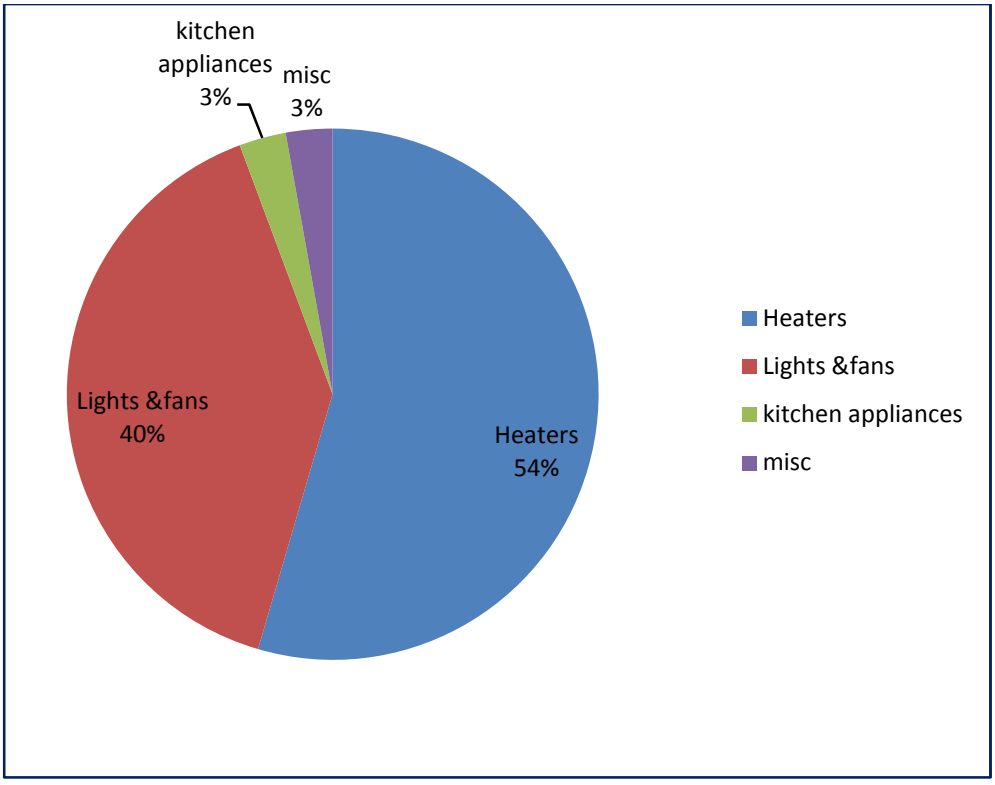
Monthly consumption variation graph



LOAD SHARE

Category	units per annum	%	Remark
Heaters	48000	54	33KW x 4HRS
Lights &fans	35000	40	200w x8 hoursx 150roomsx365days XDF 0.4
kitchen appliances	2500	3	Chapathi maker, grider, exhaust,etc
misc	2500	3	yard light & any instaneous use
Total	88000	100	

PIE CHART



ENERGY PERFORMANCE INDEX (PER STUDENT)

Total energy consumption per annum = 88000 units

No of maximum occupants = 300

Energy index = total energy per annum / no of occupants = 88000/300

= 293 units per students per annum

Considering 300 days occupancy per student

=293/300 = 0.98 units /day

Observation & remark:

- Energy consumption is relatively constant in 2018-19 & 2019-20 .
- EPI per student is high nearly 1 unit per day per student. Excluding energy used for water lifting & yard lighting.
- In above about 0.6 to 0.7 units energy is needed to heat water of 25 ltrs from 25 dec c to 50 deg C
- Proposed solar water of 2000 ltr backed by heat pump will reduce electricity consumption by 20- 30% only, because hot water is needed both morning and evening.
- Illumination level found less in many rooms. They are using only one LED lamp of 9w, which can produce 900 lumans. It is recommended to have LED tube of 20w for 10x 10 room for comfortable reading. Instead to have 2 LED lamps on each wall as alternate option.

9 Encon measures adopted by institution:

Institution has adopted energy conservation measures as mentioned below:

1) Use of renewable energy: Institution has 420 kwp capacity solar roof top on grid system. This serves 97% of its energy need, both directly and indirectly. Since institution has TOD based billing system, energy exported in day will not be compensated by import during night. Solar roof top system found working satisfactorily with kwh /day/kwp is 3.9 and CUF of 16.25%. Best CUF by MNRE us 19%, which is quite difficult to achieve in small plants. However improving and monitoring is explained in energy conservation option chapter. Use of energy during day time to take advantage of TOD is also reviewed in the said section. In general institution is almost nearer grid neutral condition with present load.

2) Integration of solar with DG; institution has three DGs of capacity 125kva 2nos and 250 kav 1no. Out of which one 125 kav is not in service. Both other two DGs use to be in operation together during day time. In normal practice Solar power will not be synchronised with DG , due to fear of back feeding. But when solar generation is less and Dg capacity is more such synchronisation can be down. Institution has taken initiation to reduce solar caoacity during power fails and sync it with DG. Such measure has resulted in reduced fuel consumption. This has saved both cost & environment. With this measures DGs are found working at average loading of 10- 25%.

3) Regular maintenance of AC: Institution has major connected laod of air conditioners of more than 150 Tr and input power of 60kva at 2.5 EER ratio. All these Acs are not used at a time. Many of them used only two to three hours a day . There are duct acs ,water cooled acs along with spilt Acs. Institution has taken care to keep them in condition by giving AMC and also monitoring the preventive maintenance. This has helped not only to keep running , but also in reducing energy need by easy air flow and proper control.

4) Switching off electric heater; Hostel has 14nos of electric heaters in four floors. Its connected load is 33 kw. Energy need is 48000 units per month. These Heaters are used two hours in the morning and two hours in the evening. Institution has recently fixed 3 nos of 5 star rated heaters. Replacing entire system by solar water heater along with haet pump in

progress. Presently hostel maintenance staff are taking proper care to switch on & off heaters as per the need. Thus helping to save energy

5) False ceiling to conditioned halls: Heat gain from ceiling and walls constitute major energy consumption in many air conditioning rooms. It is observed in meeting hall, director chamber and server room care has been taken to avoid heat gain by insulation, false ceiling, window curtain etc. Server room also has rack cooling system for effective cooling. Temperature set at 23-24 deg c in many acs used for comfort. This is in tune with BEE guide lines.

6) Use of CFL & LED luminaries; Institution found suing majorly three types of luminaries, LED, florescent tubes and CFL. Some metal halide lamps also noticed. Institution is replacing with LED lamps only, when ever existing one fails or new requirement arises.

10.0 ENCON OPTIONS

This chapter analysis various energy conservation options observed during course audit

10.1 Energy Conservation Option (An over view)

It is appreciable that institution is using renewable energy to maximum extent. Still energy conservation through efficient system and usage has its own significance. It may result in lowering capital cost, reducing maintenance, need to add more solar, increased export of energy, cost savings etc. It also shows institutions commitment for energy & environment savings and setting standards.

Institution has major following category of load (utilities):

- Air conditioners
- UPS systems
- Lights & fans
- Electric Heaters
- Pumps

Apart from energy conservation, energy monitoring & recording system are also recommended.

Institution has TOD based energy billing system , to take more advantage of renewable energy, reducing load on peak hours and in night also recommended here.

Automation is part of energy saving and it is recommended by NAAC also. Some of automation options discussed in this section.

Following are the various Energy conservation options worked out during audit phase;

Category	Proposal (Details & Analysis of each proposal are provided in next Chapters)
UPS	10kva/196 vdc ups have battery set of 26 ah 2nos. This can be replaced by 42ah 1set
	10 kva & 6kva Ups are found working in low efficiency , Can be replaced with lower capacity 6kva ,10 batteries.
	There are Two UPS of 10kva in Knowledge park. Both are under loaded. This can be merged to one UPS
	Online UPS inverter section is kept on during night also. It can be switched off , to reduce no load loss
	Power factor of many UPS are less than 0.4. It increases current in cable and load on APFC panel
	Two UPS found working on unbalanced input , may need service.
	Cooling fan of three ups not working. This creates IGBT device heat . Cooling fans to be replaced
	There is very less load 6kva ups in lab, This has more no load loss. use another small ups 1kva for critical load.
	Labs have 100ah batteries, as critical back up for long power cut. This can substituted by 65ah

	Parallel redundancy of UPS in Hospital . Changing present 10kva X 3nos UPS to 12.5kvax2nos parallel redundant UPS
Pump	There are totally 10 pumps . Among them 4 nos of heavy duty pumps. There are working at low efficiency. Recommended to replace at least 2 pumps
	one 5hp pump at hostel is not working, Another has leakage & corrosion , leading to indirect power loss.
	Re work has to be done in Pump control panels
	Due to water hard ness , pipes found having deposition . This increses head loss. Recommended to replace regularly used pipe line
	Two pumps are fixed in hostel. One for regular use another for stand by. It is recommended to use both at a time
AC	Many of Split Acs are 3 star rated , that too with old standard. But depending on usage only 24X7 usage Acs can be replaced
	Water cooled air conditioner system of 7.5kw x 2nos , to be converted to air cooled system or redesigned
	Temperature set for AC & using of Fan along with ac has to be advised to occupants.
Lighting	Replace yard lights MH lamps 8nos to LED
	Replace all CFLs & Florescent Tube To LED in phased manner
Fans	Regularly used fans to BLDC in phased manner. BLDC fans consume 30 watts in place of 75 w by regular fans
	Exhaust fans in ladies hostel rest room to be replaced with EE exhaust fans in phased manner
Heater:	Replace electric heater in ladies hostel by solar water heater of 5000 ltrs
	Newly proposed heat pump has to set to use in low tariff time as for as possible
Automation	Street lights has to be fitted with based on astronomical timer
	occupancy sensor ac be fitted at selected ac rooms where occupancy is not continuous.
	Occupancy sensors to be fitted exhaust fans used in rest rooms.
	Presently all pumps are operated manually. It has to be done automatically.
System	Institution has Contract demand 700kva and MD recorded less than 125 kva. Depending on future need & solar capacity , CD can be reduced
	Reducing LT bill in HT billing is not done in three months
	Solar CUF : Solar has good CUF of above 16.6 . But plant found working less than other in certain months. This may be some times due to maintenance. Such things to be monitored monthly
	Institution is maintaining good Power factor using APFC panel. But some UPS are working at low PF. It can be corrected at load point.
	Water TDS is high . It is measured at 700ppm.Softner is recommended . It has significance in energy savings & maintenance.

	solar DG integration : Present solar integration with DG is working smoothly. With installation of 500kva DG, Solar integration can be increased to optimum level
	Boys hostel DG; Fuel consumed by Boys hostel indicates that , it is working at very low load.
Load -TOD	Pump usage : Pumps are switched on & off as per need. Hostel pumps are working more than 8 to 10 hours a day. It has to planned to switch on pump preferably during day to use solar of during off peak hour. Storage has to be planned accordingly.
	SMPS based charger to batteries: Preset UPS have chargers based on SCR design. Recent SMPS based chargers are efficient.
	Electric heater evening usage: Presently electric heaters are kept on between 6pm to 8pm in evening. These heaters can be switched on by 4pm. This uses solar electricity at least for one hour
	Heat pump usage : presently planned heat pump may switch on during peak hour. It has to be avoided .
	Auto dimming of lights : Institution has about 5kw yard lighting load during night time. Presently available IR based lightings will automatic moment control. This will go to dim mode ,when no movement is observed.
Monitoring system	EMS - Energy management system has to be adopted to know feeder wise consumption & other parameters , Both as conservation & safety measure
	Hour meter to has to be fixed to each pump & to be recorded at least once in three months. This gives hours of pump usage and also water used.
	energy consumed by guest house has to recoded.
	All Individual quarters has meter. But one Common energy meter also has to be fixed. This helps in auditing .
	Diesel Generation efficiency is important. To know its performance SEGR is criteria. Energy meter has to be fitted DG sets and reading to be recorded every month.

