FINALENERGY AUDIT REPORT OF

JAMIA HAMDARD UNIVERSITY, NEW DELHI

CONDUCTED BY:

Petroleum Conservation Research Association (NR)

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A-2-Acknowledgements

Petroleum Conservation Research Association conveys their gratitude and thanks to the management of M/s JAMIA HAMDARD UNIVERSITY NEW DELHI for giving us an opportunity to study their Plant & machinery for the Energy Audit, which was conducted on 22-23 JAN 2018.

Our sincere thanks are due to Shri Azhar Ali Khan (AE)for his keen interest and co-operation and proactive support extended towards the conduct of the Energy Audit.

We render our sincere thanks to Mr. M. Aftab Alam (JE) for providing a platform to understand some of the critical process of operation, whole hearted support, helps and guidance during the course of study of the plant.

We are indeed touched by the helpful attitude and co-operation of Mr. Mazhar ALLEM and all technical staff, who rendered their valuable assistance and co-operation during the course of study.

The Audit team constituted of the following officers from PCRA.

PCRA TEAM MEMBERS

1- Shri Naveen Gulati	Director & Chief Regional Cordinator PCRA (NR)
2- Shri B.K.JHA	Additional Director & RC PCRA (NR)
3- Shri Sidharth Saran	Dy. Director PCRA, New Delhi
4- Shashi Bhushan Pandey	SR.CONSULTANT
5- Shri Nirmal Bir Singh	SR. Manager Energy Audit
6- Shri Ranjit Singh	Manager Energy Audit
7- Shri Manoj	Electrician

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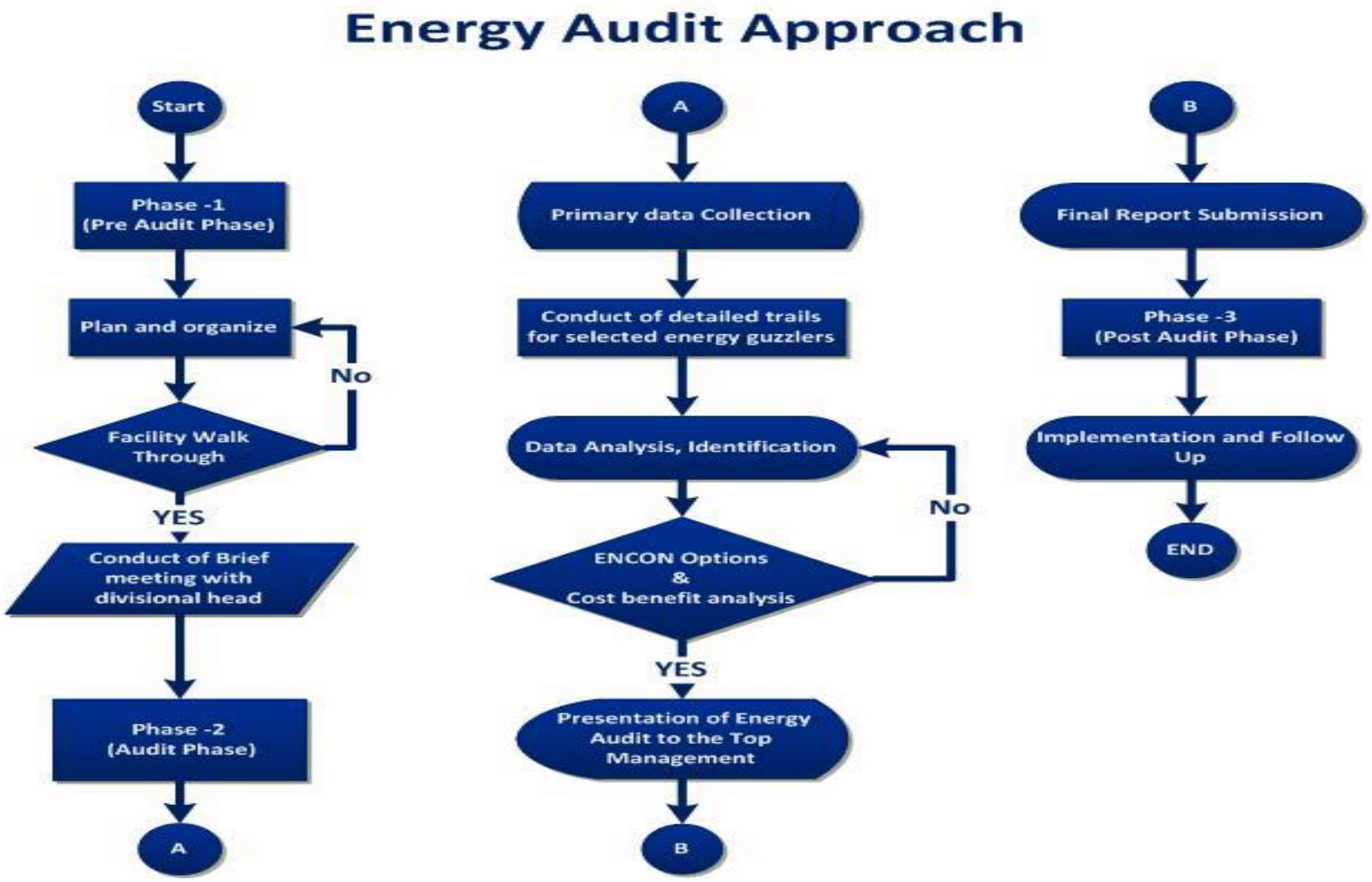
A-4-ENERGY AUDIT INSTRUMENTS USED:

- **1-FLUKE 435 –II POWER QUALITY ANALYZER & LOGGER.**
- **2-FLUKE -1735 POWER QUALITY ANALYZER & LOGGER**
- **3- RISHABH MAKE 1000 AMP POWER CLAMP METER.**
- **4- MEECO MAKE 1500 A POER CLAMP METER AND HORMONICS ANALYZER.**
- **5 ADEPT MAKE ULTRASONIC WATER FLOW METER,**
- **6- ULTRASONIC THICKNESS GAUGE**
- **7-LUTRON MAKE ANNEMOMETER, LUX METER, TEMPERATURE & HUMIDITY METER.**
- **FLUKE IR THERMOMETER**
- **ENRGY METER.**
- **CLOCK ,TEMPERATURE & HUMIDITY METER,**
- **MEASURING TAPE**
- **0-5 KG/CM2 PRESSURE GAUGE.**

ENERGY AUDIT DATA COLLECTION PERIOD:

Energy audit data was collected through measurement from 22-01-2018 to 23-01-2018

A-5--ENERGY AUDIT APPROACH



A-6 Executive Summary

JAMIA HAMDARD UNIVERSITY, NEW DELHI

BACK GROUND:

The history of Jamia Hamdard begins with the establishment of a small Unani clinic in the year 1906 by Hakeem Hafiz Abdul Majeed, one of the well-known practitioners of Unani System of Medicine of his time. Hakeem Hafiz Abdul Majeed had a vision of making the practice of Unani Medicine into a scientific discipline so that Unani medicines could be dispensed in a more efficacious manner to patients. He gave the name “Hamdard” to his venture which means “sympathy for all and sharing of pain”. His illustrious son, Hakeem Abdul Hameed, carried forward the philosophy and objectives of Hamdard in independent India. Even at the time of partition of India in 1947, Hakeem Abdul Hameed was dreaming of setting up a complex of educational institutions which would concentrate on highlighting the contribution of Islam and Islamic culture to Indian civilization and development of Unani medicines for curing diseases

On 22 Shawwal, 1367 Hijri, corresponding to 28th August, 1948, Hamdard, which was a commercial enterprise at that time, was converted into a Wakf, with the object of giving effect to Islamic teachings of public charity including health and education. In 1964, Hamdard National Foundation was created with a view to receive and disburse the profits earned by Hamdard (Wakf) Laboratories. Hamdard National Foundation was to take up charitable causes in the areas of education, medical relief and the advancement of knowledge, consistent with the principles of the true teachings of Islam.

For setting up a complex of research and educational institutions, Hakeem Abdul Hameed purchased a piece of land in Tughlaqabad area of South Delhi which was hardly inhabited in those times. In order to implement and execute the objects of Wakf as enshrined in the Wakf deed, Hakeem Abdul Hameed and his Muslim associates, established several institutions for teaching and research as given below.

In 1962, Hakeem Abdul Hameed set up the Institute of History of Medicine and Medical Research with the object of promoting education and research in the history of medicine, besides appraising the principles of medicine.

In 1963, Hakeem Abdul Hameed and his Muslim friends and associates set up Indian Institute of Islamic Studies with a view to promote the study of Islamic Culture and Civilization especially its contribution to Indian society and culture.

In 1963, Hamdard Tibbi College was set up in Gali Qasim Jaan, Old Delhi. It was later shifted to Jamia Hamdard Campus in 1980 to provide education in Unani Medicine to students so that the heritage of Unani Medicine largely available in Arabic and Persian is passed on to the students of next generation.

In 1972, Hamdard College of Pharmacy was set up with the objective of providing education and training in all branches of pharmacy. The year 1989 saw the fulfilment of the dream of Hakeem Abdul Hameed when Jamia Hamdard was given the status of Deemed to be University by the Ministry of Human Resource Development on 10th May, 1989. All the above named institutions set up by Hakeem Abdul Hameed and his friends and associates were amalgamated into Jamia Hamdard. In a brief period of only ten years, Jamia Hamdard has evolved into an institution fulfilling the objects of the wakf, which has funded it.

Jamia Hamdard was inaugurated by Late Shri Rajiv Gandhi on August 01, 1989. In his impressive speech, the Prime Minister lauded the efforts of Hakeem Abdul Hameed in setting up institutions of learning which were emerging in the form of a “Deemed to be University”. He said, “This will enable (the Muslim) minority to go forward and help India to march forward”.

