Energy Audit Report
of

M/s Institute of Aeronautical Engineering,

Dundigal, Hyderabad, Telangana - 500043

2018-19

By

SRI GAYATRI ENERGY SERVICES

we support you conserve

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ACKNOWLEDGEMENT

M/s **Sri Gayatri Energy Services,** Hyderabad places on record its sincere thanks to progressive management of M/s **Institute of Aeronautical Engineering,** Dundigal, Hyderabad, Telangana for entrusting the Energy Audit work of their College.

The study team is appreciative of the keen interest and encouragement shown by

Sri **M Rajasekhar Reddy**	Chairman
Sri **Ch. Sathi Reddy**	Secretary and Correspondent
Sri **B Rajeshwar Rao**	Executive Director & Treasurer
Dr.**L V Narasimha Prasad**	Principal

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We trust the data provided by the M/s **Institute of Aeronautical Engineering,** Dundigal, Hyderabad, Telangana personnel is true to their best of knowledge and we didn't verify the correctness of it.

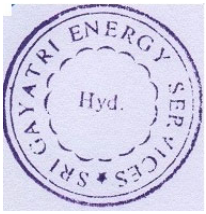
Audit Study team	
Shri D.S.R.Murthy	Senior Energy Auditor
Shri VB Chary	Engineer
Shri Thiru	Engineer

LIST OF INSTRUMENTS USED

- True RMS Power Meter
- 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 **Institute of Aeronautical Engineering**, Dundigal, Hyderabad, Telangana during 18 – 19 July 2018and 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 **Institute of Aeronautical Engineering**, Dundigal, ,Telangana for their Pro Energy Conservation measures in this regard.



For Sri Gayatri Energy Services

D.S.R. MURTHY
EA-3815
Certified Energy Auditor

Executive Summary of Observations

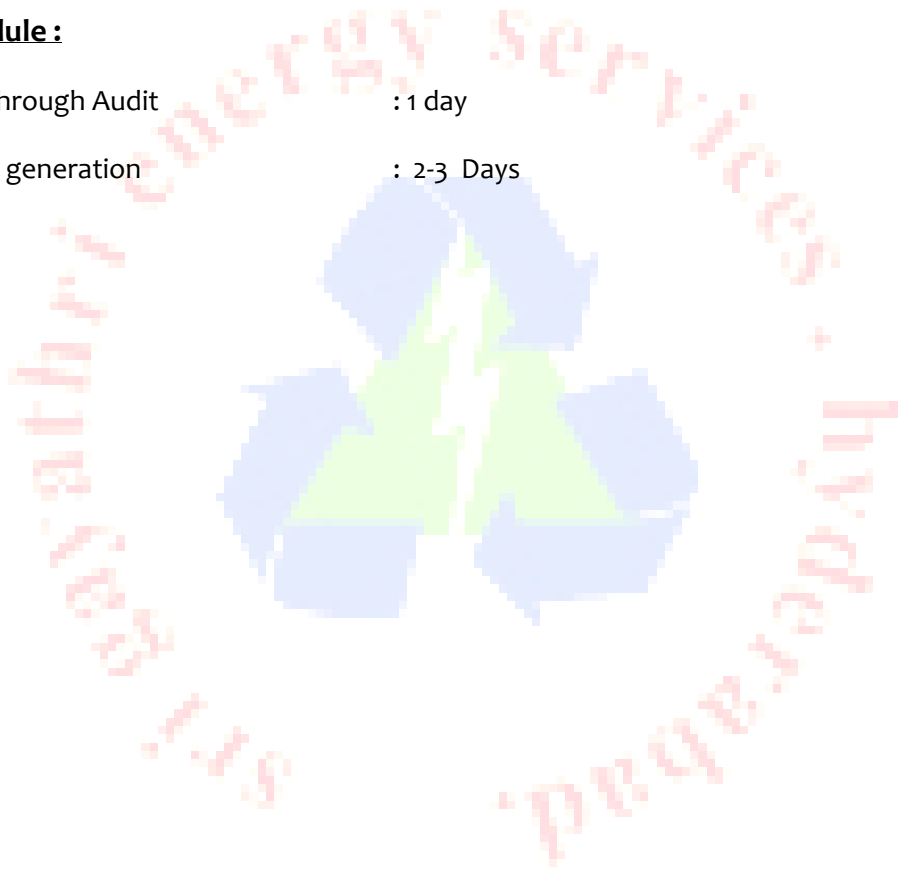
1. A Walk Through Energy Audit is carried out at the Campus with following observations.
2. The Power Factor at the Main Incoming panel (after Transformer) is satisfactory.
3. The Power Factor at the individual Blocks inadequate, it is recommended to install small PF improvement capacitor banks at the individual Blocks to improve the PF and reduce the losses.
4. It is observed that the actual Demand recorded is higher than CMD of 200 KVA, it is recommended to enhance the CMD. The institute has paid a penalty of close to Rs 5.5 L in this academic year.