10.2 Study of encon options UPS

1) Battery bank of 10kva;

Among ten UPS systems , 5 are 10kva/192 vdc systems. It requires 16 batteries to work . present system has 2 sets of 16 batteries for each ups. This can be substituted by 42 ah 16nos in future.

Present capacity 26 x2 = 52 ah

Replaced by 42 ah

Reduction in back up - 20%

Reduction in back up will not have much impact on performance. Because Generator will start immediately.

Load on ups is about 20-30% in maximum of time

Even with 42 ah at 50% loading , backup will be 30- 45min

Advantage:

Cost reduction

Easy handling, since number of batteries reduced.

Hazardous lead waste will be reduced

Present lead waste & impact of change

Present ;32nosx 5 sets x 8.8 kg each	Total 1408 kgs
Change to :16nosX5 setsx12.60 kg each	Total 1008 kgs

Cost

Battery	each	qty	amount
26ah	3300	160nos	429000
42ah	4200	80nos	336000
		savings	Rs93000/-

(above savings for three years of battery life)

2) Efficiency of ups; among ten ups six ups efficiency found below present standard. Among this 6kva UPS is working in lab, which usually runs at very low load During audit it is observed ,loading will be 5% most of times. But other five ups are of 10kva capacity and loaded between 20-50%.

Considering min 10% savings in present input power , power savings of average 500 watts is possible.

500watts X 24 hours x 365 days = 3480 units

Cost of energy saved = 3480 x 7/- =Rs 30660/-

Cost of new UPS (Excluding batteries) = 75,000/-

Simple pay back period =2.44 years

Total investment for 5 UPS = 3,75,000/-

Total savings in units = 17400 units= 1,21,800/- Rs per annum

Other advantages:

Present UPS has low PF of 0.4 , present UPS will have PF min 0.85 up to 0.95

No load and charging loss will be less , hence pay back will be much faster.

3) Merger of two UPS at knowledge park: There are two UPS in knowledge park, placed side by side. Both Ups are capacity 10kva, but most of time under loaded. Even full loading will not cross 50%. In this context one UPS can be disconnected and other UPS can be loaded. Normally on line ups will have 10% over load handling for 5 -10 mins time. There is no critical load connected to it .

   If above option is not possible, then system can be replaced by 6kva UPS with parallel operation. This will share the load ,act as stand by and total capacity will be 12kva.

   Present loading capacity 10kva X 2nos =20kva @ 0.8 Pf = 16kw
   Replacing with 6kva x 2nos @ unity o/p pf =12kw

   Cost implication for removing one ups – nil
   Cost implication by replacing by 6kva X 2nos= Rs 80,000/-
   Batteries needed – 26ah; 20nos x 2 sets = 40nos
   Savings in battery = 64 – 40 = 24 nos
   Cost savings -3300x 24= 79800/- rs

4)Switching of inverter section ; On line UPS will have two sections converter (AC-DC) and inverter sections (DC-AC). This will be continuous process.

Ups will be kept in on condition always. UPS in put can be switched on 24 X7 for battery charging needs. How ever its Out put section (DC_AC) can be switched off during non working hours, Particularly during Sundays & night time . This option is not possible for UPS which have critical load. In case UPS capacity is higher and critical load (night time load) is lower, a separate UPS can also be planned for low capacity load.

Savings as below:

No load consumption	Rph	Yph	Bph
current with inv on (no load)	1.9	1.7	1.5
current with inverter off & in put on	0.18	0.3	0.11

power	R ph Power	Y Ph Power	B ph Power	Total VA
power with inv on (no load)	437	391	345	1173
power with inv off (input on)	41.4	69	25.3	135.7

Considering min two Ups can be switched off in night & off working hours

Savings in energy = (1173- 135) x (12 hours) X 365 DaysX 2ups = 9092.88 units per annum

Cost savings – 9092 units X 7/- per unit =63644 /- Rs per annum

Investment nil

Pay back immediate.

4) Power factor of UPS

Out of eight Ups , only one ups have good input power factor of above 0.95.in all phases
Ups used in gentic lab 10kva found in very efficient condition , even though load factor is less.
10 kva UPS used in computer has good PF in R & B phase, But low pf of 0.4 in Y phase.
6 UPS used in genetic lab is single phase working at pf 0.5
All other UPS have low input power factor of 0.4 in all three phase.
Vender of UPS has to be contacted for servicing or technology up grade to correct PF to level of 0.85. Present UPS will have PF 0.95.

Reduction in KVA:
Considering load of 25% 2.5kw X 6 ups = 15kw
Kva at pf 0.4 = 15 X .4 = 37.5 kva
Kva with pf >0.85 input = 17.64 kva

KVA reduction = 37.5 – 17.64 =19. 86 kva
% reduction = 47 % reduction
This reduces loss in cable and stress on APFC panel. Reduces cable fault in ups connections.

5)Input load balance:

Two ups of capacity found un balance in current on input side. Online UPS works on double conversion . This will take always balanced input irrespective of load .

UPS capacity 10kva at computer section input measurements:

input	R	Y	B
voltage	228.6	233.4	238.5
Current	3.7	1.56	3.05
PF	0.97	0.41	0.98
VA	882.82	364.1	727.42
WATTS	818.29	149.02	712.87

UPS of capacity 10kva at knowledge park input measurement:

normal working			
input	R	Y	B
voltage	228.6	227	225
Current	1.1	11.86	0.6
PF	0.3-0.4	0.4-0.44	0.28-0.34

It seems current drawn by less loaded phase is not used for any useful load. Hence its energy is wasted.

Wastage calculation (0.41 + 1.1 + 0.6) = 2.11 amps

Power loss = 2.11x230x 0.5 = 242 watts

Energy loss per annum = 242w x 24 hours x365 days =2125 units per annum

Cost savings = 2125unis x 7 / - =14879/- rs

Apart from savings , it is indication of UPS malfunctioning.

It is required to contact service engineer of concerned manufacturer to ratify the problem.

5) Cooling fan failure;

Cooling fans in the ups found not working in three UPS. Among this two are in hospital & one in knowledge park. Cooling fan failure may result in performance degrade of IGBTs and other handling devices and may lead to failure

Recommended to replace cooling fans at earliest.

6)Loading of UPS at lab

Genetic lab has 6kva ups ,which has loading capacity up to 5kw. It will be kept always on for critical running of system. This critical 24 x7 load is less than 250w. Loading is less than 5% in most of times.

It is recommended to have another ups of 1kva or lesser and connected to critical load. Out put of 6kva can be switched on only when other load is required.

input	R
voltage	235.7
Current	3.1-3.4
PF	0.54

out put	
voltage	221.6
current	0.74
PF	0.9

DC	
voltage	215.6
current	1.56

Saving in power – 250w

Savings in energy – 250w x 24 hours x 365 days = 2190 units

Cost of energy saved = 15330/- Rs

Cost of new 1kva ups with batteries= 30,000/- Rs

Pay back period = 30000/15330 =1.95 years

7)Reduction in battery capacity:

All labs & computer lab have batteries of 100 ah capacity

100 ah at lab1	26
100 ah at lab2	16
100ah at computer	26
total	68

Even though batteries used in hospital & other places are 26x 2 = 52 ah, these are of capacity 100ah.

As discussed , reason to have higher capacity is ,these are very critical hence in event of generator fail, this has to work.

As institution has two DGs at present and one more 500kva is added, DG failure may not happen.

At present loading 100 ah will run more than 4-6 hours at 5kw load. And -12 hours at 2.5kw load. Under such long power fail condition air conditioners will also stop working.

Considering all above 100 ah can be safely replaced by 65ah or 42 ah during next cycle of replacement.

Saving in cost :

Cost of 100 ah batteries – 8500/- rs

Cost of 65 ah batteries – 5500/-

Total 100 ah batteries 16 +26+16 =65 nos

Savings in cost = (8500-5500)x 65nos =1,95,000/- for every three years

Reduction in lead waste : (32.8 – 20.3)kg X 65 nos = 812 kgs every three years

6)PARALLEL REDUDANCE UPS TO HOSPITAL:

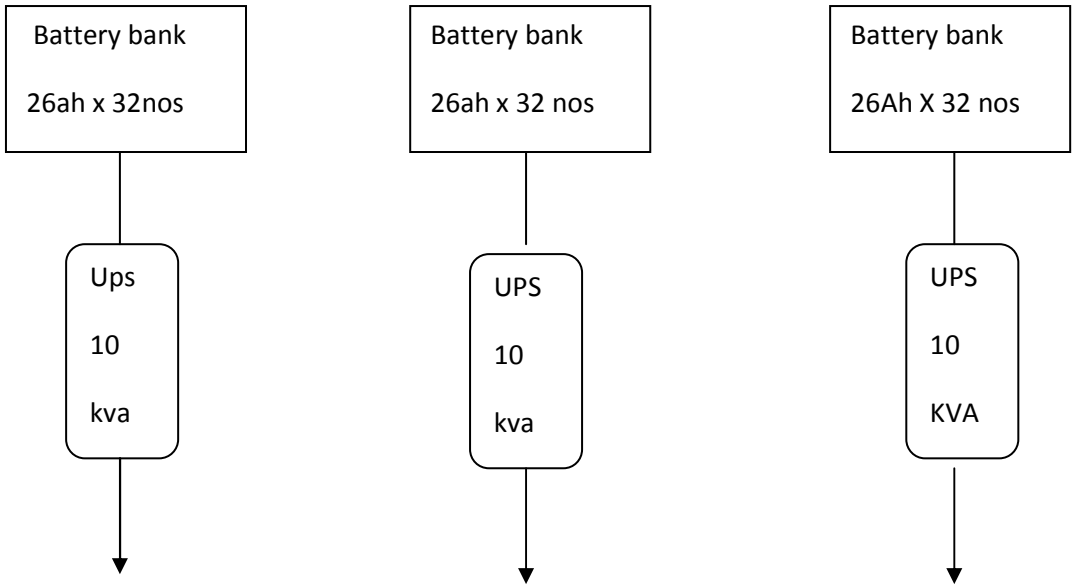
Presently three nos 10kva ups with 32 batteries to each ups is working in hospital.

Loading on them is very low . It will be normally less than 15% and may go to peak up to 30%. Hospital ups is critical and reliability has to be high.