Contribution of Hakeem Abdul Hameed to promote the cause of education, health and social service was acknowledged by the Government of India in 1965 when he was awarded Padma Shri for his valuable contribution and for his personal qualities of sacrifice, devotion and commitment to the cause of education. He was also awarded the Padma Bhushan in 1991. The services rendered by Hakeem Abdul Hameed to the cause of education of

Muslims have been acknowledged not only in India but in other countries too.

Jamia Hamdard was conceived as a seat of higher learning in Unani Medicine, Islamic Studies, Biosciences, Pharmacy, Nursing and other areas of knowledge by its founder as a means of fulfilling the objects of the wakf. Over a period of last ten years, Jamia Hamdard has emerged as an outstanding institution of higher learning with distinct and focused academic programmes. Graduate programme in Information Technology and Computer Applications and Post-graduate programmes in Information Technology, Computer Applications, Business Management, Physiotherapy and Occupational Therapy have been started in the last few years. Undergraduate programmes in Physiotherapy and Occupational Therapy are being introduced from this year. Jamia Hamdard offers postgraduate and doctoral programmes in several disciplines for which advanced facilities are available

A-6-2 LAND & BUILDINGS:

For accommodating all facilities more than 150 acres of land has been occupied and various buildings have been constructed like Admin building, hospital, various faculty buildings, hostels labs etc.

A-6-3- ELECTRICAL POWER SUPPLY SYSTEM:

For meeting the energy demand 11 KV POWER SUPPLY HAS BEEN TAKEN FROM BSES.and 3 substations have been created. Emergency generator 3 nos have been installed to supply power in case there is power failure from power supply co.

Electriciy is the main Energy source and diesel is the supplementary fuel for DG sets.

A-6-4- EXECUTIVE SUMMARY:

ENERGY CONSERVATION RECOMMENDATIONS:

JAMIA HAMDARD UNIVERSITY NEW DELHI has taken some of initiative to change some old tube lights to LED lights but are very eager to take substantial measures for Energy Conservation and to improve further energy performance.

Following are the recommendations based on the energy data measurement, analysis and evaluation:

- **Reactive power compensation at L.T. Feeders. Presently the reactive power compensation is being done AT L.T. side but at 11 KV side avg. POWER FACTOR is 0.953. This data is based on KWH CONSUMED AND KVAH BILLING DONE FOR LAST 12 MONTHSi.e. from FEB- 2017 to JAN-2018. So there is a further opportunity to improve the p.f. near unity at L.T. SIDE. Capacitance requirement is 773 KVAR. KVAH Saving is 5.13 Lakhs KVAH and energy cost saving will be RS. 50.86 Lakhs. The investment required will be @ Rs.2000/ KVAR, RS.15.46 LAKHS and payback period will be 3.64 months. Although always it is recommended to carry out reactive power compensation near to the load. For reactive power compensation the KVAR requirement has been measured and tabulated in table no.2.11 for individual loads and substations .It is recommended to install specific value capacitors as per the details in the table and then check the p.f. at HT side. If it is very near to 1 then it is O.K. otherwise install further capacitors in the LT side since there is a transformer between HT and LT side which is an inductive load which has to be compensated with capacitors.**
- **Contract Demand is 2500 KVA but it has crossed insevenmonths during 2017-18. Recommendation is the provision of Demand Controller, Smart ENERGY METERS, RS-485 to digital data converter, Energy Management system Software, Centralized SCADA BASED SYSTEM for Control & Management of MAX. DEMAND (IT has crossed to 3450 KVA in place of 2500 KVA seven times in the year 2017) to avoid penalty and additional demand charges (Although no penalty was reflected in the bills but appearing as additional charges). Real time Monitoring and control of 20 Smart**

Energy Meters on critical Substations/ loads& their readings, Energy consumption pattern, switching ON/OFF of NONESSENTIAL L.T. Loads automatically from Centralized Server /computer in custody of Assistant Engineer . It will also reduce good amount of manpower of manual monitoring. Expected saving by avoiding penalty (in UP Demand charges becomes double, in BSES TARIFF no clear mention is there and tariff gets revised from time to time) and additional KVA charges shall be approximately RS.12.35 LAKHS. Expectedinvestment shall be RS.10 LAKHS and payback period shall be 9 months.

- It was informed that the JAMIA HAMDARD UNIVERSITY has a plan and is in process to get another source of 11 KV Power supply for HIMSR and HAHC which consumes about 60% of the total present consumption. This project will avoid overloading of the existing old11 KV feeders and will also avoid penalty of crossing the contract demand.This project and installation of MAX. DEMAND CONTROLLER recommended in this Energy Audit Report shall be expedited at fast speed and this will also make the electrical system more sturdy and reliable.
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- **Reactive power compensation on LT DOMESTIC FEEDER with installation of 45 KVAR Capacitor Bank for colony feeder .Expected energy saving shall be 0.2687 LAKH KVAH and the cost of energy saving shall beRS.2.82 LAKHS. The investment will be 0.81 Lakhs and payback period will be 4 months. This evaluation has been done based on monthly energy bills of BSES RAJDHANI POWER LTD.**
- **It came out during the discussions with the concerned engineers that, there is no Energy metering system for the each student in hostel rooms and to some extent there is wastage of energy due to behavior issues and other issues. There is a saying that "Until unless you measure you can't manage". Although,at present wing wise Energy meters are installed for AIRCONDITIONING LOAD just for monitoring wing wise energy consumption but one can't control as there is no individual student responsibility to reduce the energy consumption as no student is directly paying.**
- **It is recommended to install Energy meters in the each hostel room for measurement and JAMIA HAMDARD MANAGEMENT may make a policy to charge if the Electricity Consumption is beyond a certain limit It is recommended that 200 Energy meters are installed as a pilot project in the buildings where unmetered power supply is being provided like in student hostels. Expected Energy Saving shall be 0.246 Lakh KWH/ year and the cost of energy saving will be RS.2.58 LAKHS/ year. Investment in Energy meter installation is estimated RS.3.0 LAKHS and payback period is 14 months.**

- **JAMIA HAMDARD University New Delhi has lot of open land and no. of buildings where roof top solar panels can be installed.To start with it is recommended to install 3 nos. 100 KW SOLAR PANELS TO GIVE DIRECT SUPPLY TO GRID or direct use in the University campusin day time. Installation of 300 KW p grid connected 100kw each solar panel at NON SHADED OPEN SPACES OR ROOF TOP OF THE BUILDINGS.**

  Expected Annual Electrical Energy Saving shall be 7, 20, 000 KVAH and the Cost of Energy Saving will be RS.21.6 LAKHS. Investmentshall be approximatelyRS. 84 LAKHS and Payback period shall be 3.89 years.

- **7.0-Other Opportunities:**
- **7.1 – Changing the tap of transformers to get 230 V LINE TO NEUTRAL on LT side.**
- **7.2- Switching off the lights during lunch period or tea break or when not required.**
- **7.3- Provision of remote control for lights based on occupancy sensors, in galleries, rooms, wash rooms, conference halls and cabins.**
- **7.4 –Photo cell operated relays and switches to switch ON/OFFstreet and flood lights.**
- **7.5- To set the thermostat of Air conditioners at 24-25 degree C to cut off AC so that temperature does not go below 24 degree C.**
- **8.0 UP GRADATION OF EXISTING ELECTRICAL SYSTEM 11KV& 415 VPANELS &,TRANSFORMERS & ACCESSORIES**
- **8.1. 11 KV PANELS AND 415 V PANELS (PCC & MCC) at SUB STATIONS& TRENCH:**
- **11KV & 415V Electrical panels ,breakers and indicating bulbs, relays Protection relays, CONTACTORS SWITCHES , MCCB,MCB, tripping system ,spring charging motors etc. have become very old and reduced reliability. It is recommended that whole system must be upgraded with energy efficient new electrical panels. Up gradation will involve new panels,VCB, ACB, LED INDICATING BULBS, energy efficient spring charging motors, latest numerical combined protection relays inplace of individual electro mechanical relays etc. These new panels will consume about 90 watts / panel in place of 300 watts present old /panel. Saving is 210W/ panel. For 50 panels the annual saving is 92 KWH amounting RS. 735 per year. Although this amount is not large but it will help in reliability and uninterrupted power supply which is essential for a hospital, LAB and class rooms and Admin building.**<u>**However as discussed, the Electrical Engineering Department of Jamia Hamdard has already worked on it and a proposal is also in the pipe line.**</u>**Secondly lot of cables have been bunched and laid in substation buildings, it was informed by concerned engineers that since a separate 11 KV FEEDER is proposed for HIMSR, these cables will be removed. It is recommended to take this project on priority basis.**

- **Since there is a recommendation to upgrade and overhaul completely the old ELECTRICAL System,there will be further requirement of further competent electrical team for planning,design, construction, commissioning and operation & maintenanceof electrical panels and equipment. There will be need to train the existing officials in view of upgraded new technology and also recruit further competent and related qualifiednew persons like B TECH. ELECTRICAL ENGINEERS,DIPLOMA HOLDERS AND ITI etc.**
- **8.2. Roof and floors of the substation require proper maintenance and renovation. Cables to be dressed properly and cable trenches to be covered by MS CHEQURED PLATES OR CONCRETE SLABS and trench filled with sand for cable cooling.**

A-6-5 -EXECUTIVE SUMMARY:

ENERGY & COST SAVING PROJECTS AT A GLANCE:

FOLLOWING ARE THE ENERGY CONSERVATION PROJECTS WHICH CAN BE IMPLEMENTED BY M/S JAMIA HAMDARD UNIVERSITY NEW DELHI IN NEAR FUTURE:

S. NO.	ENERGY SAVING PROJECT	ANNUAL KVAH SAVING	ANNUAL AMOUNT OF	INVESTMENT COST OF THE PROJECT IN	PAYBACK PERIOD MONTHS

		IN LAKHS	SAVING IN RS. LAKHS	RS. LAKHS	
1	Reactive power compensation at LT feeders. Presently the reactive power compensation is being done at L.T. side but 11 KV side avg. POWER FACTOR is 0.953. This data is based on KWH consumed and KVAH billing done for last 12 Months FEB- 2017 to JAN-2018. So there is opportunity to improve the p.f. near unity at different L.T. FEEDERS for commercial use. Capacitance requirement is 773 KVAR	5.13	50.86	15.46	3.64
2	Provision of Max Demand Controller, installation of 20 Smart Energy meters, RS-485 to Digital Converter, Energy Management system Software, Centralized SCADA BASED SYSTEM for Control & Management of MAX. DEMAND (IT has crossed to 3450 KVA in place of 2500 KVA seven times in the year 2017) to avoid penalty and additional demand charges (Although no penalty was reflected in the bills but additional charges are reflected), Monitoring and control of 20 Energy Meters & their real time readings display on server, Energy consumption pattern, Automatically switching ON/OFF of NONESSENTIAL LT Loads when max demand reaches near contract demand. Review by	-	RS 12.35S	RS. 10	9

	Controlling Engineer. It will also reduce manpower for manual control of Electrical System.				
3	Reactive power compensation on LT DOMESTIC FEEDER for colony with installation of 45 KVAR Capacitor Bank	26870 KWH	RS. 2.82	RS.0.90	4
4	Installation of 200 Energy meters in the buildings where unmetered power supply is being provided like in student hostels to minimize and control Energy wastage through implementation of Energy Conservation policy like charging if the consumption is higher than a prescribed limit.	24600 KWH	RS.2.58	Rs.3.0	14
5	Installation of 300 KW PEAK grid connected 3 NOS 100kw each solar panel at main Admin Building and other Hospital BUILDINGS/ open land	720000 KWH	RS.21.6	RS.84	47
6	TOTAL Annual Saving & Amount of investment	6.36 Lakh KVAH	RS.90.21	RS.113.3	
7	Over all Energy saving % w.r.t total Energy Consumption	5.8%			

SCOPE OF WORK COMPLETED:

1-REVIEW OF ELECTRICITY Bills, Contract Demand and Power Factor:

1.1 -Incoming power supply is 11KV by M/S BSES RAJDHANI POWER LTD.NEW DELHI

Data of Electrical Bills were received from Jamia Hamdard University for the period fromFEB-2017 TO JAN-2018 in APRIL-2018. and clarifications in MAY-2018

ENERGY AUDIT DATA collection was done from22-01-2018 to 23-01-2018 BY MEASUREMENT.

Electrical supply to JAMIA HAMDARD COLONEY is measured at LT 415 V and power supply for tariff purpose is Domestic Residential Type. NO. of units consumed are charged as per the Domestic Residential Supply and no. UNITS are subtracted from the main HT METER READINGS.

A- HT POWER SUPPLY

- **H.T POWER ENERGIZATION DATE-15-05-2002**
- **H. T. Sanctioned load- 2528 KW**
- **Contract Demand- 2500 KVA**
- **Maximum Demand varies from 1560 KVA IN FEB-2017 TO 3450 KVA in JUNE-2017**
- **The maximum Demand has crossed the contract demand 7 times in the year in the month of OCT-17, SEP-17, AUG-17, JULY-17, JUNE-17, MAY-17 & APRIL-17**
- **HT. Power factor is ranging from 0.944 in NOV-17 to 0.966 in JAN-2018. There is a potential to improve the power factor to near unity which will increase the energy saving and energy cost also.**
- **Average power factor at H.T. is0.952**

B- LT POWER SUPPLY:

- **L.T. Sanctioned load-198 KW**
- **L.T. Contract Demand-228 KVA**
- **L.T Maximum demand varies from 74 KW IN NOV.17 TO 250.40 KW IN JUNE –JULY-2017**
- **The Domestic LT POWERS SUPPLY FOR RESIDENTIAL use, power factor varies from 0.924 IN NOV-17 to 0.0.969.**
- **The average power factor is0.949, so there is potential to improve the p.f. and energy and cost saving.**
- **Max demand has crossed twice in JUNE-JULY –AUG 17 to 250.40 KW w.r.t. Contract Demand of 228 KVA (216 KW).**
- **The bill give details of KWH and KVAH readings,and Max. Demand of the month in KVA and readings are taken on from 01-TO 30 th of the every month and bills are raised from 10-to 15 th of every month.**
- ## 1.2 APPLICABLE BILLING TARIFF:

The billing is made at following tariff:

A- NON DOMESTIC H.T. MAIN METER

- **Fixed DEMAND charges: RS. 130.00 /KVA. FOR 2500 KVA Contract Demand**
- **NORMAL UNIT CHARGES- RS. 8.40 /KVAH**
- **ENERGY CHARGES DURING PEAK HOURS- 20% EXTRA ON ENERGY CONSUMED DURING PEAK HOURS**
- **ENERGY CHARGES DURING OFF PEAK HOURS- REBATE (20%) ON ENERGY CONSUMED DURING OFF PEAK HOURS**
- **Surcharge- @8% on Energy Charges +Fixed charge- Rebate**
- **Electricity tax @5% on Energy Charge on surcharge, PPAC AMOUNT & TOD Surcharge / rebate amount.**

B- LT DOMESTIC CONNECTION FOR COLONY

- **Fixed Charge- RS.100/ KW/Month for 198 KW sanctioned load**
- **Energy Charges-**
- **First 200 KWH- RS.4.00/KWH**
- **Next 200 KWH-RS. 5.95/ KWH**
- **Next 400 KWH- RS. 7.30/KWH**
- **Next 400 KWH –RS. 8.10/KWH**
- **Balance units KWH- RS.8.75/KWH**
- **Surcharge- @8% on Energy Charges +Fixed charge- Rebate**
- **Electricity tax @5% on Energy Charge on surcharge, PPAC AMOUNT & TOD Surcharge / rebate amount.**

1.3 MONTHLY BILLING DETAILS:

1.3.1 H.T MAIN POWER SUPPLY FOR COMMERCIAL USE

S.NO.	MONTH	KVAH Units Consumed	Unit Charges in RS.	Total Energy Charges	MDI in KVA	P.F.
1	JAN-18	7,64,396	64,20,926	78,91,580	1800	0.966

2	DEC-17	6,69,782	56,26,168	69,60,910	1620	0.963
3	NOV-17	6,34,856	53,32,790	66,17,370	1620	0.944
4	OCT-17	9,23,024	77,53,401	1,12,53,110	2580	0.947
5	SEP-17	17, 26,660	1,48,85,170	1,54,42,608	3240	0.954
6	AUG-17	18,14,794	1,52,44,270	1,54,42,608	3240	0.954
7	JULY-17	11,24043	94,41,961	1,10,58,000	3300	0.954
8	JUNE-17	11,12,980	93,49,032	1,22,27,890	3450	0.951
9	MAY-17	11,02,981	92,65,040	1,12,69,260	3330	0.945
10	APRIL-17	1O,43,685	87,66,954	1,03,49,960	2910	0.949
11	MARCH-17	6,72,140	56,45,976	67,3040,036	2295	0.950
12	FEB-17	5,80,116	48,72,974	59,,23,143	1560	0.958
TOTAL	12 Months	1,09,17,873	8,34,06,427	9,81,63,337	30945	0.953
Average	PER Month	9,09822 KVAH	69,50,536	81,80,278	2578	0.953

1.3.2 ENERGY CONSERVATION MEASURES:

REACTIVE POWER COMPENSATION ATL.T. SIDE

- **1-It is possible to improve the p.f. from 0.953 to unity at L.T Level. It will result in energy saving as follows:**
- **2-TOTAL UNITS CONSUMED PER YEAR = 1,09,17,873 KVAH**
- **3-TOTAL UNITS CONSUMED IN KWH PER YEAR =0.953 X 1,09,17,873 =**
- **1,04,04 733 KWH**
- **No of units saving by maintaining unity p.f. = (1,09,17,873-1,04,04,733) KVAH =5,13,140 KVAH**
- **Cost of Energy Saving = 5, 13, 140 KVAH X RS.8.40 X 1.18 = RS.50,86,244.00**
- **For maintaining unity power factor reactive power compensation KVAR REQUIRED= 0.30 X AVERAGE MAXIMUM DEMAND = 0.30 X 2578 = 773 KVAR**
- **Cost of 773 KVAR CAPACITOR = @ RS.2000 X 773 KVAR = RS.15,46,000.00**
- **Payback period = Investment x12/ Energy saving per year =**
- **RS. 15.46 LAKHS X 12/ RS.50.86 = 3.64 MONTHS**

1.3.3-L.T. DOMESTIC POWER SUPPLY FOR COLONY:

There are three Energy meters but only two meters are working namely Meter no. 29005079 and Meter no.29507362. By adding these two meter readings total LT LOAD and Energy consumed in KWH is calculated. Finally these units are subtracted from the main H.T. METER READINGS to account for H.T. ENERGY Consumed in KVAH.

