Energy Audit Report
of

JAYAMUKHI INSTITUTE OF TECHNOLOGICAL SCIENCES

(UGC-AUTONOMOUS, Affiliated to JNTUH, Narsampet, Warangal (R), 506 332)

2021-22

By

SRI GAYATRI ENERGY SERVICES

we support you conserve

Flat: 401, SS Enclave,2-1-255, St. No:14,Nallakunta, Hyderabad,M:9848050598

Email:srigayatrienergyservices@gmail.com

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ACKNOWLEDGEMENT

M/s **Sri Gayatri Energy Services,** Hyderabad places on record its sincere thanks toprogressive management of M/s **Jayamukhi Institute of Technological Sciences, Warangal®**, Telangana for entrusting the Energy Audit work of their College.

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We trust the data provided by the M/s **Jayamukhi Institute of Technological Sciences**,Warangal Telangana personnel is true to their best of knowledge and we didn't verify the correctness of it.

Audit Study team

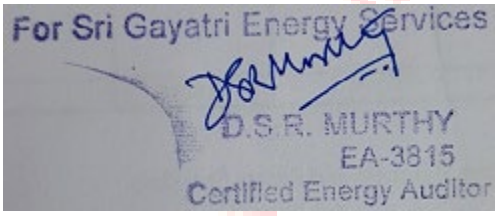
Shri D.S.R.Murthy	Senior Energy Auditor
Shri Durga Rao	Engineer
Shri Sai Ganesh	Engineer

LIST OF INSTRUMENTS USED

- True RMS Power Meter
- Digital Earth Resistance meter (Clamp Type)
- Digital Earth Resistance Meter (Conventional Type , Kyoritsu, Japan)
- Digital Infrared Thermometer (Fluke)

CERTIFICATE

We here by certify that we carried out Energy Audit in the M/s **Jayamukhi Institute of Technological Sciences, Warangal** Telangana during 19 FEB 2022 and following Observations were presented below. The Energy Bills were analyzed for energy consumption ,Power factor , Electrical Load distribution , Distribution Losses if any and Recommendation to reduce the same .We appreciate the efforts of the M/s **Jayamukhi Institute of Technological Sciences, Warangal** Telangana for their Pro Energy Conservation measures in this regard.



Executive Summary of Observations

1. A Detailed Walk Through Energy Audit is carried out at the Campus with following observations.
2. The Power Factor at the Main Incoming panel (after Transformer) is satisfactory .
3. The Power Factor at the individual Blocks needs further improvement , it is recommended to install small PF improvement capacitor banks at the individual Blocks(Engg/MBA/B.Ed/Pharma Blocks) to improve the PF and reduce the losses.
4. It is observed that the Existing Fans installed are Energy Inefficient fans which may be replaced as and when opportunity comes with Energy Efficient one which result in energy savings (Detailed Calculation is enclosed).
5. It is observed that some of the Split AC's installed are not of star rated , it is recommended to replace them with minimum 3 star rated AC's as and when the opportunity comes .
6. It is observed that the CMD is high and average demand recorded in this current academic year is low, it is recommended to keep this in observation and reduce the CMD if it is consistently low for another 2-3 months.
7. The Electrical machine load is though its high the diversity is low hence no recommendation for this load.

Detailed Walk Through Energy Audit scope of work

1. Physical inspection of the premises with reference to Energy Efficient equipment/ Energy Conservation measures/ Renewable Energy.
2. Identifying the Energy saving Opportunities within the premises by installing efficient equipment /devices / system of the electrical installation.
3. Identifying the Energy Saving opportunities by adopting continuous suitable monitoring methods

Project Schedule :

1. Walk Through Audit : 1 day
2. Report generation : 2-3 Days

Introduction of the Institution

Sponsored by the Jayamukhi Educational Society, the Jayamukhi Institute of Technological Sciences came into being in 2001 to provide quality and contemporary education with social relevance in the engineering faculty with an ultimate vision to maintain global standards in higher learning and research. The Institute has the approval of AICTE and recognized by the Government of Telangana. It is an affiliated college of Jawaharlal Nehru Technological University (JNTU), Hyderabad .

The Institute has come upon 40 acres of green pastures in Narsampet, about 30km away from the historic city of Warangal and presents a picturesque and panoramic view. JITS offers a four-year B.Tech. Programme in the disciplines of CSE, ECE, EEE,CIVIL and ME with a total intake of 660 students and at the postgraduate level, it offers courses like M.Tech. (CSE), M.Tech. (SWE), M.Tech. (VLSI Design), M.Tech. (Embedded Systems), M.Tech.(Power Systems) ,M.C.A., M.B.A. in addition to Pharmacy and B.Ed. Courses under the fold of the same Society. Accreditation: Based on its outstanding academic, curricular and co-curricular track record established by it within a period of just seven years, the National Board of Accreditation of the AICTE has for the first time accredited all the four branches of engineering offered by Jayamukhi Institute of Technological Sciences. The branches include CSE, ECE, EEE, and IT. Wherever students go, the organizations prefer the students from the NBA accredited colleges and treated on par with the students of IITs and NITs.