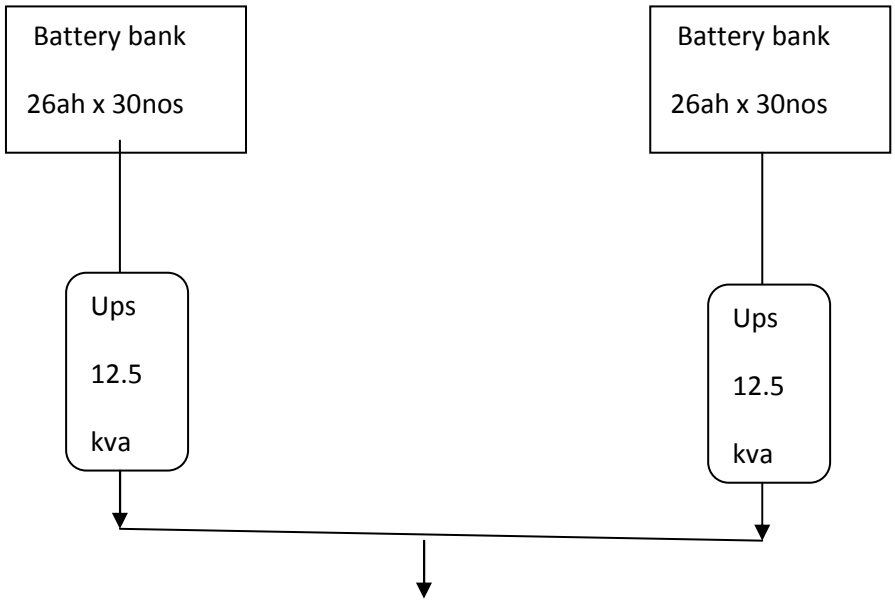
Keeping loading , criticality of application and presnt efficiency level ,we suggest it to replace by 2nos of 12.5 kva parallel redundant ups

Efficiency has to be min 80% with input near unity PF is preferred.

Existing system:



Proposed system



Savings;

Average loading on total 3 ups 6KVA(say)

Present Efficiency (average 50%) = input kva = 12kva

Expected improvement (80% efficiency)= 7.5 kva

Savings = 12- 7.5 = 4.5 kva

Energy savings = 4.5 x 6 hours x 300 days =8100 units

Savings in no load loss = 1kva x 18 hours x 365 =6570 units

Total unit saved = 14670

Cost of energy = 14760x 7/-= 1,02,690

Cost of new 2nos parallel redundant ups= 2,25,000 (existing batteries used)

Less savings in battery = (96-60)nos x 3500/-= 1,26,000/-

Effective cost =99,000/-= Aprox1,00,000/- (say)

Pay back period will be one year.

Other advantages:

Parallel redundancy will have equal load sharing in all two UPS

Reliability will be more

Increase in power factor

Decease in Peak & night time load

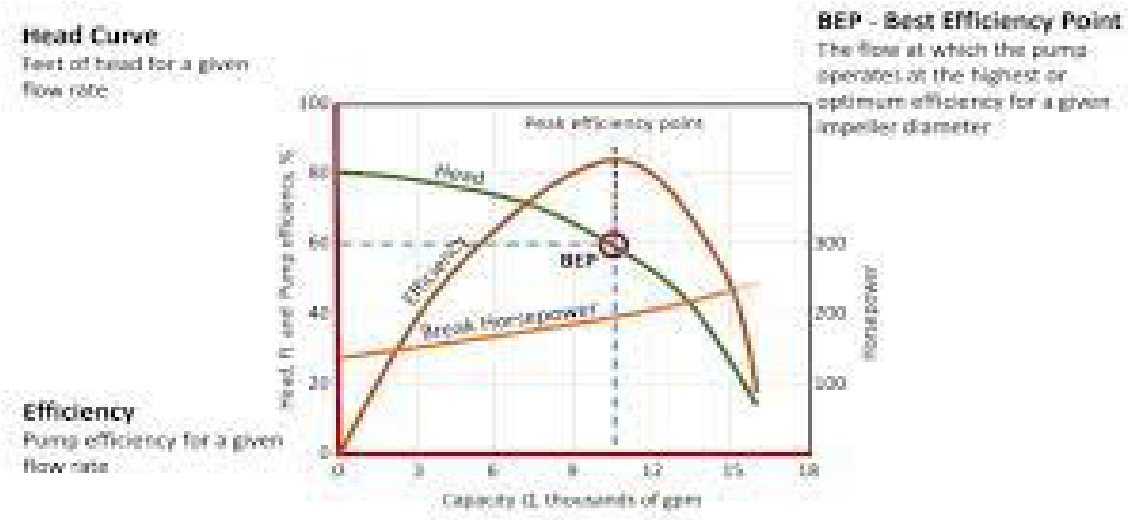
10.3 Study of Encon option study- PUMPS

1)Replacing heavy duty in efficient pumps:

There are four pumps of higher capacity

NO	LOCATION	RATED CAPACITY HP	POWER MEASURED KW	HOURS OF USE	Measured Efficiency	ENERGY PER ANNUM KWH
1	KNOWLEDGE PARK	7.5HP	6.216	1.5HRS	31.30%	3394.5
2	100BACK SIDE	7.5HP	6.81	1HR FOR 2 DAYS	26.24%	1225.8
3	HOSTEL	5HP	3.2	8 TO 10HRS	19%	11834
4	HOSTEL	5HP		NOT	not in use	

Efficiency level of star rated pump will 55-65%. How ever it efficiency mainly depend of its point of operation. But under any practical conditions heavy duty pumps has to operate at efficiency level of 45% and above.



There is no technical data of pump model available at institution. Low efficiency will be because of pump selection (non star rated), Operation Deviation from Best Efficiency Point, hardness in water, head loss in pipe.

Based on efficiency level and hours of operation ,We recommend to replace two pumps at hostel immediately and one bore well pump at knowledge park in next phase.

Replacing hostel pumps with minimum efficiency of 50%:

Present consumption with 19%- 11834 units

Consumption after replacing by 50% efficient pump: 11834X 0.2 /0.5 = 4733 units

Savings = 11834 – 4733 =7101 units

Cost savings = 7101x7/- = 49707 rs

Cost of pump = 50,000/- (2pumps)

Pay back period < one year

Replacing 7.5 hp bore well pump☹knowledge park back side)

Present efficiency ;31.30 %

Proposed efficiency level ; 50%

Present energy consumption; 3394 kwh

Energy consumption after replacing with new 50% efficient pump ; 3394x 0.31 /0.5 =2102 units

Savings per annum = 3394-2102= 1291 units

Cost savings = 1291 x 7/ - = 9037 Rs per annum

Cost of 7.5 hp pump = 30,000/-

Pay back period = 30,000/ 9037 = 3.31 years

(since pump usage is less , pay back period will be more)

For efficient usage of both above:

Savings in energy will be inform of reduced running hours , with high delivery.

Pump needs to be selected based on pump curve.

Pump has to be star rated with IE3 motor ,wherever applicable.

Pipe line deposition to be removed or pipe and valves to be replaced

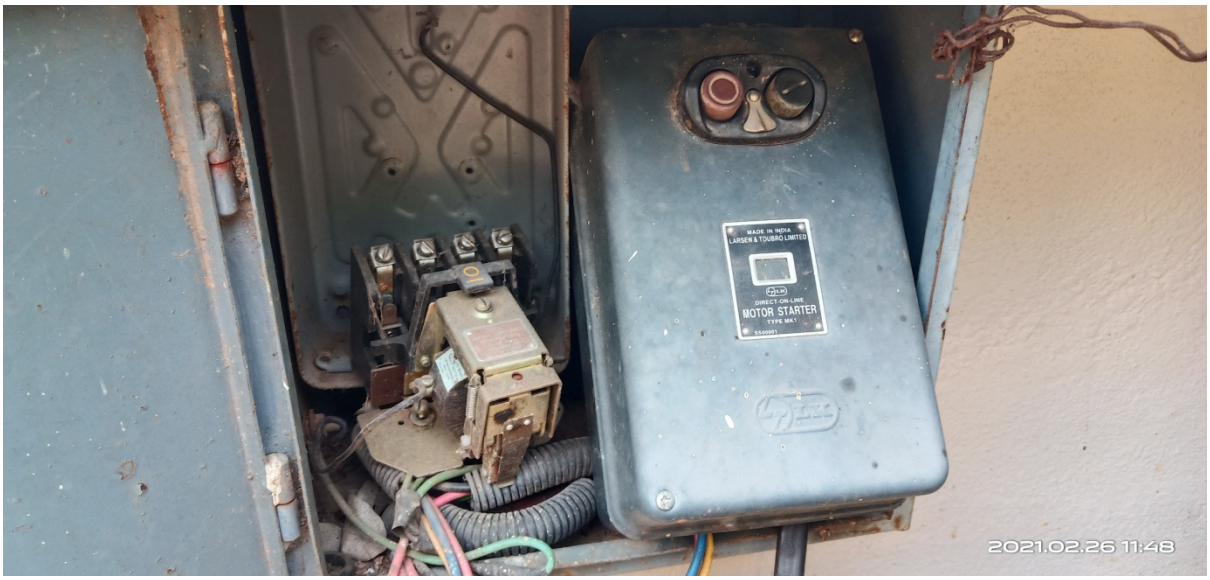
2.condition of pumps at hostel:

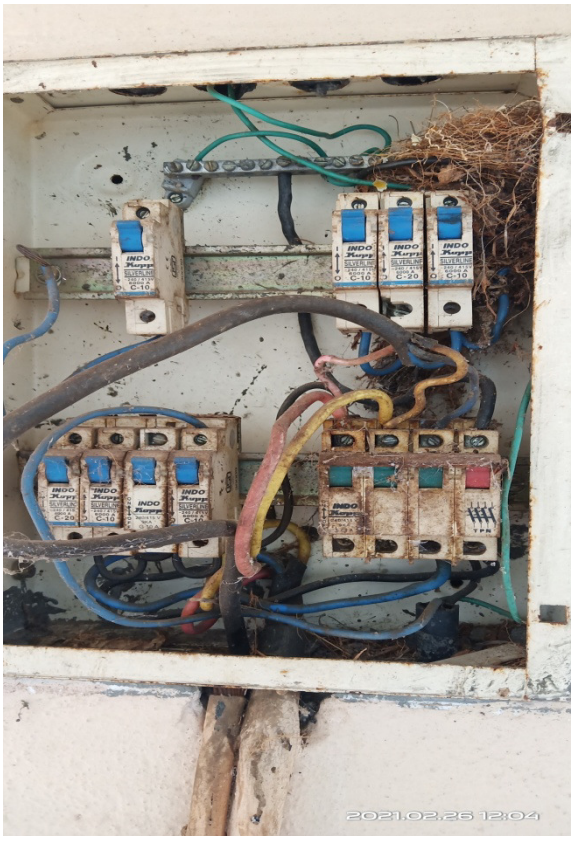
Hostel premises has two pumps to pump water from GLR to OHT. Among this one pump is uased another is stand by. During audit it is observed that pump were in not good condition. One pump was not working , pipe lines were having deposition , valves and pipe lines were leaking.

