ENERGY AUDIT REPORT

EROS CITY SQUARE

Gurgaon

(November, 2014)

ENERGY AUDIT SERVICES

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CONTENTS

PERFORMANCE CURVE

TABLES

CHAPTER # A

INTRODUCTION

'EROS CITY Square' is located at Golf Course Extension Road, Sector – 49 & 50, Rose Wood City, Gurgaon. This is basically a Commercial Complex. The Building has been constructed with a very decent and attractive look for the Business centre.

There are Upper Basement and Lower Basement for Parking. The Building consists of Ground Floor and 4 Floors.

All the Energy Consuming items like Chillers, Pumps, Lifts, Lighting etc., are as per the latest trend in the Technology. Power Distribution System is also very well planned.

Power Supply is received at 11 KV from DHBVN.

Sanctioned Load = **1640 KW**

Contract Demand = 1475 KVA

Building has been constructed in the recent past and occupancy is on lower side, as on date.

All the necessary efforts are being undertaken for Energy Conservation, in a very dedicated way.

CHAPTER # B

EXECUTIVE SUMMARY

We have carried out the assignment for Detailed Energy Audit during the month of November, 2014. We found this assignment to be very challenging and also very interesting as because it has been constructed recently and selection of various Energy consuming items – Chillers, Pumps, Cooling Towers, Lifts, Lighting etc are **as per the latest Technology**. These steps **contribute to a great extent** for Energy Efficiency.

We have carried out very elaborate measurements for various Operating-Parameters, related to Energy efficiency, covering each area. We have studied all the common areas under the control of the Management.

- **MAIN OBSERVATIONS**

Based upon the measurement data, analysis of the performance and our observation, it is observed that Energy utilization is **very well managed**. **Some of the very effective steps** are being highlighted here with: -

1. **POWER FACTOR**: being maintained **very close to Unity**.
2. **Chillers:** Chillers are **very efficient** and operating hours is **minimum possible.**
3. **Pumps:** Pumps have been selected efficiently and **VFD has already been provided** for Secondary Chilled water Pumps**.**
4. **Lifts**: Lifts are also as per **the latest Technology.**
5. **Lighting:** Lighting is also **very well planned.**

   (a) Lighting in Corridors is by 3 Watt, LED Lamps**.**

   (b) **Solar Lighting**: - For Outside Lighting 10 nos**. Solar Lighting with 12 Watt, LED Lamps have been provided.**

   © Lighting in the common areas like Basements etc ate by mostly CFL Lamps, T**- 5 Tube Lights and 36 Watt Tube Lights with Electronic Chokes.**

   These steps deserve **APPRECIATION.**

Annual Electricity Consumption data for the year 2013-14

Sl. No.	Parameters	2013 – 14 (Annual)
1.	KWH Consumed	13.50 Lac Units
2.	P.F.	**0.98**
3.	Annual Electricity Cost	Rs. 126.02 Lac
4	Avg. Billing Rate	Rs. 9.33 per Unit
5	Recorded highest Demand	**705 KVA**

- **OUR OBJECTIVE**

  To determine what further Energy Saving can be achieved, on the most practical lines. Our thrust has been towards hidden losses & Technical up- gradation.

- PROPOSALS for further ENERGY SAVING

  We have identified certain areas especially lighting, having potential for further more Energy Saving.

- **ENERGY AUDIT REPORT**

  Each area has been covered with elaborate details, in the respective Chapters. We have provided elaborate Technical details as well as Cost- benefit calculations for each Proposal for Energy Saving.

- **EXECUTIVE SUMMARY**: - We are highlighting here with only areas where further more Energy can be saved. Various Proposals are being summarized here with for the quick reference of the senior Management. For details, the respective Chapters may please be referred.

- **SUMMARY OF Various Proposals**

1. Expected saving has been worked out on the **annual basis**.
2. All figures in **Rs. Lac**

Sl. No.	PARTICULARS	Unit Rate	EXPECTED annual Saving		Estimated Cost of Implementation (Rs. Lac)
			QTY	Amount (Rs. Lac)	
1.	ELECTRICITY	7.08 per Unit	0.47 Lac Units	3.33	2.86
2.	TOTAL	-	-	**Rs. 3.33 Lac**	**Rs. 2.86 Lac**

- Amount of Expected Annual Saving = Rs. 3.33 Lac
- Estimated Cost = Rs. 2.86 Lac
- It may please be appreciated that each Proposals for Energy Saving are on the most practical lines.
- We sincerely thank the Management for extending the best possible co-operation to us to carry out the Assignment.

(R. B. SINHA)

For **ENERGY AUDIT SERVICES**

Accredited Energy Auditor (AE 0067)

By B.E.E.