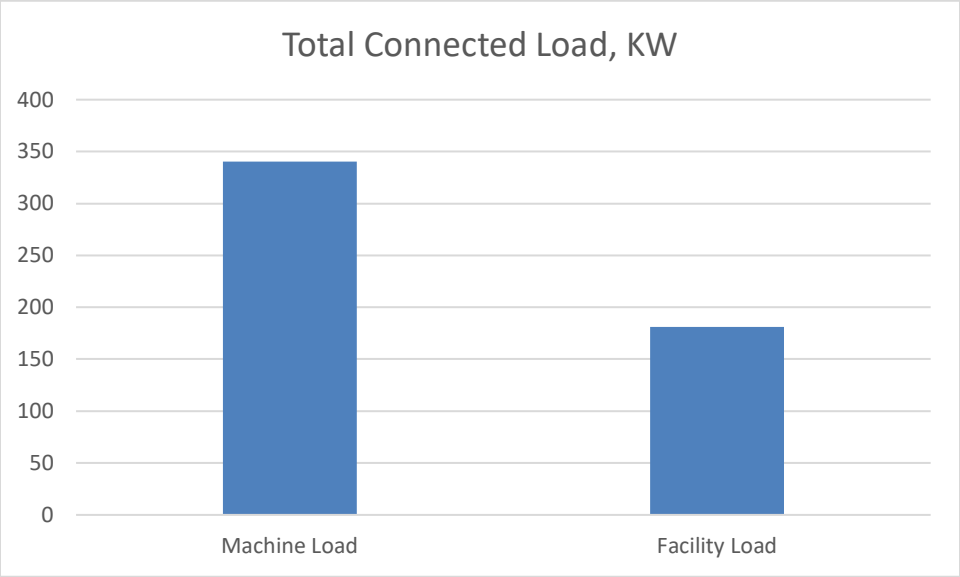
Facility Description

The Facility Receives Power supply from TSNPDCL at 11 KV, the installed transformer is 11 KV/433 V transformer of 315 KVA and the Contracted Maximum Demand with TSNPDCL is 200 KVA, The total connected Load is around 521 KW.
At present due to Covid 19 Lock downs the Demand is not reaching close to the 80 % value of the CMD .

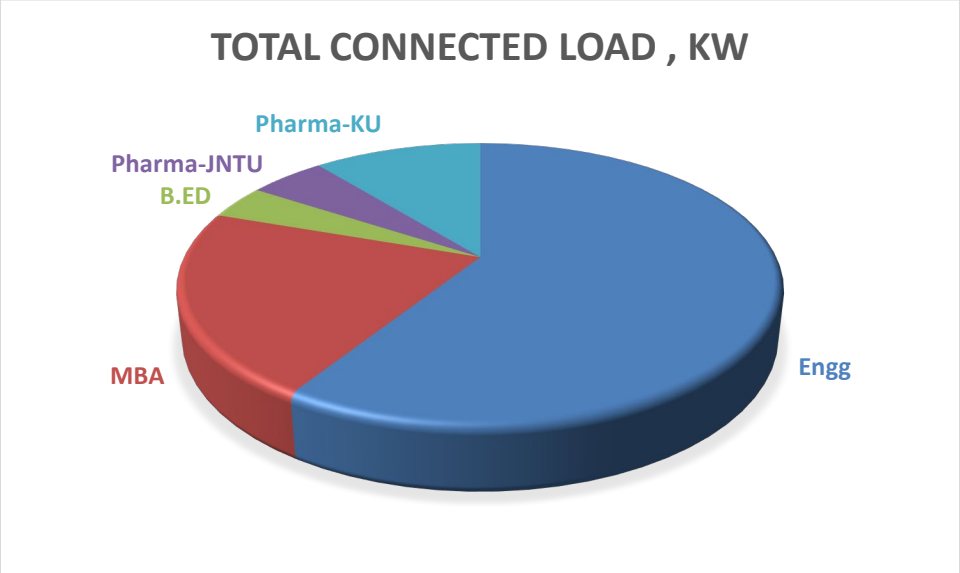
Hence it is recommended to reduce the same.