Loss of water is loss of energy and deposition will lead to head loss. It is also indication of problem in impeller .

3) pump control panels:

Some of the control panels need to replaced for safe operation.





3) impact of hardness in pump efficiency:

Water found having TDS of 700 ppm. Water is pumped from Bore well to GLR and then to OHTs for utility. Water pumped from bore well to GLR will pass through pipe and control values. There will be deposition of salts leading to head loss . This amounts to efficiency loss. Control values need to be replaced periodically , this should to standard procedure. It also recommended to have softener from GLR to OHT.

4) Parallel operation of hostel pumps:

There are two pumps in hostel premises. One will be working regularly , another will be stand by.

There is valve to control the flow.

We recommend to have

Two separate suction and delivery pipes for each pump . This avoids valve head loss and corrosion related problems.

Operate two pumps simultaneously, particularly during day time. This will make tank filling faster, thus avoiding use of pump during peak and non solar period.

10.4 Study of encon options - Air conditioners:

1) Upgrading lower EER air conditioner

Institution has 53 nos of split air conditioners . Most of them are either doesn't have star rating , or having 3 or 4 star rating of 2010 standard. Their EER (energy efficiency level is less than 3) only few have more than 3.

1.0 ton split ACs	20
1.5 ton split ACs	16
2 ton Split ACs	17
total	53

3 star ACs	30nos
4 star ACs	04 nos

Present minimum recommended standard is EER 3.5. However all 5 Star ACs will have EER of above 4.5

Following table given by BEE for comparison

Energy & Cost Saving

1.5 Ton Split Air Conditioner (Various Star Rating)

Star Rating	EER	Cooling Capacity (Watts)	Input Power (Watts)	Units Consumption/ Day (kWh)	Per Unit Charge (approx.) (Rs.)	Electricity Cost/Month (Rs.)	Cost Saving per year (w.r.t. Base Star) (Rs.)
Base Star	2.5	5200	2080	17	4	2040	0
1	2.7	5200	1926	15	4	1800	1200
2	2.9	5200	1793	14	4	1680	1800
3	3.1	5200	1677	13	4	1560	2400
4	3.3	5200	1576	13	4	1560	2400
5	3.5	5200	1486	12	4	1440	3000

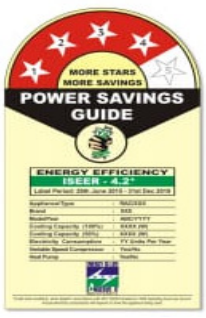
Note: Assuming 8 hours operation per day for five months in year

5. Inverter Type Air Conditioner

Mandatory Appliance

Standard: IS 1391:1992
ISO 16358-1: 2013

Star Labeling Parameter
Indian Seasonal Energy Efficiency Ratio (ISEER)



Indian Seasonal Energy Efficiency Ratio (ISEER) - Higher is better

Star Level	Min ISEER	Max ISEER
Star 1	3.10	3.29
Star 2	3.30	3.49
Star 3	3.50	3.99
Star 4	4.00	4.49
Star 5	4.50	-

But many of ACs are not used regularly. They are in good working conditions and maintained regularly. Replacing them will not have very high period and increase in capital investment. It mat be replaced once its running life is over or in case of any major fault.

2) Server room Acs; Server room has duct type rack cooling acs.

24X7 server ac details	2nos
cooling 4500kcals/hr	4500 kcals /hr
voltage-230	230vac
amps 9.4a	9.4 amps
ton 1.4	1.4
watts -1990w	1990 watts
EER calculated	2.645729

Star label does not applies to duct acs at present . How ever above is old system and used for 24 X7. This sytem can be replaced with new system with EER min 4.

Expected reduction in power consumption ; (1990- 1400) = 590 watts
Consider min 500 watts for 8 hours compressor on
Savings = 500w x 12 hours x 365 days = 2190 units
cost savings at rs 7/- per unit = 15330

3) Use of fan with AC & temperature set:
It is recommended by BEE to set AC temperature above 24 deg C for comfort use. It has also recommended to use fans along with ACs. This will increase comfort level. When fans are used with Air conditioners, even 25 -26 deg C will also meet human comfort. Every degree rise in set temperature will save 5% of energy.
It is recommended to use pedestal fans or wall fans in AC halls with false ceiling and cealing fans in regular rooms.

4) Converting water cooled chiller plant to air cooled system,
There are two system of capacity 7.5 ton. One will be working and another will be stand by.

Observation:
This is very old system ,presently energy inefficient
System control is also old technology.
Compressor motor runs even cut off temp is reached
Cooling tower has leakage

Recommendation:
We recommend this to change to air cooled system.

Advantages:

Power savings up to 3.5 hp

Water savings

Easy maintenance

System becomes more reliable

Simple system

Cost implication to covert existing system

Rs 75000/- each

Energy savings

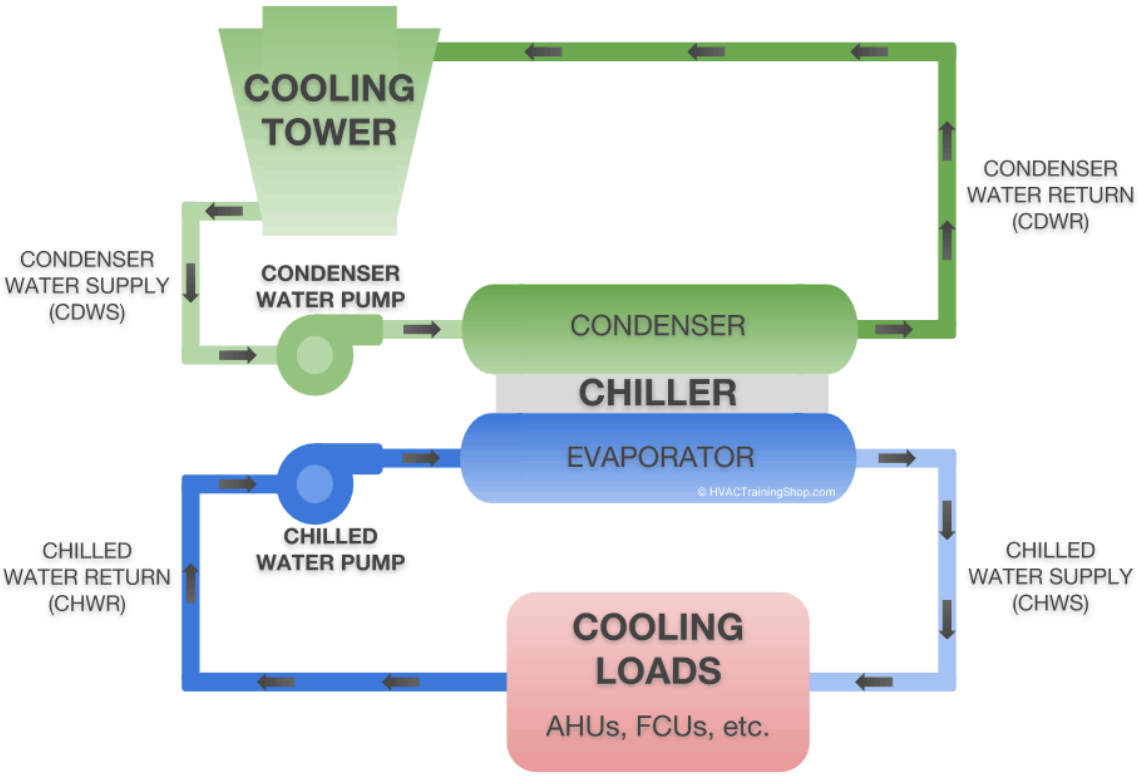
Taking about 4 hours running average per day= 3.5kw X7/- X 4hours per day x250 days=

Cost savings = 24,500/- per year

(ROI) Return on investment = 75000/ 24500 =3.06 years.

Since another system will be maintained for reliability purpose , in view of criticality of application, ROI is con criteria here.

Indicative diagram: (present working)



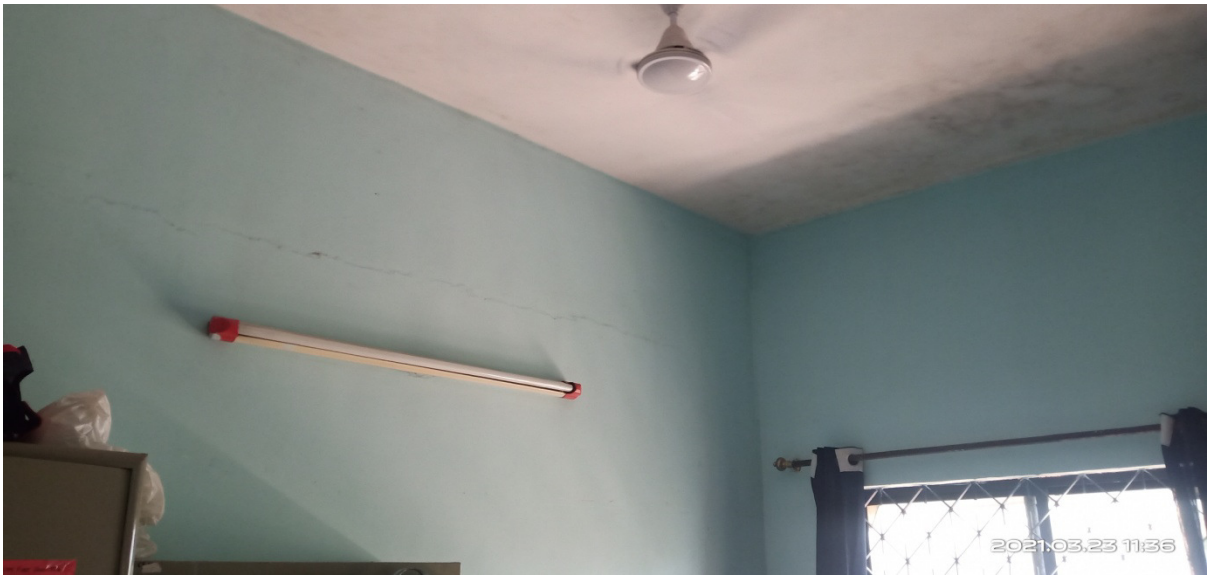
After changing the system , green colour marked component will be replaced by air condenser with fan of 0.5 hp to 1hp

10.5 Study of encon option- lighting

Institution has 5kw yard lighting load in night , 3.0 kw of lighting load at hostel and 4kw load at quarters , about 2kw load at other places . In day time including all building 8-10 kw lighting load observed. Majority of them are CFL ,T5 tubes and LED lights But LED portion is less of about 25%.

We did not noticed any incandescent bulb or old magnetic ballast tube in the premises. Many Tube lights in hostel has been replaced by LED bulb.

Preset day LEDs are encouraged as energy efficient and environmental friendly. All CFLs and Florescent tubes will have mercury ,which is hazardous waste.



However don't recommend to replace CFL & Tubes immediately , as it may result in huge e waste & hazardous waste. We recommend to replace them in phased manner.

It is noticed that, 8nos of MH lamps working in yard , which of 250 watts each. We recommend to replace it by LED of 100w.