CHAPTER # C

SUMMARY of VARIOUS OPTIONS for

ENERGY SAVINGS

Performance of the various plants and machinery including lighting etc., has been worked out, based upon the measurement data. Performance as well as effective utilization of Electricity has been observed to be **Very Good**. This is so because it is a recent installation and all the items have been selected as per the latest trend in **Energy Efficiency.**

As such, there is **marginal potential for further Energy Saving. Summary of the Options for Energy Savings is being illustrated herewith.**

OPTION for ENERGY SAVING

Sl. No.	Area	PROPOSAL for Energy Saving	Expected Annual Saving	Estd. Cost	Ref.	Remarks
C.1	**36 Watt, Tube Lights**	**Upper Basement and Lower Basement** Lighting details are tabulated in **TABLE # 17 & # 18** along with Illumination Measurement data. **36 Watt, Tube lights** with Electronic Chokes, glowing on 24 Hours basis:- Lower Basement – **149 Nos.** Upper Basement – **123 Nos**. Total Tubes = **272 nos**. **Proposal** It is being proposed to replace all these 36 Watt, FTL, glowing round the clock, by 18 Watt LED, Tubes. This is as per the latest Technology. Please refer I.3 & I.4 for the details.	47,000 Units **Rs. 3.33 Lac**	Rs. 2.86 Lac	Tables # 17 # 18 I.2 I.3 I.4	

CHAPTER # D

MONTHLY ELECTRICITY BILLING

D.1 Latest Tariff

Power Supply is received at 11 KV from DHBVN.

a) Sanctioned Load = **1640 KW** contract

b) Contract Demand = **1475 KVA**

- **Latest Tariff**

c) Energy Charges

Energy Charges is based upon KVAH Consumptions.

$$KVAH = \frac{KWH}{P.F.}$$

As such, P.F. is of vital importance.

$$\mathbf{KVAH} \propto \frac{\mathbf{1}}{\mathbf{P.F.}}$$

d) **Fixed Charges**

Fixed Charges = @ Rs. 160/- per KW of sanctioned load.

Sanctioned load = 1640 KW

Fixed charges = Rs. 160/- per KW x 1640 KW

= **Rs. 2, 62,400/- per Months**

e) **Electricity Duty**

Electricity Duty = @ 10 PPU on KWH Consumptions.

(f) Fuel Surcharge = **@ Rs. 1.21 per Unit**

(g) M. Tax = 5 PPU on KWH Consumptions.

D.2 Monthly Electricity Billing

We have studied and analysed Monthly Electricity Billing, for al period of two years.

Following parameters have been tabulated as following:-

i) Monthly KWH Consumptions

ii) Monthly KVAH Consumptions

iii) Average Monthly Power Factor

iv) Average recorded Demand – KVA

v) Total Billing Amount – Rs.

vi) **Average Billing Rate** $= \frac{\text{Total Billing Amount}}{\text{Total KWH Consumptions}}$

Sl. No.	Year	Table #
1.	2012 – 13	**Table # 1**
2.	2013 – 14	**Table # 2**

D.3 DATA Analysis

i) KVAH Billing

KVAH Billing has been started since June – 13 only.

ii) **Demand – KVA**

Contract Demand = 1475 KVA

Actual recorded highest Demand = 705 KVA

In fact, **occupancy is very less, as on date**.

Table # 1

Monthly Electricity Billing

(Year 2012 – 13)

Billing Months	Units Consumed (KWH)	Units Consumed (KVAH)	Avg. Monthly P.F.	Actual Max. Demand (KVA)	Total Billing Amount (Rs.)	Avg. Billing Rate (Rs. /KWH)	Remarks
Oct-12	30420	--	-	417	404542	13.30	
Nov-12	30495	-	-	417	402899	13.21	
Dec-12	31245	--	-	261	349512	11.19	
Jan-13	40800	-	-	417	469516	11.51	
Feb-13	47070	--	-	417	508329	10.80	
Mar-13	43155	-	-	417	436107	10.11	
Apr-13	71610	--	-	417	637131	8.90	
May-13	69390	-	-	417	714823	10.30	
Jun-13	94155	95595	0.98	417	974196	10.35	
Jul-13	87900	88890	0.99	417	890851	10.13	
Aug-13	95820	97305	0.98	417	799879	8.35	
Sep-13	97365	98790	0.99	417	904941	9.29	
Total (For 12 Months)	**7,39,425**	**3,80,580**	**-**	**-**	**74,92,726**	**10.13**	

Note: Contract Demand = **1475 KVA**

Table # 2

Monthly Electricity Billing

(Year 2013 – 14)

Billing Months	Units Consumed (KWH)	Units Consumed (KVAH)	Avg. Monthly P.F.	Actual Max. Demand (KVA)	Total Billing Amount (Rs.)	Avg. Billing Rate (Rs. /KWH)	Remarks
Oct-13	89775	92235	0.97	477	871139	9.70	
Nov-13	111360	114465	0.97	417	1068390	9.59	
Dec-13	80925	82425	0.98	417	818418	10.11	
Jan-14	81330	82695	0.98	417	809854	9.96	
Feb-14	73560	75270	0.98	417	752526	10.23	
Mar-14	89100	90780	0.98	417	866439	9.72	
Apr-14	80445	81990	0.98	417	803072	9.98	
May-14	157050	160020	0.98	655.5	1370173	8.72	
Jun-14	149655	152415	0.98	705	1142174	7.63	
Jul-14	131100	133785	0.98	705	1188117	9.06	
Aug-14	155370	158085	0.98	705	1545785	9.95	
Sep-14	129630	132165	0.98	705	1194680	9.22	
Oct-14	133605	135825	0.98	705	1221022	9.14	
Total (For 13 Months)	**14,62,905 KWH**	**14,92,155 KVAH**	**0.98**		**1,36,51,789**	**9.33**	