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

Institute of Aeronautical Engineering (IARE), Hyderabad was established in the year 2000 and is run by Maruthi Educational Society founded by a devoted group of eminent professional and industrialists having a long and outstanding experience in educational system with a mission 'Education for Liberation'. It is the first institute to start B.Tech program in Aeronautical Engineering in the state of Telangana and has gradually transformed itself into an integrated multi-disciplinary technological institute. It is the most preferred institute with 100% admissions in the state of Telangana.

IARE is a prestigious Autonomous engineering college offering seven B.Tech programs Computer Science and Engineering, Information Technology, Electronics and Communication Engineering, Electrical and Electronics Engineering, Aeronautical Engineering, Mechanical Engineering, Civil Engineering and six M.Tech programs in engineering and MBA (Master of Business Administration) with 18 years of rich standing in the educational sphere. The institute is approved by AICTE, New Delhi; recognized by Govt. of Telangana; permanently affiliated to Jawaharlal Nehru Technological University Hyderabad (JNTUH); and accredited by National Assessment and Accreditation Council (NAAC) with 'A' Grade. All the seven B.Tech programs are accredited thrice by National Board of Accreditation (NBA), New Delhi since 2008. The institute also received UGC recognition under Sections 2(f) and 12(B) of the UGC Act.

The institute is ranked 139 in Engineering category as per National Institutional Ranking Framework (NIRF) – 2020, Ministry of Human Resource Development (MHRD), Govt. of India. This illustrates positive performance and quality standards we maintain in Teaching, Research, Employability, and Innovation.

Besides the institute has been ranked by different independent national agencies which include Careers 360 (AAA+), India Today (50), The Week (95), Times of India (75), Competition Success Review (23), Outlook (127), DataQuest (49), Business World (60).

The total number of students is 4952 and that of faculty is 292, out of which, 68 are Ph.D's (33%) ensuring healthy faculty student ratio. The research activity on campus is woven in pursuance of its vision & mission statements around the philosophy of Inspire, Innovate, and Implement to benefit the contemporary society. It unwinds itself into different fields such as environment, aerospace, PLC, CAD/CAM, CNC machining, tool design, welding, embedded systems, and low power VLSI digital system design. Emphasis is also being laid on manufacturing, automation, business analytics, big data, cloud computing, wireless technology, image processing, and next generation networks.

IARE has fourteen sponsored research projects, and has received grants of worth Rs. 510 lakhs for research and other activities by different agencies including DST, AICTE, UGC etc. The institute has a record of intellectual property with 850+ research paper publications by faculty as well as students and 1705+ citations, 35 patents in last 5 years. Internal Revenue Generation through consultancy facilitates and promotes activities pertaining to energy audit, mobile apps, drones in agriculture, agricultural tools, and material testing.