Electrical Load Distribution

The Incoming power supply is from a 11 KV TSNPDCL ,with one Transformers of rating 11kV/433 V 315 KVA , The total connected load is around 521 KW . The emergency supply. taken care by DG Sets . All the three Blocks are equipped with UPS supply for Power back up for the computer systems. The details of the connected Load across the campus is given below

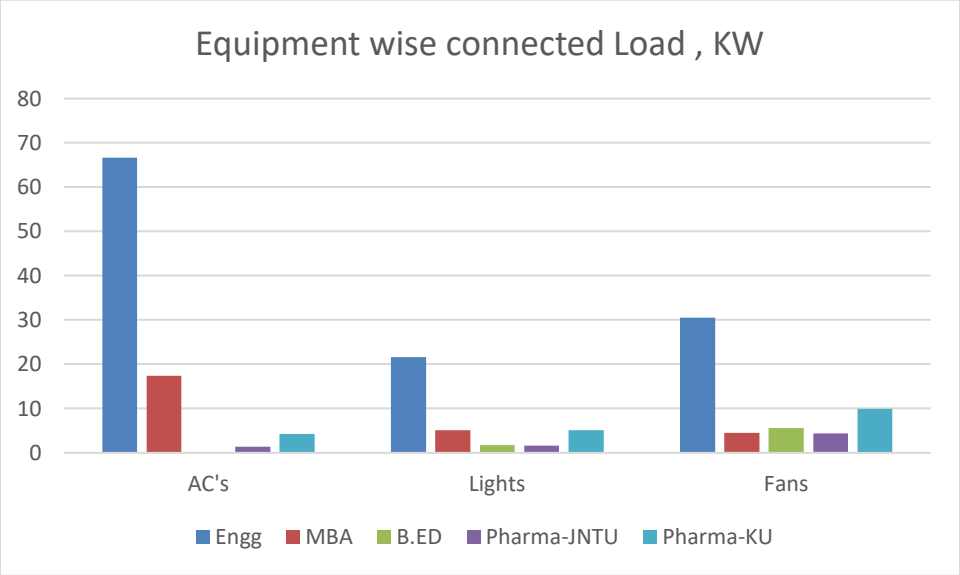


The Various Electrical Load Power distribution across the campus is shown below



Observation : The Engg Block is having maximum connected Load across the campus , the load is Machines and the Split AC's . The various energy efficiency opportunities studied for the improvements

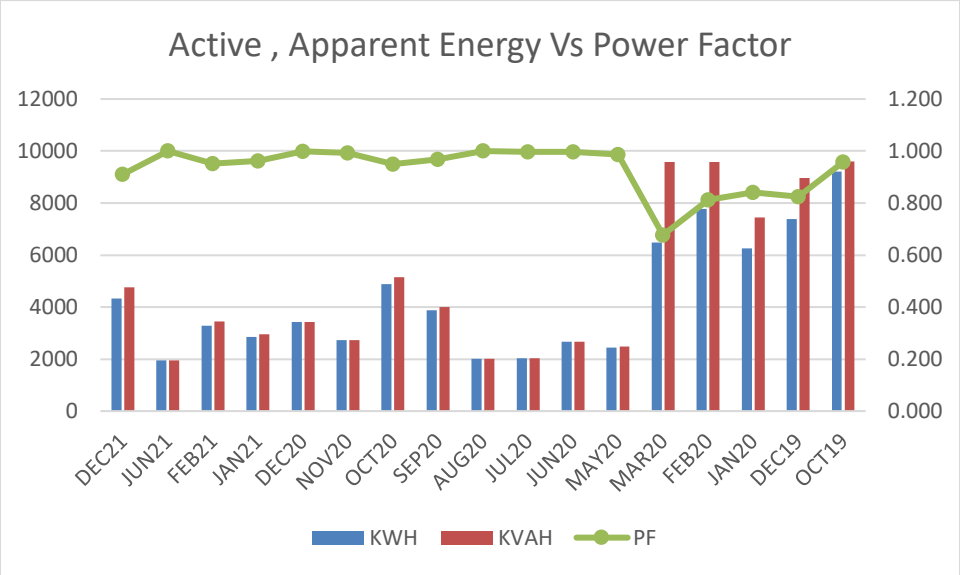
Equipment wise Connected load across all Blocks



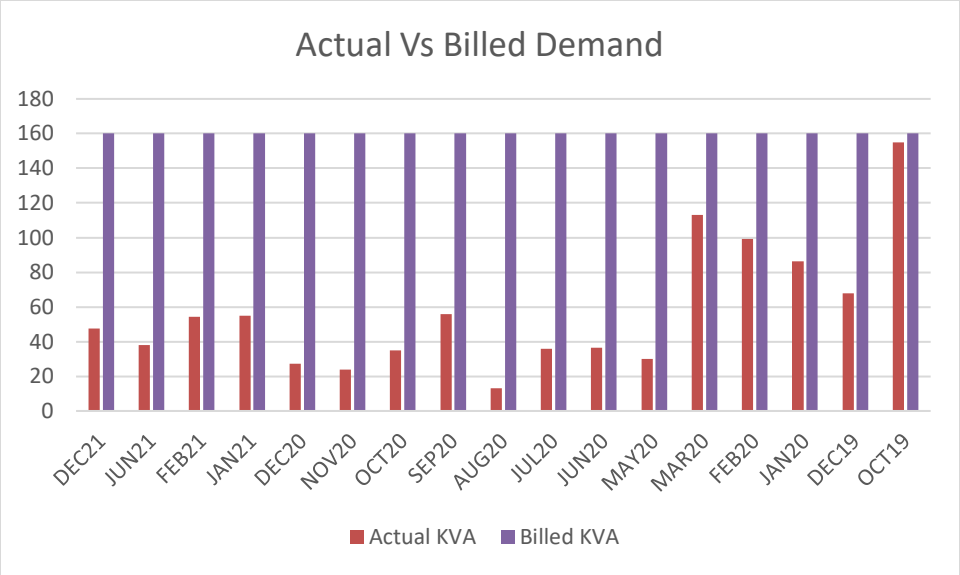
Observation : The Major load in the equipment is Split AC 's and the consumption will increase during the summer months due to increase in ambient temperatures . Thus it is recommended to keep the set temperature at 27 Deg C to reduce the energy consumption. Also recommended to install wet gunny bag covering the Outdoor unit to reduce the Δ T between Ambient and Fan.