Note: Contract Demand = **1475 KVA**; Sanctioned Load = **1640 KW**

D.4 Summary of Electricity Billing

Sl. No.	Parameters	2012 – 13 (Annual)	2013 – 14 * (Annual)
1.	KWH Consumed	7,39,425	13.50 Lac Units
2.	KVAH Consumed	-	13.77 Lac Units
3.	P.F.	**0.985**	**0.98**
4.	Annual Electricity Cost	Rs. 74.93 Lac	Rs. 126.02 Lac
5.	Avg. Billing Rate	10.13	9.33
6.	Fixed Charges of the total Electricity cost	42 % Rs. 4.26 /Unit	23.1 % 2.33 per unit
7.	Recorded highest Demand	**417 KVA**	**705 KVA**

* Table # 2 for the year 2013 – 14, contains the monthly billing for 13 months. And as such, for annual data the same has been converted for 12 months.

D.5 Power Factor

Monthly Power Factor has been plotted for both the years, on **GRAPH # A.**

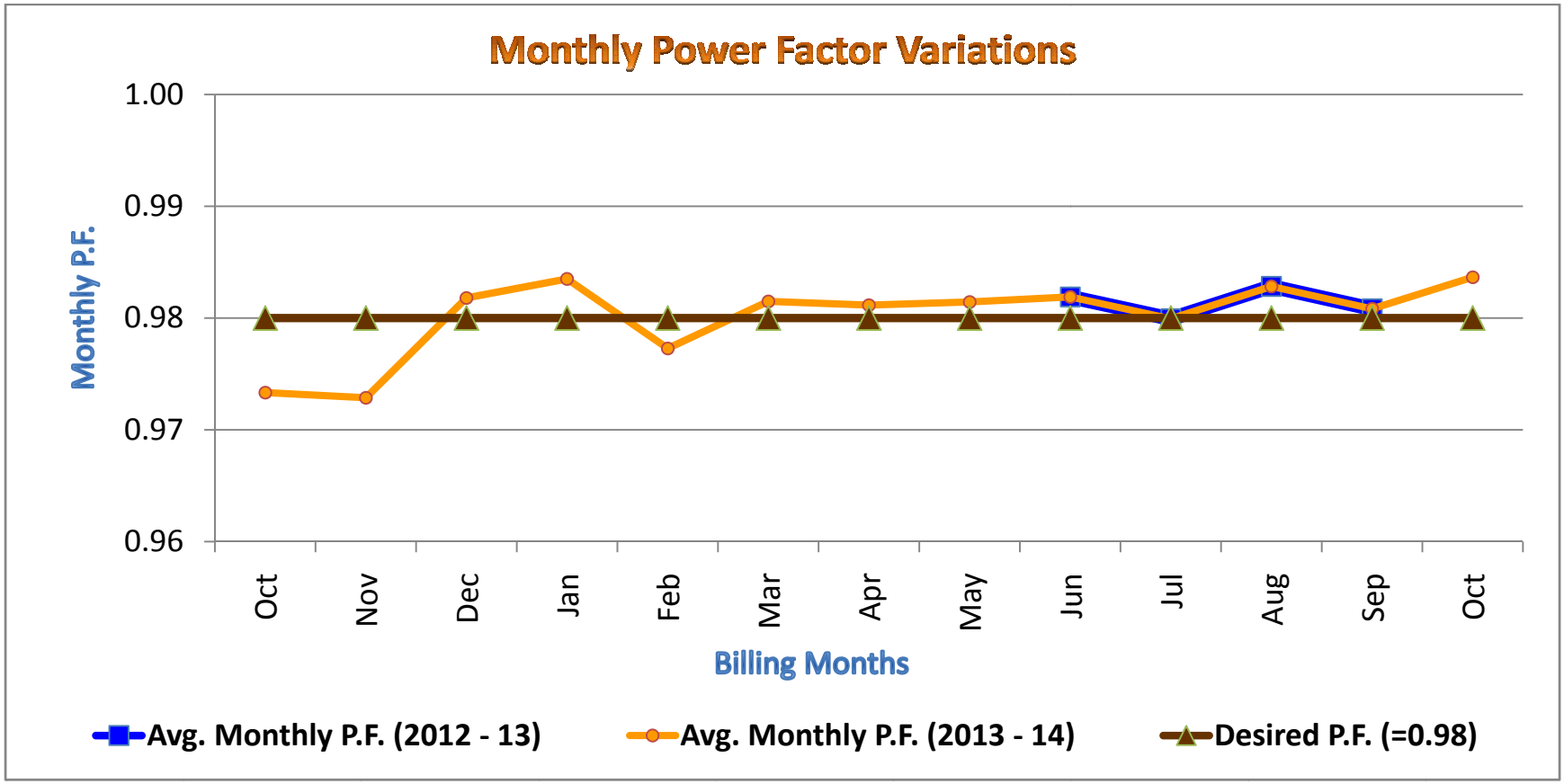
Desired P.F. = 0.98 has also been plotted.