Big placements greet our students with ample opportunities with around 62 core and software companies visiting the institute every year with 700+ Placements. Placement and training centre is instrumental in signing the Memorandum of Understanding (MOU) with many reputed organizations including Capgemini, L&T Infotech, TCS, Cognizant, Accenture, Wipro, Mindtree, MPhasis, NTT Data,

Infosys, Hexaware, Optum, TEK Systems, Atos Syntel, Tata Advanced Systems Limited, Cyient, Virtusa, Temenos and so on...

To promote incubation centres, start-ups and entrepreneurship, IARE signed an MOU with National Research Development Corporation (NRDC) to cooperate for the development of technologies and their successful transfer to industry for commercial and socio economic benefits. The students are provided with avenues to showcase their talents and innovative skills. They also participate in various national level engineering competitions like Baja SAEINDIA, Supra SAEINDIA, Go-kart, ADC championships to name a few and have made their mark by winning prizes and ranks. They participate in national and state level project competitions as well as conferences to share their research findings. Students have represented the institute at international level as well.

The central library houses a rich collection of books for all subjects with recent publications. There are about 76,473 books, 20,665 individual titles, nearly 714 National / International Journals, 2715 back volumes, and e-journals from Elsevier (Science Direct), Springer, ASME, ASCE and IEEE (ASPP). Apart from this, the students have an exclusive access to DELNET for resource sharing. The library is open for 10 hours on weekdays and even on Sundays. Book distribution process has been automated for quick and easy access. For circulation of library books 'Automated Self Service Kiosk' has been installed, which enables users to issue, return and renew books by themselves.

Institute has state of art infrastructural facilities to support teaching-learning, research and administrative services. The institute is spread over 17 acres with built up area of 3, 37,500 sft. housing 65+ smart class rooms, 4 flipped classrooms, 4 conference halls, auditorium, 8 research laboratories, 103 academic laboratories, science and technology startup park, technology innovation and incubation center, open air amphitheater, makerspace, community facilitation center, skill development center and library. Campus-wide networking with 600 Mbps internet connectivity, Wi-Fi and CCTV facility is available. To reduce the consumption of electricity efficient lightings are used with solar electric energy of 160 KW on the grid. A captive power of 480 KVA is provided to ensure smooth working of the institute in times of power outage. The institute operates 32 buses for the benefit of students and staff.

IARE has a home away from home with the best amenities for the students to provide them a comfortable lifestyle within a vicinity of 1 km of the campus. The institute provides separate hostels for boys and girls, made to grow as places to support learning not only academics but also life skills in a multi-cultural and multi-lingual environment.

Students are encouraged to participate as actively in sports and other extracurricular activities as in academics. The institute maintains a separate unoccupied open area of 4 acres for the play fields in any time fit condition. Apart from this, the institute also has several sports rooms where students can play and revive their energies and be mentally and physically fit.

The IARE also enjoys geographical advantage, as it is well connected by air, rail and road. The college campus is adjacent to Nehru Outer Ring Road close to Dundigal junction exit-5, making it accessible to several important centers in and around the city. The Campus is situated 20 Km away from Secunderabad railway station and 11 Km from JNTUH University, Kukatpally, in a lush green and pollution free environment.