Energy savings – (250w -100w) x 12 hours x 365 days x 8nos =5256kwh

Cost savings - 5256 x 6/- =31536/-

Cost of LED lights = 5000 x 8 = 40,000/-

Pay back period = 1.26 years

10.6 Study of encon option FANS;

1) Replacing old fans by BLDC fans ;
   During course of audit, we tried to identify fans which could be replaced by recent super energy efficient fans.
   Apart from hostel and quarters in other places fan usage is limited to 4-6 hours per day , about 250 days in a year.
   Recent technology BLDC fans consume 30w of power , in place of 75w power by regular fans. However recent 5 star rated fan consumes 55watts.

   Investment on each fan – 2500/- rs each
   Pay back period will is calculated as below;
   Units to be saved = 2500rs /6rs per unit (night use)
   Unit to be saved = 416 units
   Hours of operation @ 30w savings = 416 /0.03 = 13888 hours of use

   Since pay back period will be more It is not recommended at present.
   However this option can be considered only while installing new fans.

2) Replacing old exhaust fan by energy efficient exhaust fans.
   We have observed old exhaust fans at kitchen of hostel . But it is said the presently they have stopped using that. Unser such condition it is better to remove from its position.
   Apart from above old exhaust fans found in rest rooms , which are currently in use, These fans consume 80 watts and working at PF 0.5.
   It is already recommended to fix occupancy sensor to each fan. Else fan will run more than 8-10 hours in a
   Consumption of old fans 80 w
   Consumption of proposed exhaust fans = 50w
   Energy saved = 30wx 6 hours x 365 days =65 kwh
   Cost saved = 65units X 6 /-= 390 Rs

Coat of new fan – 1000/- rs
Pay back period = 1000/390 =2.56 years.
Pay back period – 3 years for 6 hours of average use

10.7 Study of Encon option- Heater

1.Replacing electric heaters by solar water heater:

Presently total 33 kw capacity electric heaters are working in the hostel. This is used morning two hours and evening two hours , totally 4 hours.

Based on above data about 132 kwh energy required per day.

That is equal to 132 x860 = 113520 kcals. per day.

Presently planned capacity of solar water heater -2000 ltrs

Solar water heater of 100 ltr can give 5000 kcals per day.

But due to mixing of cold and hot water only 50-60% will be effective.

Based on above statistics, about 50 % of hot water requirement can be met by proposed solar water heater. Hence additionally proposed heat pump need to be used every day.

It is recommended to have 5000 ltr capacity solar water heater to meet maximum of hot water need.

2 Use of heat pump:

Heat effective way of getting hot water. This can be used as additional source with solar water heater. Institution has planned to install heat pump along with 2000 ltrs solar water heater.

- Since students have practice of taking bath in evening, water heated by solar will be utilised by 6pm. At this time if heat pump gets on , it will take power from electricity to heat .
- It will be peak electricity tariff time.
- If water heated by heat pump not utilised fully, then solar capacity will not be utilised fully.
- It is recommended to add more solar heater in future
- Logic based control and temp setting has o be done based on usage pattern. Thus Use of heat pump during peak can be avoided .

10.8 Study of encon option -AUTOMATION

1) Timer for street light:

Street lighting load is about 5kw, which runs about 12 hours a day for 365 days. As discussed with your electrical in charge they have different control circuit and there is possibility to fix automatic timer to on off these lights. Presently it is done manually.

Presently CCMS (Central Control & Monitoring Systems) Being installed in corporation limits for street light control. Instead of this timers can be fixed , which can On off automatically based on time set. This time setting can be changed as per the season for better efficiency. Astronomical timers are also available in market, which is programmed as per the seasonal variation.

Estimated cost for 4 systems – 40,000/- rs

Present consumption – 5kw x 12 hours x 365 days = 21900 units

Savings expected 10% - 2190 units

Cost benefit – 2190 x 7 =15330 /- rs

Pay back period = 40,000/ 15330 =2.60 years.

It is recommended to install one or two systems on trail basis.

This energy saving is important, as this is not compensated by solar power.

2) Occupancy sensor to ac rooms:

Majority of institution Acs are 1.5 to 2 ton capacity, which draws power ranging from 1700 – 1900 watts. Every hour of unnecessary run may result in 2units loss. Un attended run may be due to person left for other work, lunch time and after working hours.

IR based occupancy sensors are economic and easy to install.

Cost of sensor Rs 1500/-

Unattended hours (savings to get pay back in 2 years)= 70 hours per year

Min 5 such system can be installed.

Cost = 7500/- for 5 sets

3) Occupancy sensor to exhaust at rest rooms;

During audit , it is observed in ladies hostel many exhaust fans are running continuously. Exhaust fans run at low PF of 0.6 and will have power rating 80-100w. It has become general practice to install occupancy based sensors in rest room. This will run for 10 mins more even occupants left the place.

Cost of sensor – 350/- rs

Unattended hours (savings to get pay back in 2 years)= 250 hours per year

Even though pay back period becomes more, this measure will create awareness in students about importance of energy saving in small items too.

1) Pump automation:
   Presently all pumps are operated manually either by practice or as when need arises. Over flow results in waste of water and energy. Dry sumps creates most un comfort situation. There is need to switch on pumps before tank dries up and also switch off when filled. Apart from this pumping has to be planned in such a way , it is used mainly during solar generation. To implement all above pump auto mation both sensor and time based controls are needed.

   - As priority one float sensor based auto on off can be installed.
   - If auto on off implementation is not possible, ‘Alarm’ system can be fixed. This is simple & economic
   - Float based sensor are suitable for hard water

10.9 Study of encon option in system

Contract demand;

Month	CD KVA	Billing kva	MD RecKVA	Excess Billing – MD kva	% of CD	Difference amount of BD-MD (rs)
Apr-20	700	595	120	475	17.14	104500.00
May-20	700	595	134	461	19.14	101420.00
Jun-20	700	595	114	481	16.29	105820.00
Jul-20	700	595	104	491	14.86	108020.00
Aug-20	700	595	103	492	14.71	108240.00
Sep-20	700	595	105	490	15.00	107800.00
Oct-20	700	595	107	488	15.29	107360.00
Nov-20	700	595	108	487	15.43	107140.00
Dec-20	700	595	122	473	17.43	104060.00
Jan-21	700	595	134	461	19.14	101420.00
Feb-21	700	595	133	462	19.00	101640.00
Mar-21	700	595	146	449	20.86	98780.00
						Rs12,56,200.00

From above table , it is obvious that only 20% of Contract demand has been utilised. But billing will be made for 85% of contract demand

Cons of reducing contract demand:

Solar capacity is depending on contact demand. Present Solar roof top capacity is 472 kwp. Hence min 600kva is required

There may be capacity additions in future. Getting additional load will be difficult.

Pros of reducing contract demand;

If contract demand is reduced by 100kva (to 600kva CD) billing demand will come down by 85kva

Annual savings in Cost; 85kva x 12 months x 210 rs = 2,14,200/- Rs

With additional STP and new building load , maximum demand may go up to 300kva.

Maximum demand controller can be fixed to isolate load in case CD is crossed.

Solar capacity can be increased , if import becomes more during day time.

1) Reducing LT bill in HT billing.
   Institution has two meters , which is recorded by chescom. One main HT meter and another LT sub meter. Since LT meter power is also drawn by same HT meter, it consumption has to be deducted while giving HT billing. This deducted LT reading is billed separately in same bill. This practice is not done in billing months of Apr 20 & may 20 and june 20. Same has been corrected in later months
   Since previous years bills are not made available us, we could not able to verify them. It can be done by consumer.

Month	units	charge	amount
Apr-20	721	6.80	4902.80
May-20	938	6.80	6378.40
Jun-20	687	6.80	4671.60
Total	2346	6.80	15952.80

2) Solar CUF comparison:
   Institution has 5 solar plants of different capacity on different buildings. All solar panels are subjected same ambient condition and solar irradiation. Even though over all performances is satisfactory, there is variation in generation of each plant on standard bench mark of kwh/kwp/day. (or CUF)
   It is recommended to keep track of such deviation and take corrective action thro solar installer. Many times this will be due to dust accumulation , string failure ,etc

Month	**special Ed-30KW**	**Academic-65KW**	**Audiology & admin-90KW**	**New Audiology - 80KW**	**clinical BLDG-120KW**	**Department of ENT - 40KW**	**speech& language -45**	**AVG KWH/DAY/KWP**
October-19	3.954	3.586	3.050	3.517	3.392	3.548	3.890	3.471
November-19	2.932	3.404	2.243	3.280	3.556	2.721	3.605	3.130
January-20	3.931	4.009	3.388	3.420	3.835	3.510	4.141	3.711
February-20	5.254	5.701	4.079	4.493	5.015	4.148	5.324	4.813
May-20	4.828	4.983	4.394	4.540	4.774	4.371	4.566	4.640
June-20	4.959	4.463	3.082	4.085	4.409	4.916	4.471	4.191
September-20	3.607	3.792	2.867	3.074	3.468	3.306	3.556	3.334
January-21	4.288	4.484	3.280	3.563	4.126	3.727	4.208	3.902
February-21	4.283	4.581	3.248	3.696	4.233	3.846	4.271	3.975
March-21	4.813	4.631	3.873	4.038	4.268	4.050	4.631	4.254
average	**4.285**	**4.363**	**3.350**	**3.771**	**4.108**	**3.814**	**4.266**	**3.942**

3) Power factor correction;

It is appreciable that institution is maintaining good power factor of 0.95 always. Majority of load category are inductive loads .such as Acs, Pumps, UPS,ETC.

Among above ACs and pumps are tested and found working at PF above 0.8. But as noticed UPS are found at low pf of 0.4

Even though APFC panel is working satisfactorily and correcting it, it is recommended to have capacitors at load point, where low pf originates. In this context either action has to be taken to increase PF of UPS or to fix correction capacitor of min value at UPS points.

This will reduce current in the cable 7 reduces stress on APFC panel.

4) Water softner;

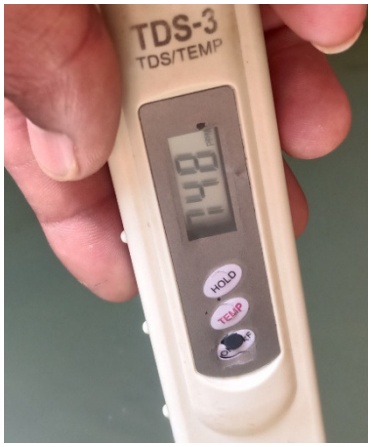
TDS of water at GLR is measured at 700ppm. This is high. It has its impact on energy saving and equipment maintenance.

It has created depositions in water pipes and valves. It has reduce effiecincy of pump and created leakage at certain joints.

It has also affected solar water heater life. Since flat plate collector solar heaters were used, which are more susceptible to hard water .Tanks will also get corroded.

Electric heater coil failure also intimated by concerned staff.

It is recommended to use water softener ,before installing new pumps, solar heater, etc



5) Solar Integration with DG:

On power fail both 125 kva & 250 kva DGs will be operated in day time. Solar integration will reduce the load on DG ,hence reducing fuel consumption. But due to less load on DG ,its efficiency will come down . Still keeping in mind of fuel saving, this measure is in practice.

If solar production is more and load is less , Generator will get reverse power . This will damage the DG set.