- **Conclusion**

From **GRAPH # A;** it can be concluded that Power Factor is **very well managed**.

GRAPH # A

Monthly Power Factor Variations



D.6 Fixed Charges

Fixed Charges is based upon sanctioned load.

Fixed Charges = @ Rs.160/- per KW per months

Monthly Fixed Charges = Rs. 160/- per KW x 1640 KW

= **Rs. 2, 62,400/- per months**

Estimated annual amount of fixed charges

= 12 x Rs. 2, 62,400/- per months

= **Rs. 31.49 Lac**

This is a major part of the annual billing amount.

This amount to be as following:-

Year	Fixed Charges as % of Total Billing Amount
2012 – 13	**42 %**
2013 – 14	**23.1 %**

D.6.1 Recorded Demand

Monthly recorded Demand – KVA has been plotted on **GRAPH # B.**

Conclusions

It can be concluded that Contract Demand utilization is **very, very low**.

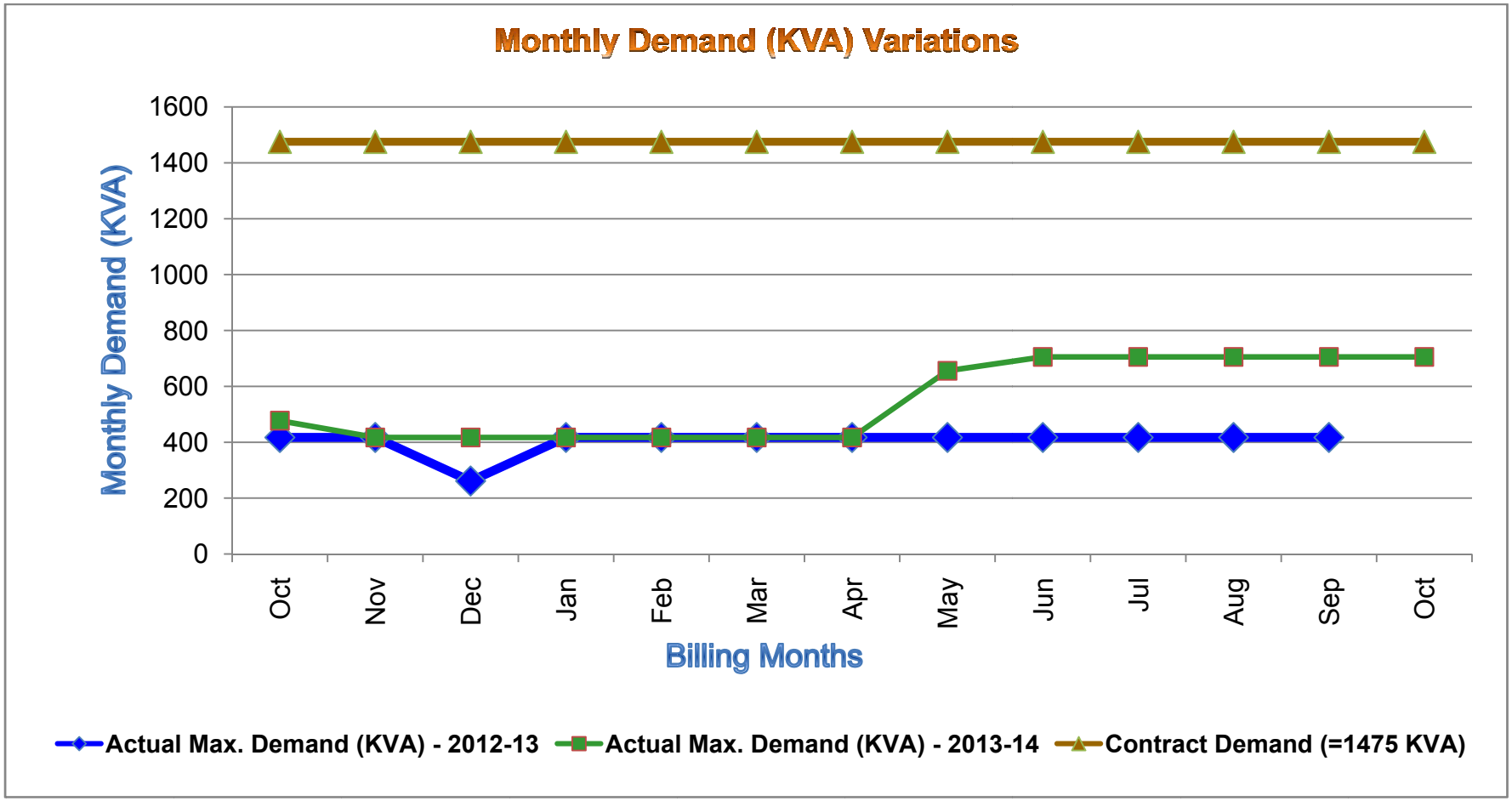
This is so because occupancy of the Building is very low.

Options for Saving in Fixed Charges

Since, Fixed Charges is based upon Sanctioned load; it **will not be practical** to reduce sanction – load (KW).