Facility Description

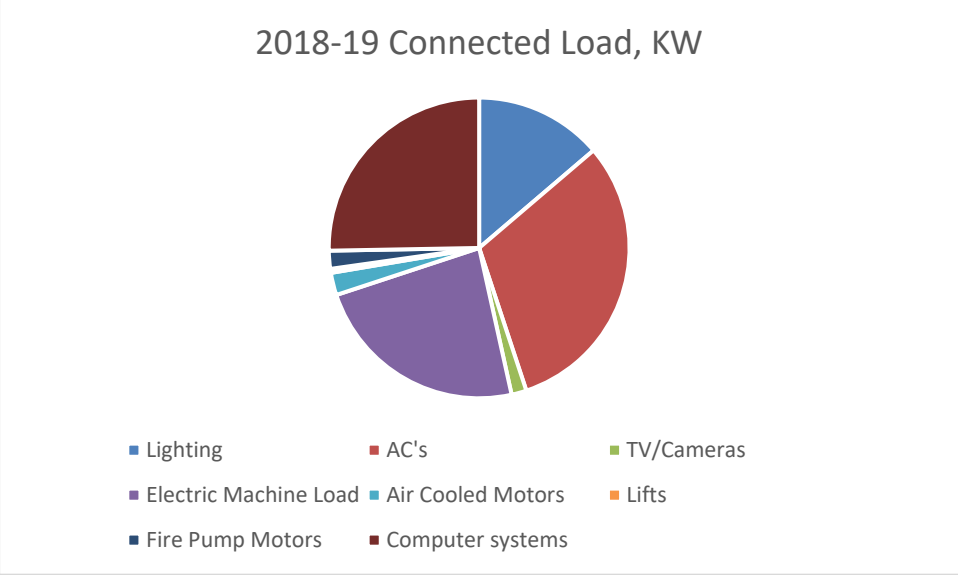
The Facility Receives Power supply from TSSPDCL at 11 KV , the installed transformer is 11 KV/433 V transformer of 315 KVA and the Contracted Maximum Demand with TSSPDCL is 200 KVA, The total connected Load is around 850 KW.

There are Three Blocks in the campus as Bhardwaja Blcok, AryaBhatta Block, Abdul Kalam Block, Sheds . The Electric machines, UPS , Computer Systems are located in these three Blocks.

Electrical Load Distribution

The Incoming power supply is from a 11 KV TSSPDCL ,with one Transformers of rating 11kV/433 V 315 KVA , The total connected load is around 850 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 ins given below

Connected Load,KW	
Lighting	117
AC's	265
TV/Cameras	13.6
Electric Machine Load	199
Air Cooled Motors	20.5
Lifts	3.7
Fire Pump Motors	16.5
Computer systems	215
Total	850.3



The Load distribution Block Wise

Name of the block	Name of the load	Total capacity (in watts)
Bharadwaj block	Drinking Water cooler, 1 (50w*5no)	0.25KW
	Fire motors,3ø (7.5hp*2no)	11kw
Abdul kalam block	**Electrical Machine's load**	**110KW**
	Air cooled motors (7.5HP*4no)	22kw
	Fire motors,3ø (7.5hp*1no)	5.5kW
Aryabhata block	**Electrical Machine's load**	**35.3KW**
	Drinking Water cooler (50w*5no)	0.25KW
	Lift-3ø (7.5hp*1no)	5.5KW
sheds	**Electrical Machine's load (in all sheds)**	**126KW**
	Drinking Water cooler (50w*5no)	0.25KW
	Air cooled motors (7.5HP*3no)	16kw

The UPS Installed across the campus is Total 30 No's and capacity total to 390 KVA.

The Power Measurements are carried out

Power Measurements of Electrical Parameters							
					Power		Remarks
Location		Voltage	Current	PF	KW	KVA	
Main Incomer	R	231.6	127.9	0.91	26.96	29.62	
	Y	238.2	119.3	0.96	27.28	28.42	
	B	239.4	130.7	0.92	28.79	31.29	
Bhardwaja Block	R	238.1	61.4	0.901	13.172	14.62	
Panel 01	Y	231.6	54.7	0.895	11.338	12.67	
	B	235.7	50.2	0.915	10.826	11.83	
Bhardwaja Block	R	236.7	7.7	0.8	1.458	1.82	
UPS-01 , 20 KVA Input	Y	233.8	10.8	0.84	2.121	2.53	
	B	240.4	9.3	0.79	1.766	2.24	
Arya Bhatta Block	R	237.9	27.8	0.97	6.415	6.61	
Panel 01	Y	No Load					
	B	238.2	31.5	0.875	6.565	7.50	
Arya Bhatta Block	R	234.2	3.6	0.13	0.11	0.88	
UPS -09	Y	No Load					
20 KVA	B	237.4	3.3	0.47	0.47	0.88	
Abdul Kalam Block	R	235.1	22.9	0.97	5.222	5.38	
Panel 01	Y	241.1	6.8	0.935	1.533	1.64	
	B	239	0	0.67	0.000	0.00	
Abdul Kalam Block	R	237	8.7	0.58	1.196	2.06	
UPS-07	Y	238.1	4.8	0.22	0.251	1.14	
20 KVA	B	240.7	2.9	0.37	0.258	0.70	
Lab shed Block	R	235.7	3.4	0.83	0.665	0.80	
	Y	238.6	4.1	0.79	0.773	0.98	
	B	238.6	3.9	0.75	0.698	0.93	