Institution has synchronised 125kva DG set with 30kwp solar on special education building

And 250 kva DG set with 65kwp at Academic Building and 45kwp on Speech & language building.

That is about 30% of DG capacity for 125 kva & 50% of DG capacity for 250kva. Recommended limit is 50% of DG capacity. Since system is running with out any problem, no recommendations to add more capacity

How ever with addition of new 500kva and additional loads , it is recommended to take judicial decision ,depending on practical usage in day time. There is option to add another 110kwp solar, when new DG is installed.

A reverse current relay may also be fixed to avoid chances of reverse feed ,in future.

6) Option to add more solar capacity:

With present installed capacity of 472 kwp, institution is meeting 97% of its energy demand by solar. But due to TOD constraint , its financial benefits are not available to full extend. Based on statistics, any further addition will lead to more day time export. Battery strorage is not recommended. Hence additional capacity can be thought of only when day time import exceeds export.

But solar water heaters are recommended , because they use stored heat energy during non sun time.

10.10 Study of encon option- TOD

Instution has TOD based tariff. Its has 4 time zones. Morning 6am-10am , 10am- 6pm , 6pm to 10pm and 10pm to 6am.

In above time zone morning 6am to evening 6pm , power supply is backed by solar generation. Hence it is logical to use more (possible) load in that time.

Second preferred time will be 10pm to 6am , where escom will give discount for consumption.

Option:

Shift loads to preferred zones

Reduce load during other time zones

Options:

1)Pump usage : Pump near hostel is used more than 10 hours a day. Keeping sufficient storage tank, this pump has to operated between 10am to 6pm.

There are other pumps used for bore wells . These pumps are 7.5 hp and operated about 1 to 2 hours per day. Hence this can be easily shifted to above time zone.

While designing auto on off for pump, a timer may be integrated in system . So that pump will operate in low tariff time zone.

Presently 5 hp pump running min 2 hours on 'non solar" zone

Consuming about 2200 units per annum.

2)SMPS CHARGER TO BATTERIES:

It is observed during audit, Some of UPS switches are kept on continuously to keep batteries in charge condition. These chargers are SCR based and working at low efficiency. Present efficient chargers will be SMPS based. Entire ups can be switched off and batteries can be kept in charging mode by SMPS charger.

Advantage:

- Saves energy during night & off working hours
- Increases battery life by low ripple charging
- Pf will be > 0.9
- Protects UPS during harsh input condition ,Particularly during lightning, high voltage, etc

Cost of SMPS float charger; 7500/-

Present loss = 100w x 12x 365 days = 438 units

Cost saved = 2628/- rs

Pay back period = 7500/ 2628 = 2.85 years.

3) Use of electric heaters in hostel;

Electric heaters are switched on evening 6 pm to 8pm. These heaters consume 33kw power . There will be 66units of energy consumption every day on peak. 50% of this energy can be shifted . It is recommended to switch on all heater by 4pm and switch of by 5pm. All heater will have auto temperature cut off , hence there wont be much impact if it kept on for another 30 mins to one hour. (Stand by loss will be 0.8 units for 24 hours). With this 50% of energy can be utilised when solar generation is present. Since institution is planning to install solar heater with heat pump, this option can be worked for time being only.

4)Heat pump usage;

It is planned by institution to have heat pump as back up supply to solar. As per our analysis presently planned 2000 ltrs solar heater may not be sufficient for 300 students , using haot water two times a day.

Under such circumstances ,heat pump will be used regularly. Every day students will use hot water 6pm to 8pm as practice. After this usage hot water level in solar tank will come down and heat pump will switch on automatically.

Above will be peak electricity tariff time, hence need to be avoided. It is recommended to observe the utilisation pattern after installation and set auto control to reduce energy during peak.

5)Auto dimming of yard (street light);

Usually after 10pm there will less people on road. An option be tried to automatically dim some lights during night. This lights will automatically become bright when any person passes by. Street light of 5kw being in use by institution. Dimming may save about 50% . But this option can be implemented in non sensitive zones where security is not hampered. It is already in practice in many places ,where solar street lights are in use.

10.11 Study of Energy conservation option -Monitoring system

We recommend following monitoring system :

1) Central energy management system- This may be cloud or local server based energy monitoring system .This records all parameters along with events of power supply. This will help to analyse actual data accurately .

   This will also give stored and real time data. This will help both energy managers and maintenance engineers. Event warning can also be set.

   This system is available from simple version of one meter costing about 25,000/- and scalable.

   2)Hour meter to pumps:

   Hour meter which cots less than 500/- Rs can be fixed to all pumps or atleast pumps above 5hp. Its reading has be recorded monthly or at least once in three months. This will help to analyse actual energy consumption and also water flow. It is simple and easily implemtable.

   3)Energy consumption by guest house;

   There is no practice of recording energy consumption of guest house. It has heavy load of air conditioners. Its consumption will help to analyse actual energy consumption of institute. It will also increase guest house in charge responsibility to save energy.

   4)Energy meter to quarters feeder.

   All quarters have individual meters . But there is no common meter to recosrd total consumption. This will help in process of audit and also any mismatch in individual energy meter.

   5)Energy meter to DG;

   Presently institution is maintaining fuel consumption and hours of running of DG sets. But energy generated by DG is not recorded. This will be basic data for bench marking DG by SEGR. Generator energy consumption has to be monitored and to be matched with best SEGR. Unit cost by electricity will be more than 30 rs per unit and it creates high pollution.

11. ENVIRONMENTAL AUDIT

This chapter covers different types waste generation , waste management at present & recommendations

11. 0 Environmental management:

An over view of Types of waste & pollutants generated by institution & method of segregation & disposal

During audit it is observed institution campus generates following types of waste.

1)Wet waste- Kitchen waste From ladies hostel , Quarters & Canteen.

2)Dry waste – Paper ,plastics, etc by Office, Visitors, Hostel, Quarters, staff

3)Leaf waste- From trees inside the campus

5) e waste – electrical fittings, computer spares

6)Hazardous non medical waste –Lead waste, Florescent lamps

9)Hazardous medical waste- from hospital

10)Sanitary pad disposal.

10) oil waste – by generator oil

10)Air pollution – Vehicle moments & generator

12)water pollution- Sewage water

13)Noise pollution – Vehicle moments & generator

Observations

Institution is treated as bulk generator of waste. Hence segregation and management at source has to be done as per corporation guide lines & PCB norms.

Segregation of dry & wet waste has to be enforced more strictly at hostel ,public place, canteen . separately marked dust bins with label is required “use dust bin “sign board are recommended.

It is seen that placed dustbins in many places. Blue dust bin has been used to bio degradable waste and blue has been used to non bio degradable waste. It is observed that publics are not following it strictly.

Air & noise pollution is very less. Vehicle moment is restricted . DG set have acoustic enclosure and exhaust is with in limit. It is recommended to to have “no horns “sign board at entrance.

Hazardous medical waste is disposed as per act. It is handed over to authorised agency GIPS BIOTECH Mysuru. About one small standard bag full of waste will be handed over to agency.

Campus has diesel generators of capacity 500kva, 250kva & 125kva 2nos. Each will be serviced every six moths.

Waste oil details

DG capacity	per service	Total per year
500kva	60 Litres	120
250Kva	30 litre	60
125Kva	13x2 =26 ltrs	52
	Total	232

Above waste oil will be carried by generator company service person , for proper disposal as per norms.

Other pollution , mainly air pollution discussed in coming chapters.

Quantum of all other types waste generation , present way of management & disposal along with recommended way of disposal has been discussed in coming chapters.

11.1 water usage & sources

Awaiting for data

11.2 LUX LEVEL & USE OF NATURAL DAY LIGHT;

We observed that natural day light is used in many places ,particularly in clinical section, patients waiting places.

However we observed , low lux level of about 60-80 lux in waiting place near front reception in hospital . It is informed to security staff at the place to keep lights on.

Some consultancy rooms found working with windows closed , due to fear of snakes. It is informed them to keep one portion of window open. Natural fresh air will reduce fatigue and good for patients too.

In electronics dept some portion found at low lux level of 60. It is advised to keep more lights on Recommended lux level is 250 lux on table top for office use.

Administration building is using both natural day light & artificial light.

Library has very good lux level, of 200-300 lux . It has artificial distributed lighting system.

Many Ladies hostel rooms have only one LED light of 9w. This is not sufficient. It is recommended to have one 18 or 20 w tube for 10 x10 room. In case LED bulb min 2 LED bulbs of 9w are required in opposite walls.

During night time, there is lighting load of 5kw , mainly CFLS, LEDs and some MH lamps. Lux level is sufficient . Recommended min lux level is 20 lux for walk paths. All roads f institution is wellilluminated in night with min 50 lux.


HOSTEL ROOM
Believe in Yourself
2021.03.23 11:27

11.3 Generator exhaust report

Data awaited.

11.4a E waste

Institution is found producing following types of E waste

- E waste category 1 as per Pollution control board- **Information technology and telecommunication equipment**

- E waste category 2 as per PCB- **Consumer electrical and electronics:**

- Hazardous waste - Florescent fittings that contain mercury

Till now E waste is not handed over to any authorised e waste collector or e waste recycler as per information received by concerned staff.

It is estimated that institution may produce about 75-100 kgs of e waste every year. This will be mainly computer spares, medical equipments , electrical fittings ,etc. It is also Estimated that about 500 to 1000 florescent tubes and CFL bulbs replaced every year. Above contain mercury , which is hazardous.

Recommendation:

Items belonging to above three category has to be disposed according to Pollution Control Board rules.

1.E- Waste (Management & Handling) Rules, 2011 were notified in 2011 and had come into force since 1st May, 2012.

2. Implementation Guidelines for E-Waste (Management) Rules, 2016

According to above guidelines Section 9.1 & 9.2

*The bulk consumers may ensure that e waste generated by them is handed over only to producer take back system or to authorized dismantler / recycler who is part of producers take back/channelization system.

*The end of life intact fluorescent and other mercury containing lamp, as collected above, may be stored either in the same boxes in which new lamps are brought or other boxes of similar size. They should be stored upright. The due precaution may be taken while packing more than one used lamps, so as not to cause the possibility of breakage during the storage and transportation.

11.4b LEAD WASTE

UPS batteries are major source of Lead waste generation , in the institution.Apart from this batteries are used in vehicles.

UPS battery details

Institution has 8 set of UPS located at different places. UPS used in lab & hospital are said to be most critical.

UPSMAKE	CAPACITY	BATTERY CAPACITY	QTY IN EACH SET	SET	TOTAL	Weight EACH	TOTAL
SILICON	10KVA	26AH/12V	32NOS	5	160	8.8	1408
EMERSION	10KVA	100AH/12V	26NOS	1	26	32.8	852.8
EMERSION	6KVA	100AH/12V	16NOS	1	16	32.8	524.8
EMERSION	10KVA	100AH/12V	26NOS	1	26	32.8	852.8
TOTAL	76KVA			8	228		3638.4

Since institute has SMF VRLA batteries, there is no risk of acid fumes. In addition there is also no risk of distil water maintenance and disposal of sulphuric acid after completion of battery life. Batteries found in good charging condition. No overcharging or bulging of batteries noticed. In generally SMF –Sealed Maintenance Free Batteries have less life than Tubular batteries. But in this case ,all ups are backed by generator. This avoids deep discharge of batteries ,reduces DOD (Depth Of Discharge), resulting in extended life of batteries.