The Monthly Billing details for L.T. Domestic Loads are as follows:

S.NO.	Month	MDI KW	KWH Consumed	Unit Charges IN RS.	Total Charges IN RS.	POWER FACTOR
1	JAN-18	107.20	37,568	3,26,370	4,04,290	0.969
2	DEC-17	94.40	31,040	2,69250	3,37,410	0.955
3	NOV-17	74.40	26,440	2,29,000	2,90,275	0.924
4	OCT-17	88.80	35,108	3,04,846	3,79,650	0.931
5	SEP-17					
6	AUG-JULY-17	250.40	65,454	5,70,297	6,52,240	0.952

7	JUNE-17	250.40	67,600	5,89,150	6,73,440	0.959
8	MAY-17	204.00	70,421	6,13,833	7,01,430	
T0TAL	8 MONTHS	AVG-133.7	3,33,631	29,02,746	34,38,735	0.949
Monthly Average	8 Months	133.7	41,703	3,62,843	4,29,841	0.949
AVG.Annual ENERGY Consumption	12 Months	133.7	5,00,436 KWH	RS.43.55 LAKHS	RS.51.58 LAKHS	0.949

1.3.2 L.T. DOMESTIC POWER CONSUMPTION ANALYSIS& ENERGY CONSERVATION MEAURES BY REACTIVE POWER COMPENSATION AND INSTALLATION OF ENERGY METERS IN HOSTELS:

A- REACTIVE POWER COMPENSATION:

- **Annual L.T.DOMESTIC Power supply consumption is about 5.0 LAKH KWH Units & Total energy charges are RS. 51.58 LAKHS.**
- **The average power factor is 0.949 which could be improved to unity.**
- **Due to power factor improvement, the energy saving potential is 26,870 KWH Units which will give Energy cost saving of about RS. 2,82,135.00**
- **CAPACITORs required to improve p.f. from 0.949 to unity =45 KVAR**
- **Cost of Investment for 45 KVAR Capacitor = RS. 2000 / KVAR X 45 KVAR =RS.90000**
- **Payback period= Cost of investment x 12 / Cost of Energy Saving = RS.90000X 12 / RS.2,82,135 = 3.82 MONTHS**

B-INSTALLATION OF ENERGY METERS WHERE UN METERED POWER SUPPLY IS PROVIDED e.g. HOSTELS

- **During the month of MAY-17 & JUNE-17 the LT DOMESTIC POWER CONSUMPTION has gone up 1.75 times than the annual average of about 41000 KWH units. It is mainlydue to air conditioning loads in residential houses and hostels.**

- **Jamia Hamdard University Management must ensure that all energy consumed by hostel rooms are metered which will bring at least 10 % in energy saving amounting =0.1 x AVG.41000 KWH Monthly Energy consumption x 4 months (April to July)= 16400 KWHduring summer months and 5% Energy Saving during winter 4 months**
- **(NOV TO FEB) due to use of heaters = 0.05 x 41000X 4 = 8200 KWH.**
- **Total energy saving = 16400 KWH + 8200 KWH= 24600 KWH**
- **Total energy cost saving = RS. 2,58, 300.00.**
- **Cost of installation of 200 Energy meters = RS.1500 / Energy MeterX 200 NOS.= RS.3,00000.00 (Cost of the single phase meter may vary depending upon the manufacturer and class of accuracy etc. (RS. 1500 TO RS. 5000) if purchased in bulk from reputed manufacturer of digital energy meters**
- **Payback period = Cost of investment / Cost of energy saving per year =**
- **RS.300000 x 12/ 2,58,000 = 14 Months**

2.0- ELECTRICAL SYSTEM NETWORK:

- **2.1 POWER SUPPLY TO JAMIA HAMDARD UNIVERSITY AT 11 KV from BSES RAJDHANI POWER LTD. Through 3x300mm2 XLPE Cable and 11KV,630A, VCB. TO 12 KV COPPER BUS BAR. Then there are three 11KV,630 A VCB for three FEEDERS through 3x 185 mm2 11KV XLPE Cable. Then further 11 KV feeders through ACB are connected to various transformers. LT metering is done for domestic power supply to colony and hostels**
- **Following are the transformers which are installed to meet the various loads:**

S.NO	VOLTAGE RATIO KV/V	RATING IN KVA	% IMPEDANCE
1	11/440	1000	5.35
2	11/440	750	4.40
3	11/440	500	5.01
4	11/440	400	4.78
5	11/440	400	4.78
6	11/440	1250	4.99

7	11/440	1250	4.99
8	11/440	630	4.40

- **There are two main transformers of 1250 KVA capacity 11 /433 V DY-11 with +5 to -15% AUTO OLTC WITH RTCC. The secondary of the 1250 KVA Transformer-1 is connected to PCC 1 through 2000A 4P EDO TYPE AIR CIRCUIT BREAKER and Transformer -2 to PCC-2 through 2000A 4P EDO TYPE ACB& bus duct. PCC-1 AND PCC-2 are connected through 2000A 4P EDO TYPE ACB. BUS COUPLER and AL bus bars are 2000A TPNand AMF PANEL**
- **There are 3 nos. 1010 KVA KVA DG sets connected to LT 2000A TPN AL BUS BARS THROUGH 1600 A EDO TYPE ACB**
- **Various LT loads are tapped from PCC-1 AND PCC-2 like UPS panel, 500 KVA APFC PANEL, different building power supply panels etc .**
- **The 11 KV/ 110 V Potential transformer of main VCB was burnt.**
- **All Electrical parameters have been measured and is given in table under section 3.0 & heading Electrical Parameters Measurement and Analysis.**
- **For reactive power compensation KVAR has also been measured and recorded in the table.**
- **It is strongly recommended that we carryout reactive power compensation at different load panels by installing capacitors of required KVAR in place of L.T. POWER CONTROL CENTERS after secondary of transformers. In the table at 2.11 KVAR values have been given which are required to bring the p.f. to unity.**
- **THD V AND I has also been measured and where it is exceeding the limit remark of High THD I has also been given.**
- **% Loading of the feeders has also been indicated.**

2.1-ELECTRICAL PARAMETERS OF FEEDERS:

S NO	NAME OF FEEDER	PHASE	VOLT P-N	I-AMP	KW	KVA	PF	KVAR	THD - V	THD - I	LOADI NG	REMARKS
1	SUB	R	231.6	608	132.8	146.4	0.954	64	1.6	16.7		READING -

	STATION NO 2 MAIN INCOMER LT SIDE (CT RATIO 2000/5), 1250 KVA											1
		Y	233.9	492	110.8	116.4	0.962	22.8	1.5	21.7		
		B	235.0	660	150.8	157.2	0.974	44.4	1.4	17.8		
				TOTAL	394.4	420	0.963	131.2			33.6 %	LOW TR.-2 LOADING
S N O.	**NAME OF FEEDER**	**PHASE**	**VOLTP-N**	**CURR ENT**	**KW**	**KVA**	**PF**	**KVAR**	**THD - V**	**THD - I**	**LOADI NG**	**REMARKS**
2	SUB STATION NO 2 MAIN INCOMER LT SIDE , CT RATIO 2000/5 1250 KVA	R	230.6	648	136.8	148.8	0.95	40	1.6	15		READING - 2
		Y	234	496	113.6	118.4	0.967	22.8	1.5	18.2		
		B	236.8	648	148.4	154.4	0.977	22.4	1.4	16.3		
				TOTAL	398.8	421.6	0.965	85.2			33.7%	Low Tr.-2 Loading
S N O.	**NAME OF FEEDER**	**PHASE**	**VOLT L1-L2**	**CURR ENT**	**KW**	**KVA**	**PF**	**KVAR**	**THD - V**	**THD - I**	**LOADI NG**	**REMARKS**
3	J.L. NEHRU HOSTEL PANEL MAIN INCOMER	R	342.4	229.3	46	53	0.92	22	1.6	5.9		
		Y	392.7	220.6	50	53	0.91	21	2.7	7.6		
		B	404	243.9	60	61	0.93	21	1.3	6.8		
				TOTAL	156	167	0.92	64				
S N	**NAME OF FEEDER**	**PHASE**	**VOLT P-N**	**CURR ENT**	**KW**	**KVA**	**PF**	**KVAR**	**THD - V**	**THD - I**	**LOADI NG**	**REMARKS**

S N O.	NAME OF FEEDER	PHASE	VOLT P-N	CURRENT	KW	KVA	PF	KVAR	THD - V	THD - I	LOADING	REMARKS
4	COLONY SUB STN. NO-2 MAIN INCOMER FROM 400 KVA TFR,LT SIDE	R	232.4	48	9.98	11.32	0.925	4.02	1	8.1		
		Y	229	95	21.74	24.17	0.949	7.18	0.8	5.4		READING - 1
		B	232.1	56.7	12.48	19.77	0.972	3.24	0.9	3.2		
				TOTAL	44.2	55.26	0.948	14.44			11%	TR LOADING IS LOW
S N O.	NAME OF FEEDER	PHASE	VOLT P-N	CURRENT	KW	KVA	PF	KVAR	THD - V	THD - I	LOADING	REMARKS
5	COLONY SUB STN. NO-2 MAIN INCOMER FROM 400 KVA TFR, LT SIDE	R	236.2	54.2	11.98	12.83	0.945	4.49	1	6.7		READING - 2
		Y	234.8	85.9	19.38	20.03	0.959	5.62	1	4.4		
		B	237	48.5	16.18	16.31	0.931	3.68	0.9	8.2		
				TOTAL	47.54	49.17	0.945	13.8			12.3%	TR. LOADING IS LOW
S N O.	NAME OF FEEDER	PHASE	VOLT L1-L2	CURRENT	KW	KVA	PF	KVAR	THD - V	THD - I	LOADING	REMARKS
6	MAIN INCOMER 500 KVA TFR, LT SIDE GOLE BUILDING/ LIABRARY/ RANBAXI BUILDING	R	406.3	69.7	18.34	19.21	0.95	6.05	1.6	13.9		
		Y	409.3	54.1	14.91	16.38	0.92	6.36	1.6	17.1		READING - 1
		B	408.4	58	16.3	17.35	0.94	5.71	1.6	15.1		