Energy Consumption pattern Analysis

The Energy Bills were analyzed for understanding the pattern to reduce the energy consumption . It is observed that the college did not reach the 80% of the sanctioned CMD during the last two years , the reason attributed could be due to partial/non functioning of the college during COVID 19 pandemic . In case if the situation is not normal , then it is recommended to reduce the contract Demand to 120 KVA -150 KVA so that the fixed charges paid by the college can be saved.



Observation : The Power factor during some months is low , it is recommended to check the existing PF improvement capacitor banks , if found defective then replace the same with new one.



Observation : The Actual Demand recorded is too low compared to the 80 % of the CMD ,may be due to covid 19 pandemic . In case if this continues to be low then it is recommended to reduce the CMD to 120 KVA – 150 KVA so that the college saves the fixed charges paid on account of the CMD .

The Power Measurements are carried out at various blocks are given below

Power Measurements AY - 2021-22						
Location	Phase	Voltage	Ampere	kVA	Power factor	kW
Main Incoming Power Supply	R	239.1	61.3	14.76	0.99	14.7
	Y	238.4	62.8	15.08	0.99	15.04
	B	241.3	63.7	15.38	0.99	15.34
Engg Block	R	239.3	14.1	3.37	0.632	2.13
Main Panel-1	Y	237.8	12.2	2.92	0.398	1.16
	B	241.8	15.4	3.72	0.77	2.89
MBA Block	R	238.7	11.8	2.83	0.722	2.04
Main Panel	Y	238.5	12.1	2.91	0.77	2.24
	B	240	8.3	2	0.88	1.76
B.ED Block	R	238.7	12.4	2.96	0.812	2.40
Main Panel-1	Y	238.5	13.2	3.15	0.789	2.48
	B	240	99.8	23.95	0.879	21.05
Pharma - JNTU	R	239.3	12.9	3.09	0.755	2.33
Main Panel	Y	237.8	14.2	3.38	0.857	2.89
	B	241.8	15.4	3.72	0.885	3.30
Pharma - KU	R	238.6	9.7	2.31	0.813	1.88
Main Panel	Y	235.2	11.3	2.66	0.838	2.23
	B	240.7	14.6	3.51	0.867	3.05

Observation : During Audit it is observed that the Power factor at the individual blocks main panel found to low , it is recommended to install small capacitor banks of 1-5 KVar to improve the Power factor and reduce the load losses.

The Energy Bills Analysis is carried out to Understanding the Consumption pattern of the Institute

M/s Jayamukhi Institute of Technological Sciences, Warangal®, Telanagana										
	UNITS						CHARGES			
Month	KWH	KVAH	PF	Actual KVA	Billed KVA	TOD	Demand	Energy	TOD	Total
DEC21	4336	4761	0.911	47.7	160	653	62400	31200	653	94435
JUN21	1940	1940	1.000		160	2168	62400	31200	2168	92113
FEB21	3285	3454	0.951	54.3	160	1220	62400	31200	1220	95027
JAN21	2843	2955	0.962	55	160	2710	62400	31200	2710	96487
DEC20	3427	3433	0.998	27.2	160	1773	62400	31200	1773	93267
NOV20	2720	2738	0.993	23.9	160	1462	62400	31200	1462	93685
OCT20	4876	5139	0.949	35	160	1504	62400	31200	1504	93727
SEP20	3876	4005	0.968	55.8	160	1372	62400	31200	1372	93455
AUG20	2018	2018	1.000	13	160	1166	62400	31200	1166	93277
JUL20	2030	2038	0.996	36	160	1435	62400	31200	1435	95166
JUN20	2663	2673	0.996	36.6	160	950	62400	31200	950	93459
MAY20	2447	2481	0.986	30	160	1161	62400	31200	1161	93349
MAR20	6482	9573	0.677	113	160	1103	62400	31200	1103	137064
FEB20	7778	9573	0.812	99.2	160	1426	62400	31200	1426	137418
JAN20	6249	7437	0.840	86.4	160		62400	31200	0	120824
DEC19	7394	8959	0.825	67.9	160	1138	62400	31200	1138	132518
OCT19	9200	9601	0.958	155	160		62400	31200	0	137889

Saving Opportunities

1. The Actual Demand is observed to be recorded less than the CMD , it is recommended to reduce the CMD to 120 KVA from 200 KVA and there by Demand charges savings of Rs 15600/- per month on account of Demand Charges.
2. The Individual Blockwise Power Factor to be improved to reduce the losses .