Normally life of SMF battery is 3 to 5 years. Taking on higher side , institution is generating 3638 kgs of scrap batteries for 3 years. That is about 1212.66 kgs every year. This contains lead, PP container, oxide & chemicals.

As per PCB norms , this is handed over to authorised dealer on buy back scheme. But recent batteries have been purchased from GEM (Government E Marketing) Portal, which doesn't have buy back system. Hence it is advised them to dispose batteries from authorised battery recycler and maintain records.

In addition to UPS batteries , Institution also uses batteries for BUS. Presently one bus is in running condition , which uses two batteries of 180 ah, weighing about 40kgas each. This will be handed over to dealer ,while purchasing new batteries, as clarified by institution.

11.5 Dry waste generation & disposal

Information awaited

11.6 WET WASTE MANAGEMENT

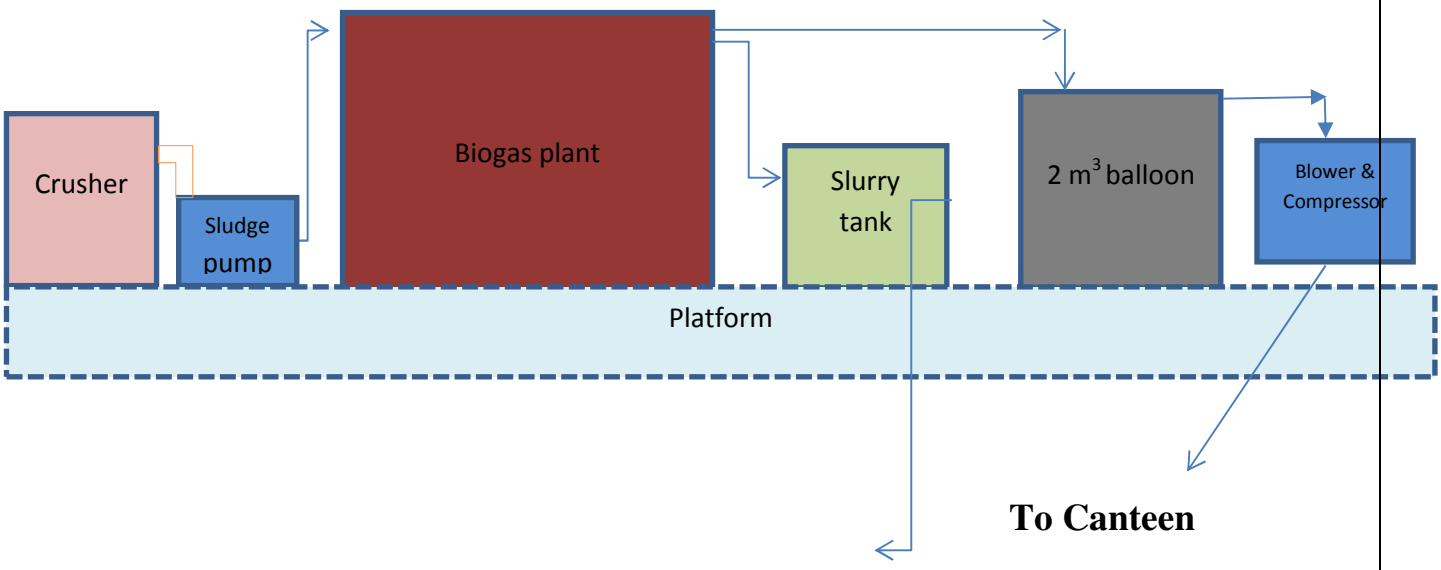
Kitchen waste Bio-gas plant at the AIISH campus

AIISH is housing Girls Hostel and Canteen for visitors in its campus. The total students staying in the girl's hostel is approximately 300 numbers. The total wet waste is approximately 30 kg/day from the hostel and 10kg/day from the canteen. The cumulative approximate wet waste is 40kg/day. These wastes can be converted biogas. The Biogas plant suggested from our end is of 50kg/day automated floating drum type. The output of biogas plant is biogas and the slurry, which is an excellent manure. The biogas generated by the 50kg/day plant is approximately $3m^3$/day.

The kitchen waste bio gas plant is supplied from NIE-CREST, and the budget is as below.

Sl No.	Particulars	Qty	Basic Price (Rs)	GST (@5%) (Rs)	Total Amount (Rs)
1	Supply of Kitchen Waste Biogas plant- (50kg/day), G I Material for digester ($3m^3$) and gas holder($1.5m^3$), Bio gas Balloon ($2m^3$), Slurry tank, Crusher, Pipe line (10m), Burner, Blower/compressor, Automation	1 Unit	5,00,000.00	25,000.00	**5,25,000.00**

Annexure- 1
Scheme for the Installation



Kitchen Waste Composting from Boys Hostel: The boy's hostel in AIISH is housing approximately 60 students. The wet waste generated by the hostel kitchen is approximately 10kg/day. These wastes can be turned into excellent manure by adopting kitchen waste composter. The Waste when mixed with carbon in certain ratio will turn into excellent manure in the span of 45 to 60 days.

Sl. No.	HSN Code	Particulars	Qty	Unit Rate	Amount (Rs.)
1	8479	• Kitchen Waste and Leaf, Mesh Aerobic Composter (Input 15kg Waste/day),(6ft Dia X 4.5ft height) GI Material, Epoxy coating. • Composting Media: Bio clean Brick – 6nos • Installation and Training.	1No.	30,000.00	30000/-
				Total	**30000/-**
				GST @12%	**1800/-**
Grand Total					**31800/-**

Benefits of Composting

1. Composting converts waste to usable product, compost, which can be used to replenish nutrients in poor soils and gardens.
2. Since 60% to 75% of the household waste is organic, composting is a great step towards solid waste management.
3. The added compost also helps to retain soil moisture thereby improving the plant growth.
4. It reduces the need for chemical fertilizers.
5. Reduces methane emission from landfills and lowers our carbon footprint.

About Bio clean Composting Media

Bio clean is a highly efficient solid state aerobic fermentation media which can convert biodegradable material into high value organic manure without any foul odour in duration of 20-30 days. Bio clean is a unique composting media. This composting media is charged with perfect combination of naturally occurring friendly and efficient aerobic microbes.

Benefits ofBio clean:

1. A hassle free, convenient method permits the processing of organic garbage, even in a domestic environment, in a short time.
2. Absolutely no foul smell. A biodegradable waste which generates foul smell, when introduced into the composting medium, loose the foul smell immediately.
3. No leachate during the process.
4. No flies when the moisture is maintained at an optimum level.
5. Frequent turning of the material is not required thereby reducing the inconvenience associated with turning.
6. The organic manure generated by this media has a very important role to play in enhancing the soil fertility and it is an excellent growing medium which can be used in home gardens and vegetable and fruit cultivation.

Method of Composting

1. Fill the composter with around 2 to 3 gunny bags of compacted dry leaves up to 2-inch thickness from the bottom of the composter.
2. Sprinkle the wetBio clean powder and water above dry leaves layer as shown in the Fig. 4.
3. Repeat the above layering process daily.
4. After around 60 days manure can be removed from the door provided at the bottom of the composter.

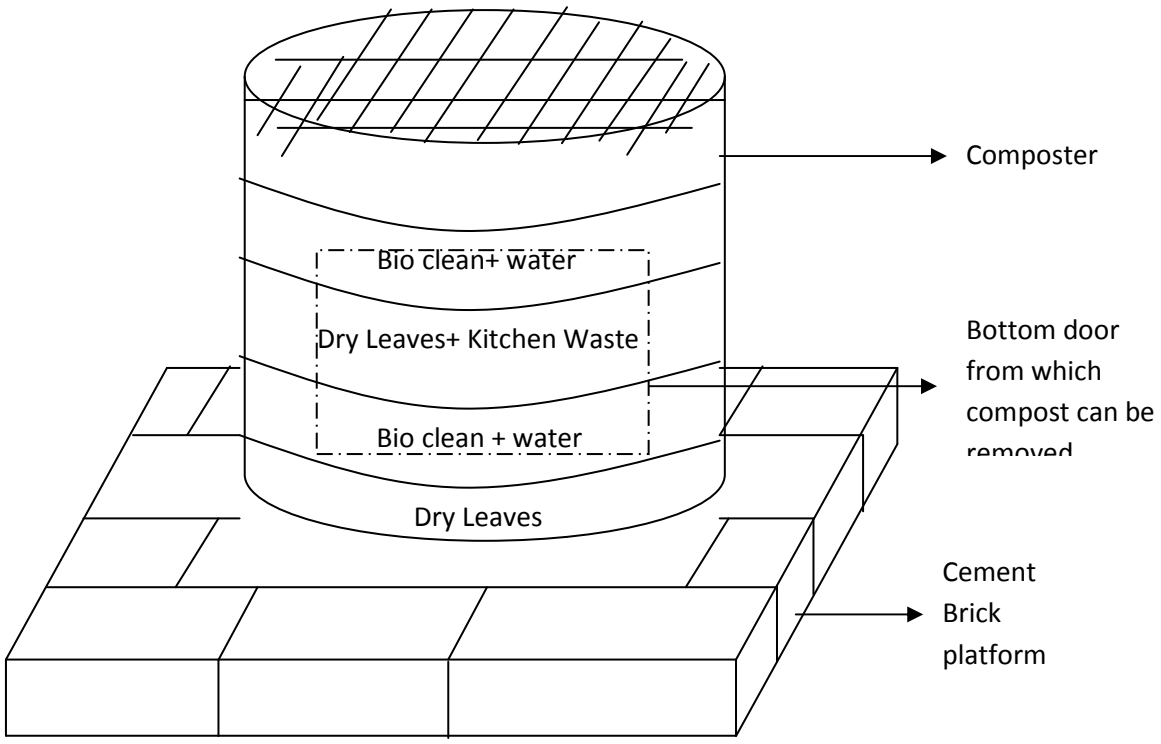


Fig. 4 Leaf composter system

11.7 Hazardous waste over view:

This on over view of all types of hazardous waste produced in institution. These information are covered in other chapters also.

Among waste produced by institution following are considered as hazardous waste.

Bio medical waste;

About one bag per day. It is handed over to authorised agency on daily basis

Sanitary pads ,(Mainly in ladies hostel)

Red coloured boxes are kept in every floor, separately to drop pads. It will be handed over to corporation separately . We have recommended incinerator in this report.(details given in separate chapter)

Generator oil :

About 232 litres of generator waste oil is replaced every year while generator service .This is collected by company service person to process as per PCB norms. (details given in separate chapter)

Lead (scrap batteries):

It is the major hazardous waste of the institution. About 1200 kgs of battery scrap is produce every year in average. It is usually given to registered vender on buy back basis , while purchasing new batteries. This is as per PCB guide lines. We have also recommended certain measures to reduce lead waste. Please refer to e waste chapter & energy conservation measure chapter for more details.

If batteries are not given on buy back basis ,it can be given to agency which has licence to handle batteries.