				TOTAL	49.55	53	0.936	18.12			10.6 %	Low TR. Loading
S NO.	**NAME OF FEEDER**	**PHASE**	**VOLT L1-L2**	**CURRENT**	**KW**	**KVA**	**PF**	**KVAR**	**THD - V**	**THD - I**	**LOADING**	**REMARKS**
7	MAIN INCOMER 500 KVA TFR GOLE BUILDING/ LIABRARY/ RANBAXI BUILDING	R	406.3	73.3	20.23	21.5	0.94	6.13	1.6	12.1		READING - 2
		Y	408.2	66.7	16.85	18.9	0.89	5.77	1.6	16.9		
		B	409.5	61.9	12.58	13.5	0.93	3.81	1.6	14.9		
				TOTAL	49.66	53.9	0.92	15.71			10.78 %	Low Tr. Loading
S NO.	**NAME OF FEEDER**	**PHASE**	**VOLT**	**CURRENT - A**	**KW**	**KVA**	**PF**	**KVAR**	**THD - V**	**THD - I**	**LOADING**	**REMARKS**
8	MAIN INCOMING SUB STN NO-3 HT SIDE CT RATIO - 100/5, 1250 KVA	R	11.81	16.6	194	200	0.98	38	0.9	4		READING - 1
		Y	11.68	17.4	200	204	0.98	34	0.9	4.3		
		B	12.1	16.8	202	208	0.96	60	0.9	5.2		
				TOTAL	596	612		132			48.96 %	
S NO.	**NAME OF FEEDER**	**PHASE**	**VOLT**	**CURRENT-A**	**KW**	**KVA**	**PF**	**KVAR**	**THD - V**	**THD - I**	**LOADING**	**REMARKS**
9	MAIN INCOMING SUB STN NO-3 HT SIDE CT RATIO - 100/5, 1250 KVA	R	11.77	20.6	232	240	0.97	52	1.1	3.4		READING - 2
		Y	11.65	20.4	232	238	0.98	42	1.2	3		
		B	12.02	20.2	230	236	0.95	72	1.1	4.7		
				TOTAL	694	714		166			57.12 %	

S NO	NAME OF FEEDER	PHASE	K VOLT	CURRENT	KW	KVA	PF	KVAR	THD -V	THD - T	LOADING	REMARKS
10	SUB STN -3, HT SIDE TFR -1 OUT GOING CT RATIO (100/5)	R	11.78	10.4	128	129	0.99	8	1	10.4		
		Y	11.64	8.6	108	109	0.99	8	1.2	12.2		READING - 1
		B	12.09	9	104	106	0.98	14	1.1	15.2		
				TOTAL	340	344		30				
S NO.	NAME OF FEEDER	PHASE	K VOLT	CURRENT	KW	KVA	PF	KVAR	THD - V	THD - I	LOADING	REMARKS
11	SUB STN -3 TFR -1 OUT GOING CT RATIO (100/5)	R	11.75	10.2	118	120	0.98	8	1	11.1		
		Y	11.62	9	98	98.9	0.99	7	1	12.2		READING - 2
		B	12.03	8	92	93	0.99	7	1.1	16.4		
				TOTAL	308	312		22				
S NO.	NAME OF FEEDER	PHASE	VOLT	CURRENT	KW	KVA	PF	KVAR	THD - V	THD - I	LOADING	REMARKS
12	SUB STN -3 TFR -1 MAIN INCOMIN LT SIDE	R	408.8	273.2	59	67	0.84	12	1.6	12.5		
		Y	409.7	224.3	42	73	0.91	6	1.6	12.7		READING - 1
		B	409.6	251.3	47	70	0.89	14	1.6	15		
				TOTAL	148	210	0.88	32				

S NO.	NAME OF FEEDER	PHASE	VOLT	CURRENT	KW	KVA	PF	KVAR	THD - V	THD - I	LOADING	REMARKS
13	SUB STN -3 TFR -1 MAIN INCOMIN LT SIDE	R	406.9	278.7	51	57	0.85	12	1.7	13.4		READING - 2
		Y	408.1	222.5	36	51	0.80	10	1.6	19.7		
		B	408.1	232.5	48	54	0.89	14	1.6	15.9		
				TOTAL	135	162	0.846	36				
S NO.	NAME OF FEEDER	PHASE	VOLT	CURRENT	KW	KVA	PF	KVAR	THD - V	THD - I	LOADING	REMARKS
14	SUB STN -3 TFR -2	R	11.74	18.0	238	248	0.95	72	1	2.1		
	OUT GOING HT SIDE	Y	11.61	19.2	236	248	0.94	78	0.9	2.5		READING - 1
	CT RATIO (100/5), 1250 KVA	B	12.02	19.8	238	258	0.91	104	1.1	3		
				TOTAL	712	754		254				
S NO.	NAME OF FEEDER	PHASE	VOLT	CURRENT	KW	KVA	PF	KVAR	THD - V	THD - I	LOADING	REMARKS
15	SUB STN -3 TFR -2 OUT GOING HT SIDE CT RATIO (100/5), 1250 KVA	R	11.73	20.6	230	238	0.96	66	0.9	4.2		READING - 2
		Y	11.59	20.4	226	246	0.94	76	1	4.6		
		B	12	20.8	232	264	0.91	102	0.9	5.3		
				TOTAL	688	748	.936	244				
S NO.	NAME OF FEEDER	PHASE	VOLT	CURRENT	KW	KVA	PF	KVAR	THD - V	THD - I	LOADING	REMARKS

16	SUB STN -3 TFR -2 INCOMING LT SIDE, 1250 KVA	R	415.2	606.4	131	146	0.93	53	0.9	4.4		
		Y	413.9	609.2	139	143	0.91	38	0.9	3.1		READING - 1
		B	412.1	618.1	133	143	0.95	44	0.9	3.5		
				TOTAL	403	432	0.93	135				
S N O.	**NAME OF FEEDER**	**PHASE**	**VOLT**	**CURR ENT**	**KW**	**KVA**	**PF**	**KVAR**	**THD - V**	**THD - I**	**LOADI NG**	**REMARKS**
17	SUB STN -3 TFR -2 INCOMING LT SIDE CT RATIO (2000/5), 1250 KVA	R	416.2	459	119	130	0.93	49	0.8	8		
		Y	414.5	428.6	127	134	0.95	36	0.8	7		READING - 2
		B	411.8	485	126	132	0.95	37	0.6	7.6		
				TOTAL	372	396	0.943	122				
S N O.	**NAME OF FEEDER**	**PHASE**	**K VOLT**	**CURR ENT-A**	**KW**	**KVA**	**PF**	**KVAR**	**THD - V**	**THD - I**	**LOADI NG**	**REMARKS**
18	TFR - 2 HT SIDE –L.T.- SIDE- OFF- NO LOAD CT RATIO - 100/5 , 1250 KVA	R	11.7	0.8	2	8	0.66	8	1	18.2		
		Y	11.59	0.6	8	12	0.67	2	1.2	8		
		B	12.01	1.4	4	14	0.84	2	1.1	11.7		
				TOTAL	14	34	0.72	12				
S N O.	**NAME OF FEEDER**	**PHASE**	**VOLT**	**CURR ENT**	**KW**	**KVA**	**PF**	**KVAR**	**THD - V**	**THD - I**	**LOADI NG**	**REMARKS**

19	TFR - 1 HT SIDE- OFF-L.T SIDE - NO LOAD CT RATIO - 100/5, 1250 KVA	R	11.8	1.0	4	8	0.79	2	1	9.1		
		Y	11.63	1.2	6	14	0.39	8	1.1	9.2		
		B	12.06	1.2	4	14	0.95	12	1.1	8.3		
				TOTAL	14	36	0.71	22				
S NO.	NAME OF FEEDER	PHASE	VOLT	CURRENT	KW	KVA	PF	KVAR	THD - V	THD - I	LOADING	REMARKS
20	DG-2 INCOMING											
		R	419.9	733.6	164	184	0.96	27	3	6.3		
		Y	417.2	618.3	137	160	0.93	35	2.9	9.1		
		B	416.6	710.3	150	150	0.99	11	2.9	8.4		
				TOTAL	451	494	0.96	73			49%	
S NO.	NAME OF FEEDER	PHASE	VOLT	CURRENT	KW	KVA	PF	KVAR	THD - V	THD - I	LOADING	REMARKS
21	DG - 1	R	415.4	681.5	136	146	0.91	46	3.3	10.7		
		Y	412.5	532.6	109	115	0.94	31	4	18.3		
		B	414.2	644.5	140	139	0.96	9	3.8	13.2		
				TOTAL	385	400	0.936	86			39.6%	
S NO.	NAME OF FEEDER	PHASE	VOLT	CURRENT	KW	KVA	PF	KVAR	THD - V	THD - I	LOADING	REMARKS
22	SUB STN -1 TFR 500 KVA LT SIDE	R	210.6	244.3	49.97	50.65	0.955	14.62	1.4	4.1		
		Y	211.9	200	40.14	43.61	0.924	16.28	1.5	3.9		
		B	215.4	221	44.96	47.49	0.949	14.64	1.2	4.9		
				TOTAL	126	141.7	0.942	45.54			28.2%	LOW TR. LOADING
S N	NAME OF FEEDER	PHASE	VOLT	CURRENT	KW	KVA	PF	KVAR	THD - V	THD - I	LOADING	REMARKS