HVAC- Air Conditioning Systems

Introduction of Air Conditioning & Refrigeration System:

The present Air conditioning system in the college is of Package Units , Split Air Conditioning units of star rated . The Air conditioning is analyzed for energy saving opportunities . The detailed measurements are taken on sample basis at some of the locations .

The Measurements of sample Split AC units are done in blocks and tabulated below

Split Air Conditioners 2021-22												
Sl. No	**Location**	**No. of A.C. Unit**	**Type of A.C.**	**Rated TR**	**Power kw**	**Inlet Temp.(°c)**	**Outlet Temp.(°c)**	**Flow m/sec**	**Arrived TR**	**Specific Power KW/TR**	**COP**	**EER**
1	EnggBlock	1	Split AC	1.5	1.152	25.3	22.8	0.39	1.23	0.94	3.74	12.79
2	EnggBlock	1	Split AC	1.5	1.225	24.7	21.9	0.44	1.55	0.79	4.45	15.17
3	EnggBlock	1	Split AC	1.5	1.35	25.4	23.1	0.45	1.30	1.04	3.39	11.57
4	EnggBlock	1	Split AC	1.5	1.375	23.7	22.3	0.36	0.63	2.17	1.62	5.53
5	MBA Block	1	Split AC	1.5	1.65	24.3	21.7	0.41	1.34	1.23	2.86	9.75
6	MBA Block	1	Split AC	1.5	1.525	25.2	22.3	0.38	1.39	1.10	3.19	10.90
7	MBA Block	1	Split AC	1.5	1.45	25.7	23.4	0.53	1.53	0.95	3.72	12.68

Energy Efficiency Opportunities

Reduce heat loads

Any reduction in heat loads results in a reduction in required refrigeration capacity and therefore energy consumption. There

are three main methods for reducing heat loads:

· Improving insulation.

· Reducing air leakage.

·Reducing incidental and auxiliary gains.

Insulation improvements

The walls of a refrigerated space should be well maintained to guard against damage or degradation of the insulating material.

visual inspection will give first indications of problems while thermographic inspection will show up cold areas where insulation is poor.

- Air leakage

Air can leak through the degraded fabric of an enclosure or through an access such as a door. Taking the steps outlined above should prevent fabric leakage, while reducing air leakage through doors is outlined below:

Reduce temperature lifts

The efficiency of refrigerating plant is dependent upon the size of the temperature lift between the evaporator and the condenser: the smaller the lift the more efficient the system.

- Head pressure control

Many systems maintain a higher lift than is necessary through the use of head pressure control. This practice aims to maintain ahigh pressure in the condenser to ensure a controlled supply of refrigerant to the evaporator. The control pressure can be reduced using a balanced port thermostatic expansion valve or an electronic expansion valve, while the installation of a liquid line pump can further reduce the need for such control. Lowering the control pressure allows the condensing pressure to fall as the outside temperature falls

from the design condition and can improve energy efficiency by50%, particularly during winter. The cost of these measures varies between 15,000 to 150000 if installed at the time of refrigerant replacement and will normally pay back in about two years.

The Package Units measurements are carried out on sample basis at various locations and following are the details tabulated calculating the SPC (Specific Power Consumption) , EER(Energy Efficiency Ratio), COP(Coefficient of Performance) .