Florescent Tubes & CFL:

Institution has more number of fluorescent tubes and CFL lamps than LED lamps. Only about 25 5 of lights has been changed to LED. However new buildings are having LEDs. An average life of Florescent lamps and CFLs is considered as two years as per E waste norms.

About 500 to 1000 nos of lamps are replaced every year. These has been handed over to normal scrap dealer. This is against PCB norms . Since all above bulbs contain mercury, they have to stored in packed box and handed over to authorised agency only (please see e waste chapter)

11.8 PLASTIC FREE ENVIRONMENT

Institution comes under bulk produces of waste, hence follow all guide lines of disposal . It is always better to educate students , staff& public about making campus plastic free.

Even though dust bins are kept at strategic location, garbage found in some places at back side. It may be due to temporary construction activity.

But we did not noticed , even single plastic waste in lawns, gardens and streets. Credit goes to horticultural team.

We did not noticed any sign board on educating on “plastic reduction”. We suggest following measures to reduce plastic waste in campus . This helps to reduce Burdon on institution and also creates awareness in public.

Recommended measures;

- Putting sign boards
- Educate visitors to ‘carry back’ their plastic waste. (slowly more restriction can be implemented). This reduces Burdon on institution. It also increases one’s personal responsibility.
- It also to be instructed to all thin plastic covers (less than 40 microns) are banned by government.
- Patients & their relatives , those who are staying in campus will carry food from out side. Many small food out lets will serve in plastic cover . Instruct them to throw left out food and cover separately.
- If plastic bottle usage is more, you can have shredder , which reduces the volume of waste.
- Instruct hostel students to dump plastic bottles, covers, packing materials in separate bins. They can keep in rooms for one week and at the end of one week it can be put to one larger bin. During audit we have noticed many plastic food covers and other waste are mixed together.
- It recyclable plastic is more ,it carry more commercial value. Hence disposing becomes easier for institution.
- Engineering & diploma students can be encouraged to take up project in institution about plastic waste Reduction , Management & Reuse technologies. It will help both students & institution.

11.9 RAIN WATER HARVESTING

INFORMATION AWAITED

11.10 Waste Water management

Sewage treatment Plant:

Campus has occupancy of more than 500 people and also regular visitors & patients. Its sewage out put is expected about one lakh litre per day

use	occupants	ltr/per person	total
Hostel	300	125	37500
Quarters	200	125	25000
Staff	500	50	25000
Others	1	15000	15000
total			1,02,500

It is required to have STP Sewage Treatment Plant of about 1.5 lakh litre per day . Presently all sewage is going to corporation UGD line. During course of audit ,we observed that ,two lakh litre per day STP is in progress. It has power requirement of 60kw.

STP is in verge of completion & expected to be commissioned with in one month .

11.11 Incinerator for sanitary pads.

Campus has ladies hostel of capacity about 300. Presently sanitary pads are dropped to red colour bin ,separately kept for this purpose in each floor. Later on this is collectively handed over to corporation ,separately covered. It is one of good practice .

Being responsible institution ,and with concept of managing waste on our own to , we recommend to install incinerators to hygienically dispose sanitary pads. This most scientific way of disposing used sanitary pads. This sets role model to others too.

INCINERATOR

The Sanitary Napkin Incinerator disposes napkins in an environment friendly method by burning the pads and converting it into ash. Burns napkins completely producing only less than 1 gm of ash per napkin

Small incinerators can also be kept in hospitals and other ladies toilets used by public.

12. GREEN AUDIT

This chapter covers green area of campus, types of vegetation, Its maintenance, composting, water bodies, etc

12.1 GREEN COVERAGE

In total campus about 25% of space is available for green coverage. Horticultural department has put good effort to maintain it well.

It is covered with trees, small plants, gardens, lawns ,decorative plants in pots,etc Details are given in other chapters.

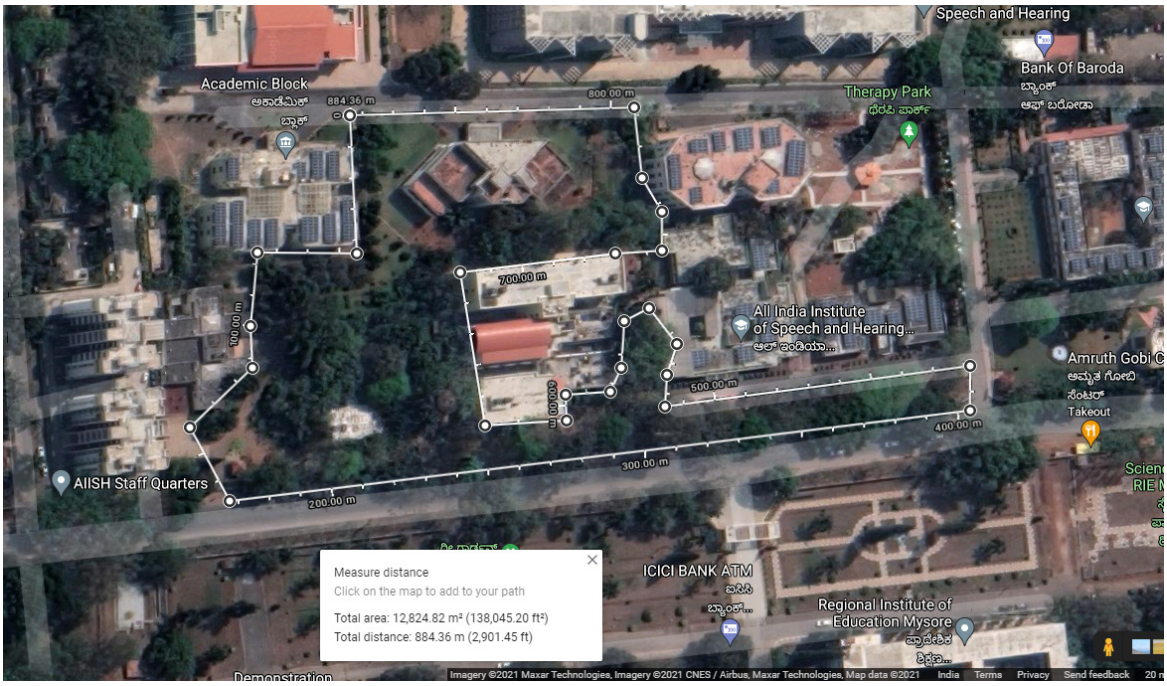
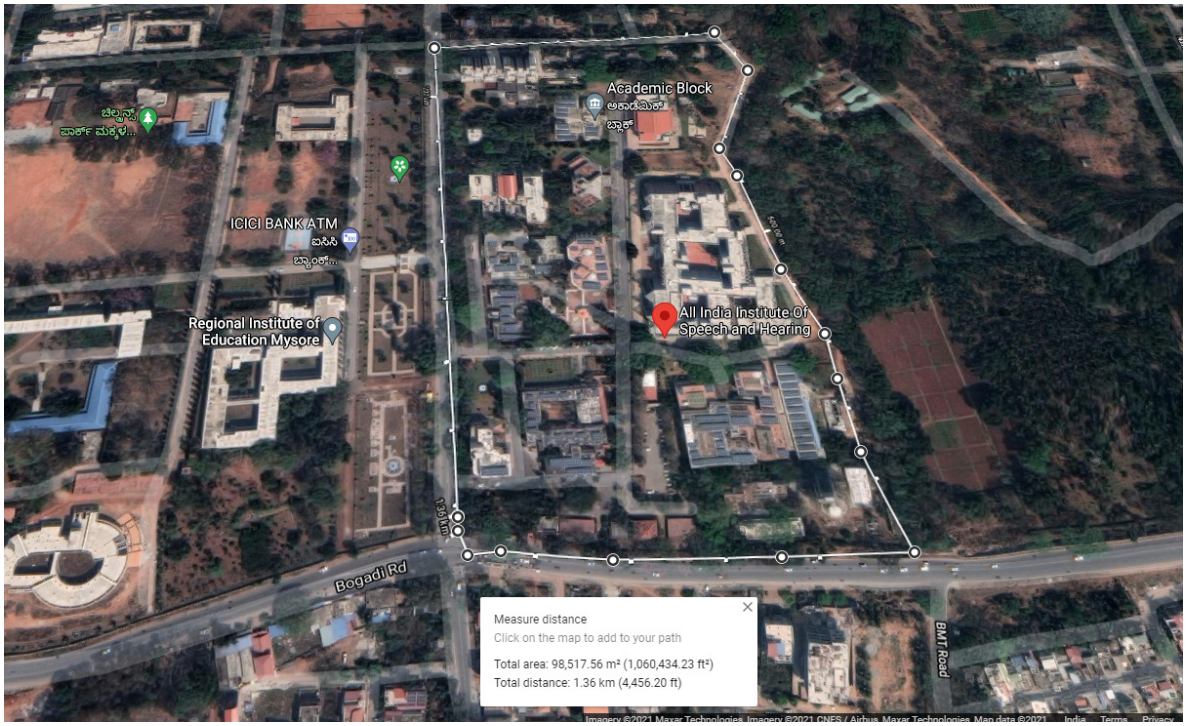


Image2 -14492 sq mtr



Total area: 98,517.56 m² (1,060,434.23 ft²)
Total distance: 1.36 km (4,456.20 ft)

Area covered by greenery (lawns & trees)	27321	Sqmtrs
total area	98517	sq mtrs
% coverage	27.73%	%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ADMINISTRATIVE BLOCK

12.2 Types of vegetation

Information awaited

12.3 water bodies

Information awaited

12.4 LEAF COMPOSTING

Composting:

Vermi-composting: During the visit we have noticed the practice of vermi-composting in the campus. The Vermi- composting is done in a separated bed by experienced staff with good knowledge. The bed volume is of approximately 80 ft^3. The composting is done at two locations inside the campus and harvested annually twice. We have noted the use of technology to convert organic waste into useful product. The output compost is used for in house gardening and for Dasara flower Show as per the gardening staff.

Leaf Composting: The leaf composting is done inside the campus in 2 different locations. In each location the leaf bed was created with the volume approximately 1120 ft^3. The leaf available annually is approximately 2240 ft^3. Cow dung water is sprayed for the inoculation of bacteria to convert the pile into compost. The location used for piling leaves to convert into manure is as of now good with enough shade and leached water from piles percolating into earth.

Suggestion: Add garden green to the dry leaves pile to enhance the manure.

13 AWARENESS ACTIVITIES

This chapter covers activities and intitaion taken by institution in conserving energy & environment , both inside & out side campus

(DATA AWAITED)

14.REFREENCES

1) BEE – Bureau of energy efficiency guide lines
2) National Productivity council Course books
3) ISHRAE-Indian Society For Heating & refrigeration & air conditioning Engineers Manuals & guide books
4) ASHRAE- American Society For HVAC standards
5) ECBC- Energy conservation Building code
6) PCB – Pollution Control Board guide lines
7) Standards & labelling program
8) Product catalogue
9) Practical guide book to energy auditing
10) Solar installation guide book- National skill development corporation
11) EESL – Energy efficiency services limited
12) Product catalogue –Pumps
13) Product catalogue –air conditioners.

END