O.												
23	SUB STN -1 TFR 630 KVA LT SIDE	R	405.4	73	11	18	0.67	11	0.9	18.2		
		Y	401.5	74.1	8	14	0.65	10	1.2	7		
		B	402.4	86.2	15	20	0.83	11	0.9	20.1		
				TOTAL	34	52	0.72	32			8%	TR. LOADING LOW
S NO.	NAME OF FEEDER	PHASE	VOLT	CURRENT	KW	KVA	PF	KVAR	THD - V	THD - I	LOADING	REMARKS
24	SUB STN -1 TFR 750 KVA LT SIDE	R	246.7	108.4	24.69	27.71	0.92	10.02	1	4.8		
		Y	244.6	107	23.35	26.75	0.84	13.86	1	5.2		
		B	218.6	78.5	15.59	18.56	0.89	7.95	2	8.1		
				TOTAL	63.63	73	0.88	31.83			9.7%	LOW TR. LOADING
S NO.	NAME OF FEEDER	PHASE	VOLT	CURRENT	KW	KVA	PF	KVAR	THD - V	THD - I	LOADING	REMARKS
25	AC PLANT 2X35 (70) TR HARC BUILDING	R	236.3	55.6	7.82	13.11	0.579	10.73	1.4	5.5		P.F. IS VERY LOW
		Y	232.5	62.2	9.1	14.6	0.678	11.59	1.5	4.2		
		B	240.8	61.7	7.81	14.76	0.602	12.51	1.2	5		
				TOTAL	24.73	42.47	0.620	34.83				INSTALL 35 KVAR CAPACITOR

3.0 ENERGY PERFORMANCE OF ROTATING EQUIPMENT

3.1- ELECTRICAL MOTORS& PUMPS:

Since JAMIA HAMDARD UNIVERSITY is a teaching institution and hospital there are no heavy industrial motor. All the motors are less than 10 KW and beyond the scope.

3.2 DIESEL GENERATING SETSENERGY PERFORMANCE

ELECTRICAL PARAMETERS: DG-1

S NO.	NAME OF FEEDER	PHASE	VOLT	CURRENT	KW	KVA	PF	KVAR	THD - V	THD - I	LOADING	REMARKS
21	DG - 1 1010 KVA	R	415.4	681.5	136	146	0.91	46	3.3	10.7		
		Y	412.5	532.6	109	115	0.94	31	4	18.3		
		B	414.2	644.5	140	139	0.96	9	3.8	13.2		
				TOTAL	385	400	0.936	86			39.6%	

ELECTRICAL PARAMETERS OF DG-2:

S NO.	NAME OF FEEDER	PHASE	VOLT	CURRENT	KW	KVA	PF	KVAR	THD - V	THD - I	LOADING	REMARKS
20	DG-2 1010 KVA											
		R	419.9	733.6	164	184	0.96	27	3	6.3		
		Y	417.2	618.3	137	160	0.93	35	2.9	9.1		
		B	416.6	710.3	150	150	0.99	11	2.9	8.4		
				TOTAL	451	494	0.96	73			49 %	

Following are the Energy Performance of different DG SETS which is combined energy performance of Diesel Engine and Generator in GRAM OF DIESEL/KWH:

S. NO.	CAPACITY	ACTUAL LOADING	ENERGY PERFORMANCE IN Gram of diesel GRAM / KWH	Remark
1-	1010 KVA DG-1	400 KVA	216	DG SET Engine performance is normal
2	1010 KVA DG SET-2	494 KVA	215	DO
3	1010 KVA DG SET-3	450 KVA	216	DO

Recommendations: 1- To carry out regular preventive maintenance as per the manufacturers recommendation and run at 70 to 80% load. During trial run load was only 40 TO 50%.

4.0 STUDY OF AIR CONDITIONING PLANT:

4.1 Following central AC Plants are installed at JAMIA HAMDARD University:

S.NO.	DETAILS OF AC PLANT	UNITS	TR	TOTAL TR	MAKE
1	Hamdard Convention Center	01	60	60	VOLTAS
2	HARC BUILDING	02	70	140	TRANE
3	NEW HOSPITAL BLOCK	02	280	560	CARRIER

4.2 During the audit days i.e. 22-01-2018 to 23-01-2018 it was peak winter and all the Central Air conditioning units were stopped. Effort was made to run the HARC BUILDING CENTRAL AIR CONDITIONING UNIT but it tripped within 3-4 minutes.

4.3 Effort was also made to run VOLTAS MAKE-60 TR Central AC plant of HAMDARD CONVENTION CENTER.

4.4 Electrical parameters of total AC Load are as follows:

PHASE	VOLT	I-AMP	KW	KVA	PF	KVAR	THD-V	THD-I
R	234.3	99.9	17.19	23.43	0.73	15.18	1.5	2.0
Y	231.8	104.4	19.03	24.27	0.78	15.07	1.8	1.9
B	234.4	97.1	17.96	22.04	0.79	13.68	1.6	2.1
		TOTAL	54.18	69.74	0.77	44		

4.5 AC PLANT FOR HAMDARD CONVENTION CENTER (AUDITORIUM):

The 60 TR AC PLANT is more than 30 years old but being maintained and run by the University Engineers however energy consumption is marginally higher in comparison to latest technology adopted in new central AC PLANT with Screw compressor and installation of energy efficient motors and variable frequency drive for compressor and cooling tower fan motor and condenser and cooling pump motor.

ENERGY PERFORMANCE OF HCC-AC PLANT:

- **There are three chilled water pumps of 10 HP and three condenser pump of 7.5 H.P.Two running and one stand by concept.**

- **2-Flow rate o chilled water as measured by the ultrasonic flow meter - 27.6 m3/hr.**
- **Flow rate of condenser cooling water- 70.858 m3/hr**
- **Chilled water inlet temperature - 7.2 degree C**
- **Chilled water outlet temperature- 4.2 degree C**
- **Temperature difference – (7.2-4.2) =3 degree C**

- **TONS of refrigeration provided by the chiller- 27.6x 1000 x 3x 1 / 3024 =27.3 TONS OF REFRIGERATION**
- **Inlet temperature of condenser cooling water to cooling tower 27.5 degree C**
- **Out let temperature of condenser cooling water from -25 degree C**
- **Temperature difference across cooling tower –(27.5-25) = 2.5 degree C**
- **Tons of refrigeration provided by cooling towers- 70.858 X1000X2.5/3024 = 58.58 TONS**
- **Combined tons of refrigeration = 85. 88 TONS OF REFRIGERATION.**
- **Combined power consumption for Chiller compressor+ chiller and condenser water pump + cooling tower fan motor = 54.18 KW**
- **KW/ TON OF COMBINED CHILLER PLANT= TOTAL POWER/ TOTAL TONS OF REFRIGERATION= 54.18/85.88 =0.630**
- **Energy Performance of Combined chiller plant is 0.630 KW/TON which is quite efficient.**
- **Coefficient of Performance (COP) = 3.516/ KW/TON= 3.516/0.63 = 5.58**
- **Energy Efficiency Ratio = 12/ KW/TON =12/0.63 = 19.04**

4.6 CENTRAL AC PLANT FOR NEW HOSPITAL BLOCK:

This plant was not run as the ambient temperature was low and patients are there in the hospital.

5.0 AIR CONDITIONERS (PACKAGE/CASSETTE/SPLIT/WINDOW):

Not runing due to low ambient temperature.

6.0 ENERGY CONSERVATION RECOMMENDATIONS:

6.1 -REACTIVE POWER COMPENSATION AT L.T. SIDE:

  - **As per the records of bills the average p.f. at H.T. side is 0.953 It is possible to improve the p.f. from 0.953 to unity at H.T Level. It will result in energy saving as follows:**
- **2-TOTAL UNITS CONSUMED PER YEAR = 1, 09, 17,873 KVAH**
- **3-TOTAL UNITS CONSUMED IN KWH PER YEAR =0.953 X 1, 09, 17, 873 =**
- **1, 04, 04 733 KWH**

- **4-No of units saving by maintaining unity p.f. = (1, 09, 17,873-1, 04, 04, 733) KVAH = 5,13,140 KVAH**
- **Cost of Energy Saving = 5, 13, 140 KVAH X RS.8.40 X 1.18 = RS.50, 86, 244.00**
- **For maintaining unity power factor reactive power compensation KVAR REQUIRED= 0.30 X AVERAGE MAXIMUM DEMAND = 0.30 X 2578 = 773 KVAR**
- **Cost of 773 KVAR CAPACITOR = @ RS.2000 X 773 KVAR = RS.15,46,000.00**
- **Payback period = Investment x12/ Energy saving per year =**
- **RS. 15.46 LAKHS X 12/ RS.50.86 = 3.64 MONTHS**

6.2-ENERGY SAVING POTENTIAL BY OPTIMIZING THE MAX DEMAND MANAGEMENT TO AVOID ANY PENALTY:

It has been noted that Max. Demand (MD) at 11 KV has crossed the Contract Demand of 2500 KVA to 3450 KVA in 7 months during the period from FEB-2017 TO JAN-2018 and similarly at colony 415V L.T. Feeders also which may result in to paying penalty and additional demand charges . It is recommended to optimize the electrical loads and cut off automatically some of the nonessential loads when the max demand is approaching the contract demand of 2500 KVA. This will be possible by installing 20 nos. of SMART Energy meters with RS 485 capability ,a demand controllers , RS -485 TO DIGITAL CONVERTER, SERVER, Energy Management Software ,contractors for cut off contactors and wiring etc.