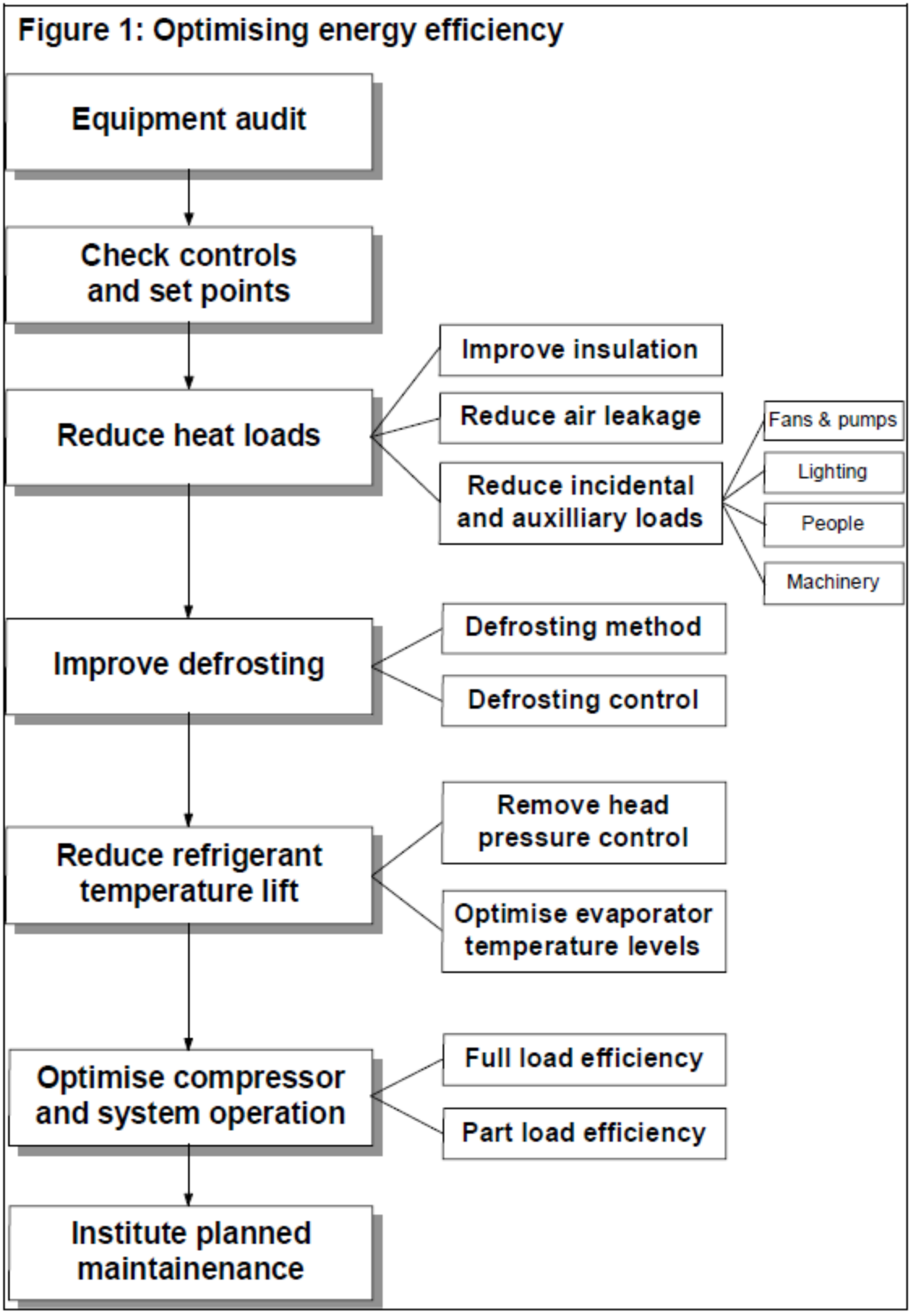


Figure 1: Optimising energy efficiency
Equipment audit
Check controls and set points
Reduce heat loads
Improve insulation
Reduce air leakage
Reduce incidental and auxilliary loads
Fans & pumps
Lighting
People
Machinery
Improve defrosting
Defrosting method
Defrosting control
Reduce refrigerant temperature lift
Remove head pressure control
Optimise evaporator temperature levels
Optimise compressor and system operation
Full load efficiency
Part load efficiency
Institute planned maintainenance

Maintenance & Electrical Safety

1. **Electrical Single Line Diagram / Lay Out Diagram / Equipment Layout / Electrical Control diagram**
    i. Check for Unauthorized Temporary Installations
    ii. Modification to be Updated
    iii. SLD reflects the actual installation
    iv. Duly approved by statutory authorities

2. **Importance of Electrical Safety in the Overall Safety System**

    Periodicity of comprehensive Electrical Safety check

    i. Understanding of electrical hazards
    ii. Electrical checkpoints in the safety checklist
    iii. Implementation priority for electrical hazards
    iv. Electrical Work Permit System
    v. Safe Electrical Operating Procedures

3 **Electrical Preventive Maintenance**

i. Is there an Electrical Preventive Maintenance programme in place
ii. Is the programme implemented? What is the slippage?
iii. Are the relevant standards (statutes and non-statutory) referred and incorporated in the EPM programme?
iv. Electrical Tests, Records, Test Procedure and periodicity (earth resistance, insulation resistance tests)
v. Is the EPM programme only documented?
vi. Transformer tests (dielectric strength, acidity, sludge deposits, dissolved gases, etc.) and periodicity
vii. Periodic calibration of meters (ammeter, voltmeter, relays, temperature gauges) and test instruments (insulation resistance megger, earth resistance megger, multi-meters, etc.)

4 **Earthing System**

i. Installation as per approved design?
ii. Installation and Maintenance as per IS 3043?
iii. Earth resistance measured periodically?
iv. Test procedure
v. Acceptable earth resistance values
vi. Is the earthing system modified when electrical installation is modified?
vii. Are neutral earth pits independent and separate?
viii. Are earth pits identified?
ix. Are two and distinct earth connections provided?
x. Is the earth continuity tested?
xi. Is bonding and earthing carried out to avoid ESD hazards?