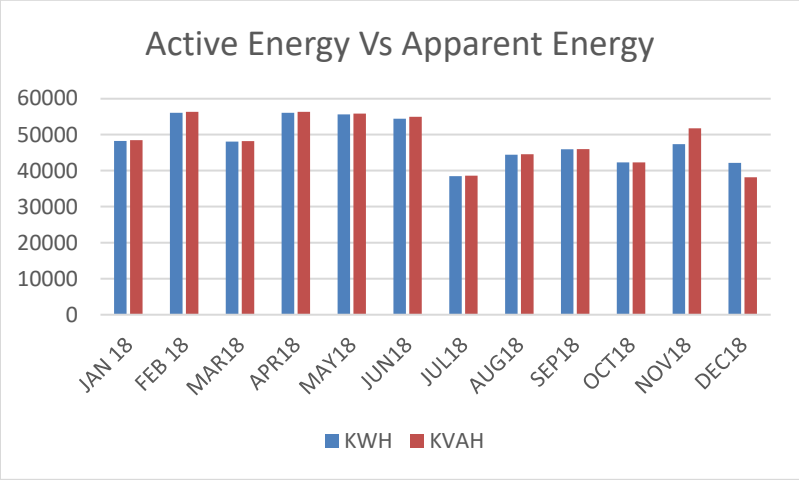
The Energy Bills Analysis is carried out to Understanding the Consumption pattern of the Institute

M/s Institute of Aeronautical Engineering , Dindigul, Medak Distt, Telangana											
Month	KWH	KVAH	PF	Actual KVA	Billed KVA	TOD1	TOD2	Demand	Energy	TOD	Total
JAN 18	48248	48454	0.997	261	160	7773	4634	78000	437676	13970	570221
FEB 18	56056	56336	0.995029	294.8	160	8760	5164	78000	505333.9	16012	667306.7
MAR18	48040	48208	0.9965	292.08	160	7080	3980	78000	432425.8	12719	590231.6
APR18	56056	56336	0.995	294.8	160	8760	5164	78000	505333.9	16012	667306.7
MAY18	55616	55816	0.9964	281.6	160	9400	4820	78000	500669.5	16353	652275.5
JUN18	54408	54948	0.99017	315.2	160	8860	4700	78000	492883.6	15594	679630
JUL18	38468	38616	0.99616	200.8	160	6676	4504	78000	393325.8	11180	393325.8
AUG18	44416	44536	0.9973	254.8	160	6600	4308	78000	399487.9	12544.2	535448.3
SEP18	45916	45992	0.998347	252.8	160	7428	4332	78000	412548.2	13524	548015.8
OCT18	42272	42288	0.99962	276.8	160	7472	4060	78000	379323	13261.8	533026.4
NOV18	47336	51764	0.999	251.6	160	8496	5216	78000	464323	15768	601445.7
DEC18	42152	38164	0.9999	158.8	160	5980	4728	62400	328785.6	10708	404422.7