Proposal is to provide SCADA BASED SYSTEM and Energy Management Software and centralized computing center management system for following:

- **1-Collection of critical Energy 20 Energy meters data remotely ON REAL TIME BASIS. Some of the existing smart Digital Energy Meters can be used and some say 10 nos. may have to be purchased.**
- **2. - Monitoring of the Max. Demand on real time basis and control by cutting off nonessential loads when thresh hold limit of MAX. DEMAND is approaching.(In 2017 the max demand crossed the limit five times.**
- **3- Monitoring of all 20 feeders for their ON/OFF STATUS.**
- **4 This system will also be used to switch ON / OFF of the nonessential loads when max. demand is reaching the contract demand**

- **ESTIMATED COST OF THE SCADA MONITORING AND CONTROL OF THE Energy meters and 11 KV feeder/ L.T. feeder is expected to cost at RS. 10 LAKHS .assuming that 10 nos . of the existing energy meter can be used.**
- **Energy saving Calculations :**
- **Contract Demand = 2500 KVA**
- **Contract Demand charges = RS.130 /KVA/MONTH**
- **Maximum Demand achieved = 3450 KVA**
- **Difference (3450-2500) = 950 KVA**
- **Expected penalty double normal rate as applicable in different states = RS.260 / KVA**
- **Avoidable Additional chargeable penalty = 950 x RS 260 X 5 MONTHS =RS. 12.35 LAKHS**
- **Annual Cost of saving = RS. 12.35 LAKHS**
- **Investment RS. 10.0 LAKHS**
- **Pay Back Period = 10 x 12/ 12.35 = 10 months**

6.3- REACTIVE POWER COMPENSATION FOR L.T. DOMESTIC POWER SUPPLY:

  - **Annual L.T.DOMESTIC Power supply consumption is about 5.0 LAKH KWH Units & Total energy charges are RS. 51.58 LAKHS.**
- **2-The average power factor is 0.949 which could be improved to unity.**
- **3-Due to power factor improvement, the energy saving potential is 26,870 KWH Units which will give Energy cost saving of about RS. 2, 82, 135.00**
- **4-CAPACITORs required to improve p.f. from 0.949 to unity =45 KVAR**
- **5-Cost of Investment for 45 KVAR Capacitor = RS. 1800 / KVAR X 45 KVAR =RS.81000**
- **6-Payback period= Cost of investment x 12 / Cost of Energy Saving = RS.81000X 12 / RS.2, 82, 135 = 3.45 MONTHS**

6.4-INSTALLATION OF 20 ENERGY METERS WHERE UN METERED POWER SUPPLY IS PROVIDED e.g. STUDENT HOSTELS

- **During the month of MAY-17 & JUNE-17 the LT DOMESTIC POWER CONSUMPTION has gone up 1.75 times than the annual average of about 41000 KWH units. It is mainly due to air conditioning loads in residential houses and hostels.**
- **Jamia Hamdard University Management must ensure that all energy consumed by individual houses and hostel rooms are metered which will bring at least 10 % in energy saving amounting = 0.1 x AVG.41000 KWH Monthly Energy consumption x 4 months (April to July) = 16400 KWH during summer months and 5% Energy Saving during winter 4 months**
- **(NOV TO FEB) due to use of heaters = 0.05 x 41000X 4 = 8200 KWH.**

- **Total energy saving = 16400 KWH + 8200 KWH= 24600 KWH**
- **Total energy cost saving = RS. 2, 58, 300.00.**
- **Cost of installation of 200 Energy meters = RS.1500 / Energy Meter X 200 NOS. = RS.3, 00000.00**
- **Payback period = Cost of investment / Cost of energy saving per year =**
- **RS.300000 x 12/ 2, 58, 000 = 14 Months**

6.5.0-USE OF RENEWABLE ENERGY(GRID CONNECTED SOLAR POWER PANEL):

6.5.1-At JAMIA HAMDARD UNIVERSITY NEW DELHI there is huge open land but there is dense vegetation also and no of buildings which are used for office purpose , class rooms ,labs and hospitals. These buildings can be used for installation of solar panels on roof top so that shade of the trees can be avoided.
Although there is scope for more than 2 M W SOLAR PANEL INSTALLATION but to start with it is recommended as below since most of office working is in day time from 09.00 to 18.00 hours
To install 100 KW p each grid connected solar panel without batteries as night time working is less on buildings to make it 300 KWp solar power station.

6.5.2 COST OF INVESTMENT FOR INSTALLING 300 KWp GRID CONNECTED SOLAR PANEL

Present cost of solar panel with inverter is about RS.40 / WATT
Cost of the panel installation = RS.40 X 300X1000 = 120 LAKHS
Subsidy by Govt. 30%
Actual investment = 70% = 0.7x120 = RS.84 LAKHS

6.5.3 ENERGY & COST SAVING:

Present day cost of purchase of electricity is RS. 8 /KWH
Cost of grid connected SOLAR POWER PANEL = RS.5.00/ KWH
Saving in tariff = RS.(8-5) =RS.3.00 / KWH
KWH GENERATED BY SOLAR PANEL:
Assuming 8 hours of office working per day and 300 sunny days in a year
KWH Generation by solar panel =300 KW X 8 HRS/DAY X 300 DAYS = 720000 KWH
Cost of energy saving= RS.3 X 7, 20, 000 KWH = RS.21.6 LAKHS/YEAR

6.5.4- PAY BACK PERIOD:

Payback period = RS.84 / 21.6 = 3.88 YEARS
After getting the experience of these solar panels this could be extended to other buildings in future.

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7-General Energy Conservation Tips

Electricity

- **Schedule your operations to maintain a high load factor**
- **Minimize maximum demand by tripping loads through a demand controller**
- **Use standby electric generation equipment for on-peak high load periods.**
- **Correct power factor to at least 0.99 under rated load conditions.**
- **Set transformer taps to optimum settings.**
- **Shut off unnecessary computers, printers, and copiers at night.**

Motors

- **Properly size to the load for optimum efficiency.**
- **(High efficiency motors offer of 4 - 5% higher efficiency than standard motors)**
- **Check alignment.**
- **Provide proper ventilation**
- **(For every 10°C increase in motor operating temperature over recommended peak, the motor life is estimated to be halved)**
- **Check for under-voltage and over-voltage conditions.**
- **Balance the three-phase power supply.**
- **(An Imbalanced voltage can reduce 3 - 5% in motor input power)**
- **Demand efficiency restoration after motor rewinding.**

Drives

- **Use variable-speed drives for large variable loads.**
- **Use high-efficiency gear sets.**
- **Use precision alignment.**
- **Check belt tension regularly.**
- **Eliminate variable-pitch pulleys.**
- **Use flat belts as alternatives to v-belts.**

- **Use synthetic lubricants for large gearboxes.**
- **Eliminate eddy current couplings.**
- **Shut them off when not needed.**

Fans

- **Use smooth, well-rounded air inlet cones for fan air intakes.**
- **Avoid poor flow distribution at the fan inlet.**
- **Minimize fan inlet and outlet obstructions.**
- **Clean screens, filters, and fan blades regularly.**
- **Use aerofoil-shaped fan blades.**
- **Minimize fan speed.**
- **Use low-slip or flat belts.**
- **Check belt tension regularly.**
- **Eliminate variable pitch pulleys.**
- **Use variable speed drives for large variable fan loads.**
- **Use energy-efficient motors for continuous or near-continuous operation**
- **Eliminate leaks in ductwork.**
- **Minimize bends in ductwork**
- **Turn fans off when not needed.**

Blowers

- **Use smooth, well-rounded air inlet ducts or cones for air intakes.**
- **Minimize blower inlet and outlet obstructions.**
- **Clean screens and filters regularly.**
- **Minimize blower speed.**
- **Use low-slip or no-slip belts.**
- **Check belt tension regularly.**
- **Eliminate variable pitch pulleys.**

- **Use variable speed drives for large variable blower loads.**
- **Use energy-efficient motors for continuous or near-continuous operation.**
- **Eliminate ductwork leaks.**
- **Turn blowers off when they are not needed.**

Pumps

- **Operate pumping near best efficiency point.**
- **Modify pumping to minimize throttling.**
- **Adapt to wide load variation with variable speed drives or sequenced control of smaller units.**
- **Stop running both pumps -- add an auto-start for an on-line spare or add a booster pump in the problem area.**
- **Use booster pumps for small loads requiring higher pressures.**
- **Increase fluid temperature differentials to reduce pumping rates.**
- **Repair seals and packing to minimize water waste.**
- **Balance the system to minimize flows and reduce pump power requirements.**
- **Use siphon effect to advantage: don't waste pumping head with a free-fall (gravity) return.**

Chillers

- **Increase the chilled water temperature set point if possible.**
- **Use the lowest temperature condenser water available that the chiller can handle.**
- **(Reducing condensing temperature by 5.5°C, results in a 20 - 25% decrease in compressor power consumption)**
- **Increase the evaporator temperature**
- **(5.5°C increase in evaporator temperature reduces compressor power consumption by 20 - 25%)**

- **Clean heat exchangers when fouled.**
- **(1 mm scale build-up on condenser tubes can increase energy consumption by 40%)**
- **Optimize condenser water flow rate and refrigerated water flow rate.**
- **Use water-cooled rather than air-cooled chiller condensers.**
- **Use energy-efficient motors for continuous or near-continuous operation.**
- **Specify appropriate fouling factors for condensers.**
- **Do not overcharge oil.**
- **Install a control system to coordinate multiple chillers.**
- **Study part-load characteristics and cycling costs to determine the most-efficient mode for operating multiple chillers.**
- **Run the chillers with the lowest operating costs to serve base load.**
- **Avoid over sizing - match the connected load.**
- **Isolate off-line chillers and cooling towers.**
- **Establish a chillers efficiency-maintenance program. Start with an energy audit and follow-up, then make a chillers efficiency-maintenance program a part of your continuous energy management program.**

HVAC (Heating / Ventilation / Air Conditioning)