Graph # B

Actual Monthly Power Demand - KVA



D.7 Variable Cost of Power

For calculating expected saving for any option for Energy Saving, Variable Cost of Electricity is being worked out, herewith.

i) Unit Charges = Rs. 5.72

ii) Electricity Duty = Rs. 0.10 per Unit

iii) Fuel Surcharges = Rs. 1.21 per unit

iv) M. Tax = Rs. 0.05 per unit

Total Variable Cost = **Rs. 7.08 per Unit**

CHAPTER # E

POWER SYSTEM

E.1 **Brief Description**

There are 2 nos., identical Step - Down Transformers, for converting 11 KV Power Supply to LT Power Supply.

E.2 Specification as following:-

Transformer Specifications

Particulars	**Transformer # 1**	**Transformer # 2**
Make	Universal Power Transformer (P) Ltd., Bangalore	Universal Power Transformer (P) Ltd., Bangalore
Rated Capacity	1750 KVA	1750 KVA
Voltage (HV /LV)	11000 /415 Volts	11000 /415 Volts
Current (HV /LV)	91.8 /2434.6 Amp.	91.8 /2434.6 Amp.
Frequency	50	50
Vector Group	Dyn 11	Dyn 11
Impedance Volt	**6.36 %**	**6.27 %**
Cooling Type	AN	AN
Year of Mfg.	2010	2010
Total Tap	17 Nos.	17 Nos.
Current Tap	**4th Tap**	**4th Tap**
Remarks		OFF

E2.1 Main Observations

Since actual Power requirement is very much, on the lower side (due to very low occupancy), only 1 No., Transformer is taken into operation at any time.

E2.2 Tap Details

Tap Position #	Voltage (HV)	Current (HV)
# 1	11550	87.5
# 2	11413	88.5
# 3	11275	89.6
# 4	11138	90.7
# 5	**11000**	**91.8**
# 6	10863	93.0
# 7	10725	94.2
# 8	10588	95.4
# 9	10450	96.7
# 10	10313	97.9
# 11	10175	99.3
# 12	10038	100.7
# 13	9900	102.1
# 14	9763	103.5
# 15	9625	105.0
# 16	9488	106.5
# 17	9350	108.1

E.3 Power Measurement Data

Voltage, load current, Power – KW and P.F. was measured for the Transformer – under operation.

Summary of all the measurement data is tabulated in **TABLE # 3.**

Conclusion

i) Total Power Load = 282 KW # (Very, Very Low)

ii) P.F. = 0.98 # (Very Good)

E.3.1 Power Measurement – Without Chiller

The exercise for Power Measurement was repeated on 19.11.2014 at 3 PM, when Chiller was 'OFF'.

Summary of all the measurement data is tabulated in **TABLE # 4.**

i) Power Consumption (Without Chiller) = 149 KW # Very Less

ii) P.F. = 0.995 (**Very Good)**

Table # 3

Transformer Power Measurement Data

CHILLER Operating

Date: 19.11.2014 (11:30 AM)

Phase #	Voltage	Load Current	Power (KW)	P.F.	Remarks
R	416	401	282	0.98	Measurement not possible in Y & B Phase, initially
Y	-	-	-	-	
B	-	-	-	-	
Avg.	**416**	**401**	**282**	**0.98**	

Note:-

- Measurement done while Chiller # 2 was operating. Since cooling load was very Low, only one compressor could be operated, at any time.

Table # 4

Transformer Power Measurement Data

CHILLER - OFF

Date: 19.11.2014 (3 PM)

Phase #	Voltage	Load Current	Power (KW)	P.F.	KVA	Remarks
R	406	228	159	**0.997**	159	Freq. = 49.96 Hz
Y	405	195	135	**0.993**	136	
B	403	215	152	**0.996**	153	
Avg.	**405**	**213**	**149**	**0.995**	**151.3**	

Note: - Normal Situation

- Measurement done without A.C. Plant operating

E.4 Harmonics

'Total Harmonics Distortion' – THD - % was measured for both Voltage & Current.

Summary of all the measurement data is tabulated in **TABLE # 5.**

Along with THD - % measurement data, % loading on the Transformer is also mentioned.

- **Conclusion**

Harmonics – well within the desired range.

TABLE # 5

Harmonics # THD Distortions - %

Date: 19.11.2014 (11:30 AM)

Sl. No.	Parameters	Transformer # 1	
1.	Loading status	Chiller Operating	Chiller OFF
2.	Load Current – Amp.	401	213
3.	Power – KW	282	149
4.	% - Loading	**16.4 %**	**8.6 %**
5.	Voltage Harmonics - %	2.4	1.8%, 2.3%
6.	Current Harmonics - %	7.5	6.5%, 7.7%
7.	Remarks	Measurement done with 1 No., A.C. Plant (Chiller # 2) operating	Measurement done without A.C. Plant operating

E.5 AUTO P.F. Panel

Both the Transformers have been provided with AUTO P.F. Panels.

Since, loading is very less, only 1 no. Transformer is being operated with 1 no., Auto P.F. Panel.