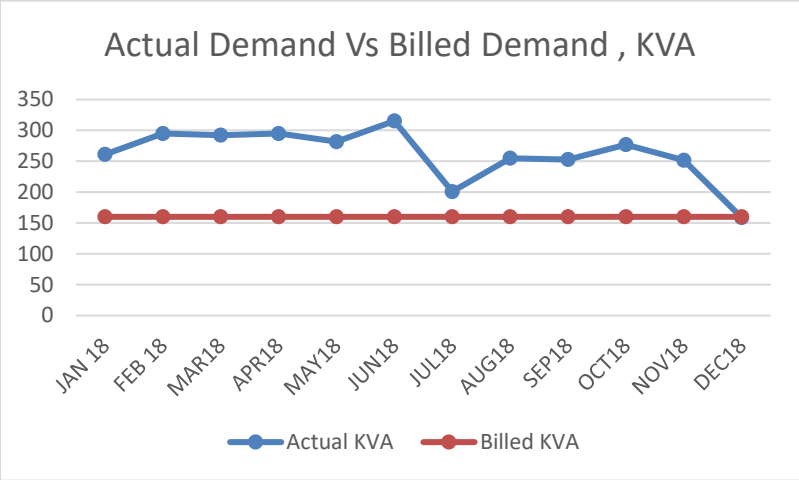
Saving Opportunities

1. The Actual Demand is observed to be recorded higher than the CMD, it is recommended to enhance the CMD to250 KVA from 200 KVA
2. The Individual Blockwise Power Factor to be improved to reduce the losses.
3. The UPS Loading to be improved OR shift the low loaded UPS load to other UPS.

Comparison of Active Energy Vs Apparent Energy



Comparison of Actual Demand Vs Billed Demand , KVA



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 Ib (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.

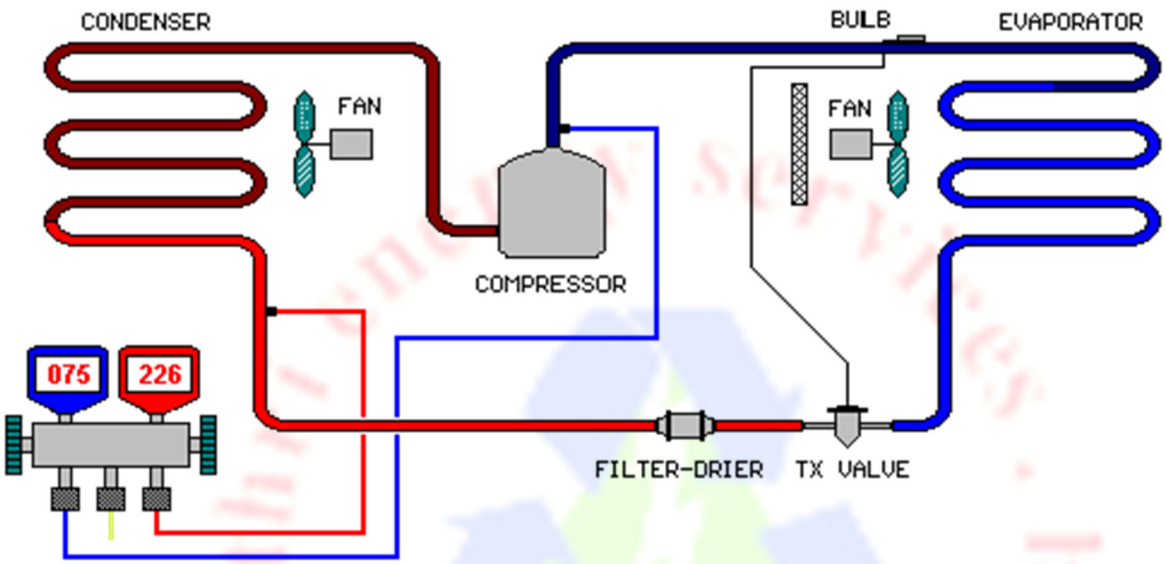
Electric Motor. Electrically operated rotary prime mover.

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 it's 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 Rendenring 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