Annexure I Conversion factors

CONVERSION TABLES

1 Kcal	3.9685 Btu
1 KWh	3413 Btu
1 KWh	860 kcal
1 Btu	1.055 kJ
1 calorie	4.186 joules
1 hp	746 Watts
1 kg	2.2 lb (pounds)
1 meters	3.28 feet
1 inch	2.54 cm
1 kg/cm²	14.22 psi
1 atmosphere	1.0332 kg/cm²
1 kg/cm²	10 meters of water column @ 4 °C
1 kg/cm²	9.807 × 10 4 passels
1 Ton of Refrigeration	3023 kcal/hour
1 Ton of Refrigeration	12000 Btu/hour
1 US Gallon	3.785 liters
1 imperial Gallon	4.546 liters
°F	1.8 × °C + 32
°k	°c + 273

Annexure -II -Abbreviations &Definitions

Abbreviations

°C	degrees Celsius
°F	degrees Fahrenheit
Btu	British thermal unit
Btu/ft2	British thermal units per square foot
J/m^2	Joules per square meter
kVA	kilovolt-amperes
kW	kilowatts
kWh	kilowatt-hours
kWh/m^2	kilowatt-hours per square meter

Definitions:

Basic definitions of terms

Absorber. The component of the vapour absorption chilling package wherein the refrigerant vapour is absorbed by the liquid absorbent.

Air Handling Unit. An air cooling unit, consisting of a blower or blowers, heat exchanger and filters with refrigerant, chilled water or brine on the tube side to perform one or more of the functions of circulating, cooling, cleaning, humidifying, dehumidifying and mixing of air.

Brine. Solution of anti-freeze substances like Sodium Chloride, Calcium Chloride, Mono-ethylene Glycol, Ethyl Alcohol etc.

Coefficient of Performance. The ratio of Net Refrigerating Effect divided by Compressor Shaft Power or Thermal Power Input. The numerator and denominator should be in the same measuring units.

Compressors. Machines in which compression of refrigerant vapour is effected by the positive action of linear motion of pistons, rotating elements (screws, vanes, scrolls etc.) or conversion of velocity energy to pressure in a centrifugal device.

Compressor, hermetic. Sealed compressor & motor unit, where the electric motor is cooled by the refrigerant and both the compressor and electric motor are not accessible for maintenance.

Compressor, open. Compressor is externally coupled to the prime mover and the refrigerant does not cool the prime mover.

Compressor, semi-hermetic. Compressor motor unit, where the electric motor is cooled by the refrigerant and the compressor is accessible for maintenance.

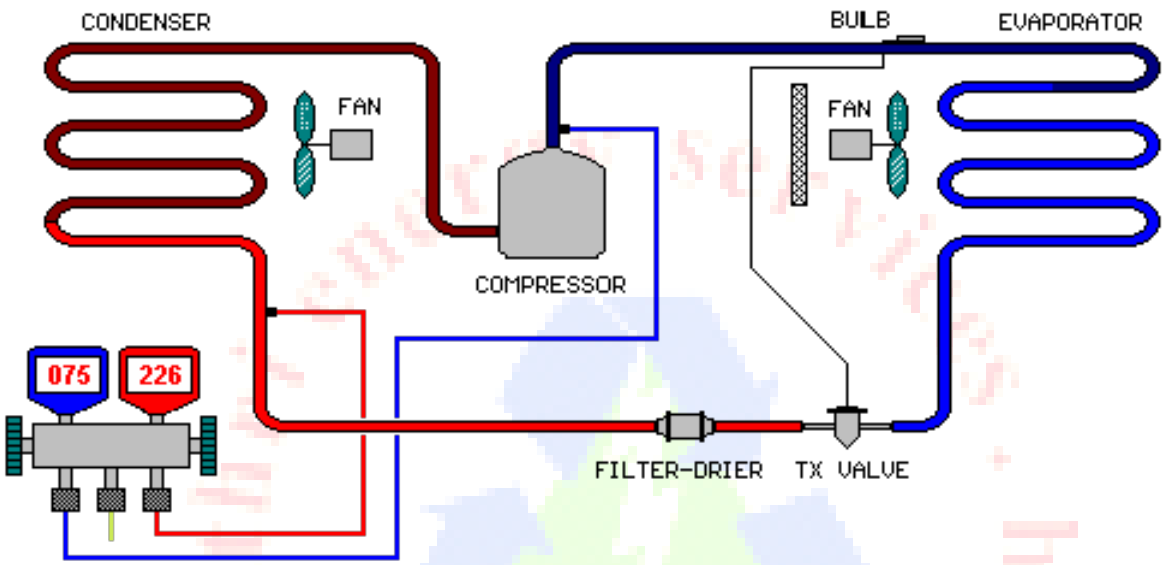
Condenser. The heat exchanger, which utilizes refrigerant to water/air heat transfer, causing the refrigerant to condense and the water/air to be heated. De-superheating or sub-cooling of the refrigerant may also occur.