CAPACITOR - Checking

Load current was measured and all the measurement data is tabulated in **TABLE # 6.**

- **Conclusion**
  i) All the measurement data for P.F. is observed to be **Very Good**.
  ii) P.F. studied on the annual basis and observed to be **Very Good**.

Please refer **TABLE # 1 & # 2** and **GRAPH # A** for the details

Table # 6

Auto P.F. Control Panel (400 KVAr)

Total Current Measurement Data

(APFC Panel # 1)

Phase	Voltage	Load Current	Power (KVAr)	Remarks
R - Φ	406	44.7	31.0	
Y - Φ	405	44.7	31.3	
B - Φ	406	44.5	31.1	
Avg.	**406**	**44.6**	**31.1**	

E.6 LT OUTING Feeders

Voltage, Load Current, Power Consumptions – KW and P.F. measured for all outgoing Feeders.

Summary of all the measurement data is tabulated in **TABLE # 7.**

E.6.1 DATA – Analysis

i) Terminal Voltage – O.K.

ii) Unbalancing in three phases is being observed. Once load – picks up – along with improvement in occupancy – then only load – balancing would be necessary.

iii) Without Chiller – Total load is about to be 9 % loading on the Transformer.

Table # 7

LT Feeders # Power Measurement Data

Date: 11.11.2014

Sl. No.	Particulars	Voltage	Load Current	Power – KW	P.F.	Total Harmonics Distortion - %		Remarks
						Voltage	Current	
1.	Rising Main # 1 (Morning Time)	413	2.2 3.0 0	1.5 2.1 0	0.96 0.98 0	-	-	
2.	Rising Main # 2 ST # 2 Tower	413	29.1 37.7 26.7	20.9 27.0 18.6	1.0 1.0 0.97	3.9	15.7	
3.	Rising Main # 3 (ST # 3)	414	35.7 19.4 18.4	20.3 13.9 11.5	0.80 1.0 0.87	3.6	17.0	
4.	Rising Main # 4	412	2.2	1.5	0.98	3.61	8.1	
5.	Rising Main # 5	413	53.1 33.0 31.0	37.1 23.0 20.4	0.96	3.4	7.0	Freq = 50.6 Hz
6.	Rising Main # 6	413	2.9 7.3 2.2	2.0 5.3 1.5	0.99	2.26	43	

Table # 7A

LT Feeders # Power Measurement Data

Date: 11.11.2014

Sl. No.	Particulars	Voltage	Load Current	Power – KW	P.F.	Total Harmonics Distortion - %		Remarks
						Voltage	Current	
7.	Lift Panel # 1	414	4.2	2.3	0.78	3.6	13.0	No Load
8.	Lift Panel # 2	413	15.4	10.8	0.98	-	-	Max. Load
8.	Lift Panel # 2	413	2.8	1.7	0.85			Freq. = 50.6 Hz
9.	Lift Panel # 3	413	2.1	1.5	0.96	-	-	Half of External Lights switched OFF due to Solar Light
10.	External Lighting	414	9.9 5.5 8.3	3.2 2.5 4.0	0.55 0.66 0.68	3.0	10.0	
11.	Common Lighting Load (Daytime)	413	43.9	28.1	0.90	3.87	21	Neutral Current = 18.8 A Freq. = 50.6 Hz.
12.	Mc Donald	412	65.8	**45.1**	0.99	3.53	5.3	
13.	S.T. # 1 (1st Floor) – Rising	413	32.7 28.1 17.0	22.7 17.8 10.0	0.97 0.89 0.83	3.71	7.92	Freq. = 50.6 Hz

Table # 7B

LT Feeders # Power Measurement Data

Date: 11.11.2014

Sl. No.	Particulars	Voltage	Load Current	Power – KW	P.F.	Total Harmonics Distortion - %		Remarks
						Voltage	Current	
# 14.	Plumbing Panel # 1	414	9.3 11.9 8.6	5.5 5.6 4.3	0.83 0.66 0.70	3.5	6.8	Freq. = 50.6 Hz
# 15.	Ventilation D.G.	414	24.9	9.4	0.53	3.4	4.2	Freq. = 50.6 Hz
# 16.	D.G. Aux. Panel	-	-	-	-	-	-	No Load . Load only when 750 KVA & 1010 KVA DG Set running
# 17.	Ventilation Panel	-	-	-	-	-	-	Not operating during Winter Season
# 18.	ACC – MCC # 1	-	-	-	-	-	-	No load. Due to Winter Season, A.C. not operating
# 19.	Fire Pump Panel	-	-	-	-	-	-	No- Load

E.7 Power Logging Measurement data

Date: 24.11.2014

Power parameter data recorded on hourly basis for elaborate study.

E.7.1 Supply Voltage

Hourly Supply Voltage is tabulated In **TABLE # 8.**

Hourly variation in Supply Voltage is plotted on **GRAPH # C.**

- **Conclusion**

Supply Voltage is **very much, well within the normal voltage**.

E.7.2 Load Current

Date: 24.11.2014

Hourly load current is tabulated in **TABLE # 9.**

Load current in three phases is plotted on **GRAPH # D.**

Data Analysis

I) Maximum load current ≤ 250 Amp. (Very, Very Low)

Load current is so low because

i) Occupancy is very low

ii) Various Plant /Utilities and lighting are Very Efficient

iii) Steps for Energy Saving – necessary steps are being undertaken, in a Very dedicated way.