- **Tune up the HVAC control system.**
- **Consider installing a building automation system (BAS) or energy management system (EMS) or restoring an out-of-service one.**
- **Balance the system to minimize flows and reduce blower/fan/pump power requirements.**
- **Eliminate or reduce reheat whenever possible.**
- **Use appropriate HVAC thermostat setback.**
- **Use building thermal lag to minimize HVAC equipment operating time.**

- **In winter during unoccupied periods, allow temperatures to fall as low as possible without freezing water lines or damaging stored materials.**
- **In summer during unoccupied periods, allow temperatures to rise as high as possible without damaging stored materials.**
- **Improve control and utilization of outside air.**
- **Use air-to-air heat exchangers to reduce energy requirements for heating and cooling of outside air.**
- **Reduce HVAC system operating hours (e.g. -- night, weekend).**
- **Optimize ventilation.**
- **Ventilate only when necessary. To allow some areas to be shut down when unoccupied, install dedicated HVAC systems on continuous loads (e.g. -- computer rooms).**
- **Provide dedicated outside air supply to kitchens, cleaning rooms, combustion equipment, etc. to avoid excessive exhausting of conditioned air.**
- **Use evaporative cooling in dry climates.**
- **Clean HVAC unit coils periodically and comb mashed fins.**
- **Upgrade filter banks to reduce pressure drop and thus lower fan power requirements.**
- **Check HVAC filters on a schedule (at least monthly) and clean/change if appropriate.**
- **Check pneumatic controls air compressors for proper operation, cycling, and maintenance.**
- **Isolate air-conditioned loading dock areas and cool storage areas using high-speed doors or clear PVC strip curtains.**
- **Install ceiling fans to minimize thermal stratification in high-bay areas.**
- **Relocate air diffusers to optimum heights in areas with high ceilings.**

- **Consider reducing ceiling heights.**
- **Eliminate obstructions in front of radiators, baseboard heaters, etc.**
- **Check reflectors on infrared heaters for cleanliness and proper beam direction.**
- **Use professionally-designed industrial ventilation hoods for dust and vapor control.**
- **Use local infrared heat for personnel rather than heating the entire area.**
- **Use spot cooling and heating (e.g. -- use ceiling fans for personnel rather than cooling the entire area).**
- **Purchase only high-efficiency models for HVAC units.**
- **Put HVAC window units on timer control.**
- **Don't oversize cooling units. (Oversized units will "short cycle" which results in poor humidity control.)**
- **Install multi-fueling capability and run with the cheapest fuel available at the time.**
- **Consider dedicated make-up air for exhaust hoods. (Why exhaust the air conditioning or heat if you don't need to?)**
- **Minimize HVAC fan speeds.**
- **Consider desiccant drying of outside air to reduce cooling requirements in humid climates.**
- **Seal leaky HVAC ductwork.**
- **Seal all leaks around coils.**
- **Repair loose or damaged flexible connections (including those under air handling units).**
- **Eliminate simultaneous heating and cooling during seasonal transition periods.**

- **Zone HVAC air and water systems to minimize energy use.**
- **Inspect, clean, lubricate, and adjust damper blades and linkages.**
- **Establish an HVAC efficiency-maintenance program. Start with an energy audit and follow-up, then make an HVAC efficiency-maintenance program a part of your continuous energy management program.**

Lighting

- **Reduce excessive illumination levels to standard levels using switching; de-lamping, etc. (Know the electrical effects before doing de-lamping.)**
- **Aggressively control lighting with clock timers, delay timers, photocells, and/or occupancy sensors.**
- **Install efficient alternatives to incandescent lighting, mercury vapour lighting, etc. Efficiency (lumens/watt) of various technologies range from best to worst approximately as follows: low pressure sodium, high-pressure sodium, metal halide, fluorescent, mercury vapour, incandescent.**
- **Select ballasts and lamps carefully with high power factor and long-term efficiency in mind.**
- **Upgrade obsolete fluorescent systems to Compact fluorescents and electronic ballasts**
- **Consider lowering the fixtures to enable using less of them.**
- **Consider day lighting, sky lights, etc.**
- **Consider painting the walls a lighter colour and using less lighting fixtures or lower wattages.**
- **Use task lighting and reduce background illumination.**
- **Re-evaluate exterior lighting strategy, type, and control. Control it aggressively.**
- **Change exit signs from incandescent to LED.**

DG sets

- **Optimize loading**
- **Use waste heat to generate steam/hot water /power an absorption chiller or preheat process or utility feeds.**
- **Use jacket and head cooling water for process needs**
- **Clean air filters regularly**
- **Insulate exhaust pipes to reduce DG set room temperatures**
- **Use cheaper heavy fuel oil for capacities more than 1MW**

Buildings

- **Seal exterior cracks / openings / gaps with caulk, gasketing, weather stripping, etc.**
- **Consider new thermal doors, thermal windows, roofing insulation, etc.**
- **Install windbreaks near exterior doors.**
- **Replace single-pane glass with insulating glass.**
- **Consider covering some window and skylight areas with insulated wall panels inside the building.**
- **If visibility is not required but light is required, consider replacing exterior windows with insulated glass block.**
- **Consider tinted glass, reflective glass, coatings, awnings, overhangs, draperies, blinds, and shades for sunlit exterior windows.**
- **Use landscaping to advantage.**
- **Add vestibules or revolving doors to primary exterior personnel doors.**
- **Consider automatic doors, air curtains, strip doors, etc. at high-traffic passages between conditioned and non-conditioned spaces. Use self-closing doors if possible.**
- **Use intermediate doors in stairways and vertical passages to minimize building stack effect.**

- **Use dock seals at shipping and receiving doors.**
- **Bring cleaning personnel in during the working day or as soon after as possible to minimize lighting and HVAC costs.**

Water & Wastewater

- **Recycle water, particularly for uses with less-critical quality requirements.**
- **Recycle water, especially if sewer costs are based on water consumption.**
- **Balance closed systems to minimize flows and reduce pump power requirements.**
- **Eliminate once-through cooling with water.**
- **Use the least expensive type of water that will satisfy the requirement.**
- **Fix water leaks.**
- **Test for underground water leaks. (It's easy to do over a holiday shutdown.)**
- **Check water overflow pipes for proper operating level.**
- **Automate blow down to minimize it.**
- **Provide proper tools for wash down -- especially self-closing nozzles.**
- **Install efficient irrigation.**
- **Reduce flows at water sampling stations.**
- **Eliminate continuous overflow at water tanks.**
- **Promptly repair leaking toilets and faucets.**
- **Use water restrictors on faucets, showers, etc.**
- **Use self-closing type faucets in restrooms.**
- **Use the lowest possible hot water temperature.**
- **Do not use a heating system hot water boiler to provide service hot water during the cooling season -- install a smaller, more-efficient system for the cooling season service hot water.**

- **If water must be heated electrically, consider accumulation in a large insulated storage tank to minimize heating at on-peak electric rates.**
- **Use multiple, distributed, small water heaters to minimize thermal losses in large piping systems.**
- **Use freeze protection valves rather than manual bleeding of lines.**
- **Consider leased and mobile water treatment systems, especially for deionized water.**
- **Seal sumps to prevent seepage inward from necessitating extra sump pump operation.**
- **Install pre-treatment to reduce TOC and BOD surcharges.**
- **Verify the water meter readings. (You'd be amazed how long a meter reading can be estimated after the meter breaks or the meter pit fills with water!)**
- **Verify the sewer flows if the sewer bills are based on them**

Miscellaneous

- **Meter any unmetered utilities to know what normal efficient use is. Track down causes of deviations.**
- **Shut down spare, idling, or unneeded equipment.**
- **Make sure that all of the utilities to redundant areas are turned off -- including utilities like compressed air and cooling water.**
- **Install automatic control to efficiently coordinate multiple air compressors, chillers, cooling tower cells, boilers, etc.**
- **Renegotiate utilities contracts to reflect current loads and variations.**
- **Consider buying utilities from neighbours, particularly to handle peaks.**
- **Leased space often has low-bid inefficient equipment. Consider upgrades if your lease will continue for several more years.**

- **Adjust fluid temperatures within acceptable limits to minimize undesirable heat transfer in long pipelines.**
- **Minimize use of flow bypasses and minimize bypass flow rates.**
- **Provide restriction orifices in purges (nitrogen, steam, etc.).**
- **Eliminate unnecessary flow measurement orifices.**
- **Consider alternatives to high-pressure drops across valves.**
- **Turn off winter heat tracing that is on in summer.**

Annexure – I

LIST OF COMPANIES WHO CAN SUPPLY SOLUTIONS FOR POWER FACTOR CORRECTION & DEMAND CONTROLLERS ,ENERGY MANAGEMENT SYSTEM SOFTWARE& SYSTEM INTEGRATION:

1-TAMO ARI ENERGY AUDIT & MANAGEMENT SYSTEMS PVT LTD.
A-401 PRANGAN HOUSING SOCIETY,PLOT NO. B-9/10,SECTOR-62 NOIDA-201301,
Name- S.B.PANDEY, BEE CERTIFIED ENERGY AUDITOR & SR. Consultant.
E MAIL-sbpandey2007@gmail .com, M-9871415604

2-INVENTUM POWER PVT. LTD.
43 J&K BLOCK, 2nd Floor, Laxmi Nagar, Delhi-110092
Name- Shahrukh Khan
Email- sales@inventumpower.com M-9650334786

3- NAAC ENERGYCONTROLS PVT. LTD.
C-135,Phase II –Extn. NOIDA ,201305
Name-CHANDEER J KAPOOR
E Mail – chndermk@naacenergy.com, M-9811199085

THE END OF THE REPORT

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