Energy Efficiency Ratio. The ratio of Net Refrigerating Effect (Btu/hr) divided by Shaft Power (Watts) or Thermal Power Input (Watts) consumed.
Electric Motor. Electrically operated rotary prime mover.
Enthalpy. The heat content of a substance at a particular temperature.
Engine. Internal combustion engine used as prime mover.
Evaporator. The heat exchanger wherein the refrigerant evaporates and, in the process, cools another fluid I(generally water, brine or air).
Fluid. The substance that is usefully cooled in the chilling package (generally water, brine or air).
Generator. The component of a vapor absorption chilling package wherein the absorbent solution is heated to evaporate the refrigerant and concentrate the absorbent.
Gross Calorific Value. The amount of heat produced per unit of fuel when complete combustion takes place at constant pressure, the products of combustion are cooled to the initial temperature of the fuel and air, and the vapor formed during combustion is condensed.
Net Refrigeration Effect. The useful cooling effect (or heat removal) in the evaporator.
Psychometric Chart. A chart or plotted curves showing the various parameters of air at different temperatures at atmospheric pressure. The parameters shown include dry bulb temperature, wet bulb temperature, relative humidity, moisture content, enthalpy and sensible heat factor.
Refrigerant. The substance that evaporates in the evaporator to provide cooling effect.
Shaft Power. Power at the shaft of any rotary equipment.
Specific Fuel Consumption. The ratio of Thermal Power Input (kg/h of liquid fuel or m3/h of gaseous fuel consumed to the Net Refrigerating Effect (Tons of Refrigeration).
Specific humidity. Mass of water vapor per unit mass of dry air.
Specific Power Consumption. The ratio of Shaft Power (kW) to the Net Refrigerating Effect (Tons of Refrigeration).
Specific Steam Consumption. The ratio of Thermal Power Input (kg/h of steam) to the Net Refrigerating Effect (Tons of Refrigeration).
Speed. The number of revolutions per minute of the shaft.
Temperature, dry bulb. The temperature indicated by any temperature sensing element when held in air.
Temperature, Inlet. Temperature measured at the inlet stream of the heat exchanger.
Temperature, Outlet. Temperature measured at the outlet stream of the heat exchanger

Annexure :3 HVAC

Introduction & back ground

Refrigeration Basics



- Refrigeration is the removal of heat from a material or space, so that it's temperature is lower than that of its surroundings.
- When refrigerant absorbs the unwanted heat, this raises the refrigerant's temperature ("Saturation Temperature") so that it changes from a liquid to a gas — it evaporates. The system then uses condensation to release the heat and change the refrigerant back into a liquid. This is called "Latent Heat".
- This cycle is based on the physical principle, that a liquid extracts heat from the surrounding area as it expands (boils) into a gas.
- To accomplish this, the refrigerant is pumped through a closed looped pipe system.
- The closed looped pipe system stops the refrigerant from becoming contaminated and controls its stream. The refrigerant will be both a vapor and a liquid in the loop.

Annexure - 4 Lighting

Recommended illumination Levels as Per IS 3646 Part I-1992			
Type of Interior Activity	Range of Service Illuminanace in Lux	Quality Class of Direct Glare Limitation	Remarks
Education			
Assembly Halls	200-300-500	3	
Teaching Spaces	200-300-500	1	
Lecture Theatres			
i) General	200-300-500	1	
ii) Demo Benches	300-500-700	1	Localized Lighting may be appropriate
iii) Seminar Rooms	300-500-750	1	
iv) Art Rooms	300-500-750	1	
v) laboratories	300-500-750	1	
vi) Libraries	200-300-500	1	
vii)Music Rooms	200-300-500	1	
viii) Sports Hall	200-300-500	1	
ix) Work Shop	200-300-500	1	
x)Computer Work station	300-500-750	1	
xi)Bath Rooms	50-100-150		Supplementary local lighting near mirror
xii) Office Rooms	300-500-750	1	
xiii) Entrance Halls, Lobbies	150-200-300	2	
xiv) Corridors, Passageway, Stairs	50-100-150	2	

Light Source Comparison			
Attributes	**Incandescent**	**CFL**	**LED**
Colur Rendering Index	100	Greater than 80	40-80
Watts/ Lamp	100	23	1
Lumen/Lamp	1600	1600	30
Lumen/Watt	16	60-80	20-30
Life (Hrs)	750	8000	50,000

Colour Rendering Index

1500 K	Candlelight
2680 K	40 W incandescent lamp
3000 K	200 W incandescent lamp
3200 K	Sunrise/sunset
3400 K	Tungsten lamp
3400 K	1 hour from dusk/dawn
5000-4500 K	Xenon lamp/light arc
5500 K	Sunny daylight around noon
5500-5600 K	Electronic photo flash
6500-7500 K	Overcast sky
9000-12000 K	Blue sky

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