E.7.3 Power Consumptions - KW

I) Hourly Power Consumptions data has been tabulated in **TABLE # 10.**

II) Hourly Power Consumptions Data has been plotted on **GRAPH # E.**

- **Conclusion**

It can be concluded that Power Consumptions is being Control **Very Effectively.**

Table # 8

Supply Voltage Hourly Logging Data

Date: 24.11.2014

Time	Voltage	Remarks
2:00 AM	415	
3:00 AM	414	
4:00 AM	416	
5:00 AM	415	
6:00 AM	408	
7:00 AM	411	
8:00 AM	405	
9:00 AM	408	
10:00 AM	404	
11:00 AM	422	
12:00 PM	419	
1:00 PM	422	
2:00 PM	405	
3:00 PM	408	
4:00 PM	410	
5:00 PM	411	
6:00 PM	414	
7:00 PM	416	
8:00 PM	420	
9:00 PM	419	
10:00 PM	418	
11:00 PM	416	
12:00 AM	418	
1:00 AM	418	

Graph # C

Supply Voltage Hourly Variation Pattern

Date: 24.11.2014

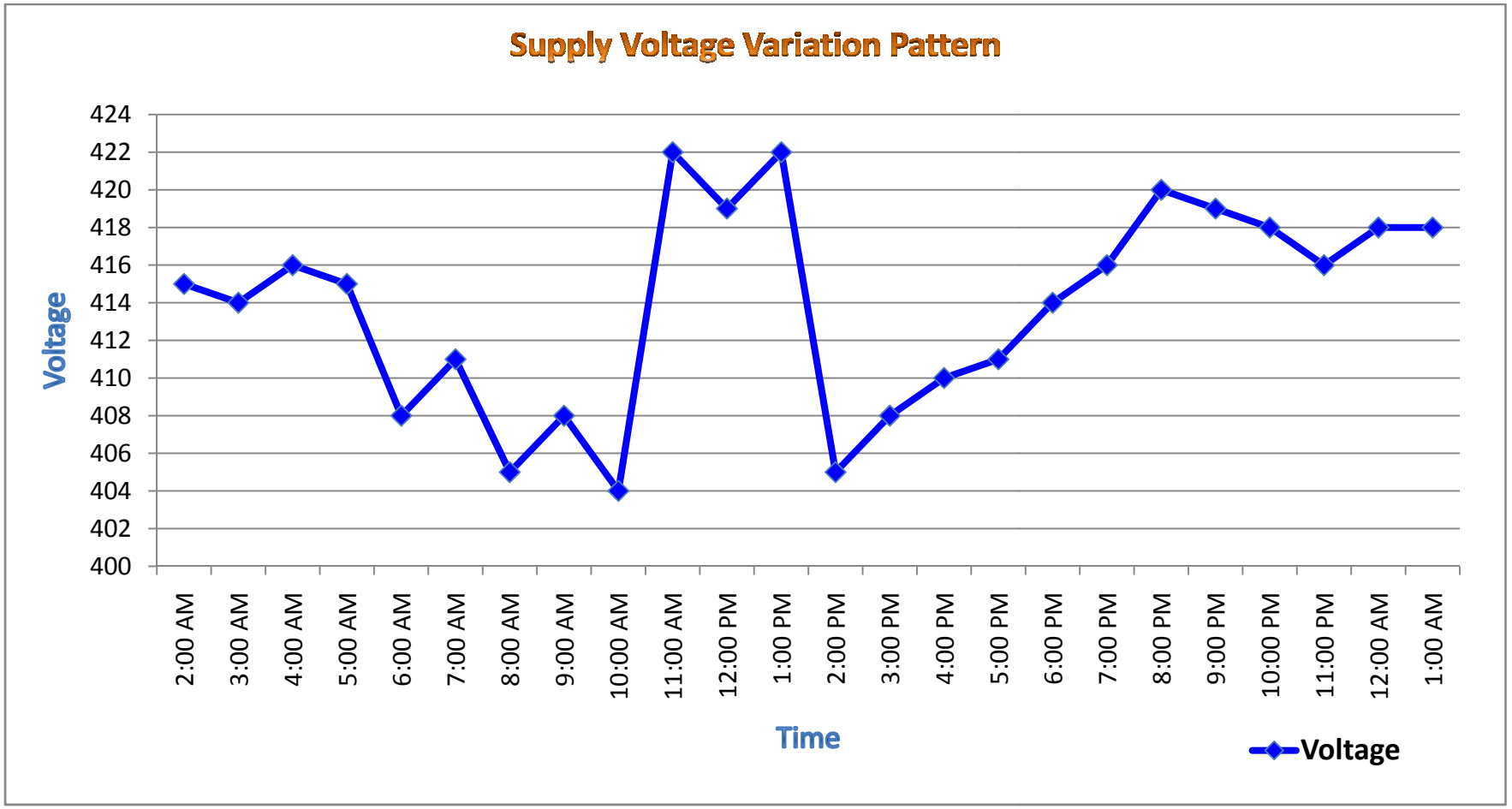


Table # 9

Load Current # Hourly Logging Data

Date: 24.11.2014

Time	Current (R-Phase)	Current (Y-Phase)	Current (B-Phase)	Remarks
2:00 AM	89	98	99	
3:00 AM	98	89	90	
4:00 AM	110	118	112	
5:00 AM	110	119	118	
6:00 AM	128	130	118	
7:00 AM	89	110	69	
8:00 AM	96	102	96	
9:00 AM	112	113	102	
10:00 AM	180	192	204	
11:00 AM	192	200	211	
12:00 PM	195	215	210	
1:00 PM	211	179	224	
2:00 PM	243	192	224	
3:00 PM	217	204	243	
4:00 PM	220	194	232	
5:00 PM	217	185	211	
6:00 PM	215	182	210	
7:00 PM	210	178	190	
8:00 PM	204	172	185	
9:00 PM	153	172	185	
10:00 PM	121	128	134	
11:00 PM	115	108	89	
12:00 AM	96	108	115	
1:00 AM	98	99	89	

Graph # D

Hourly load Current Variation Pattern

Date: 24.11.2014

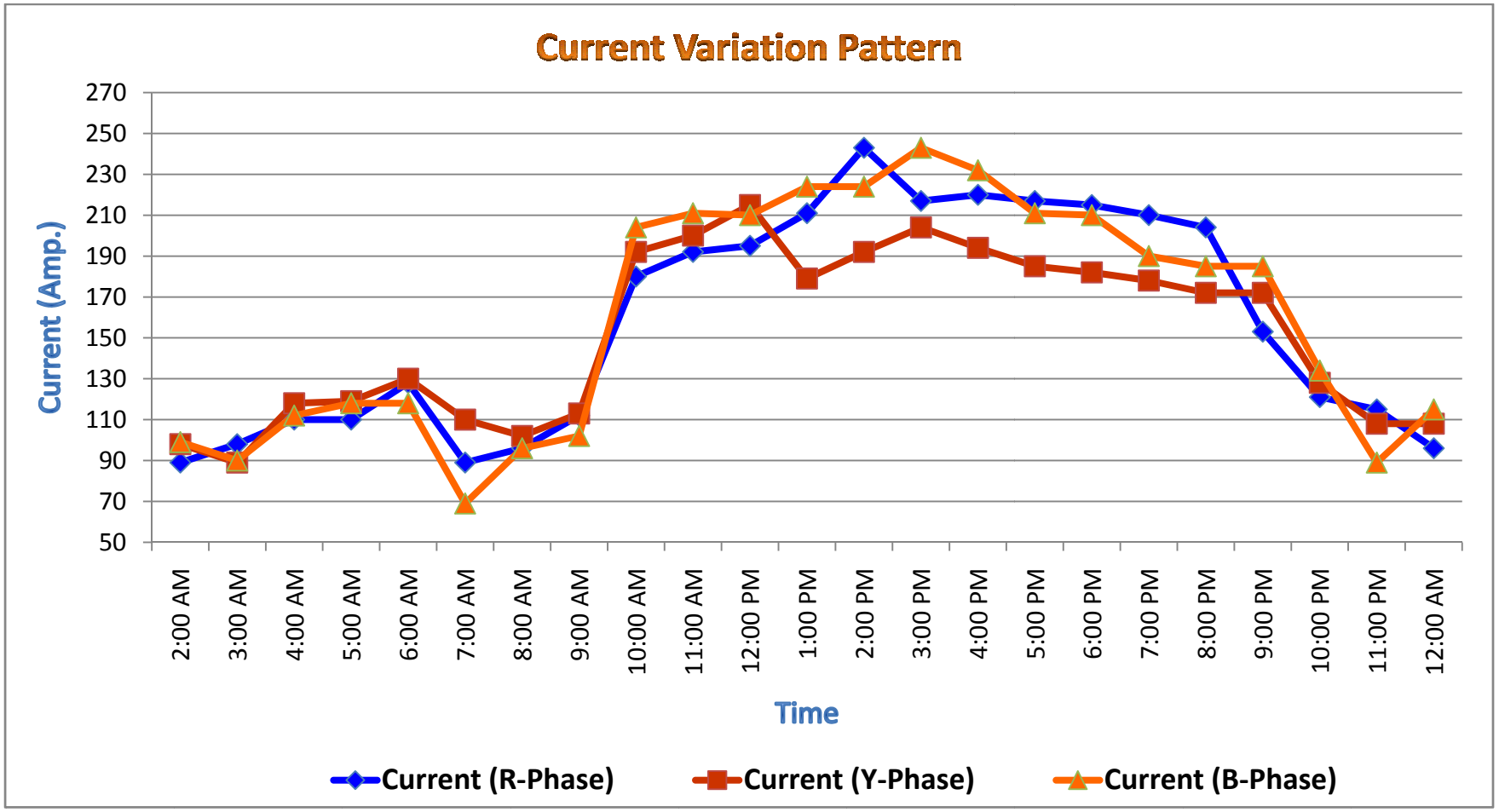


Table # 10

Power Consumption (KW) # Logging Data

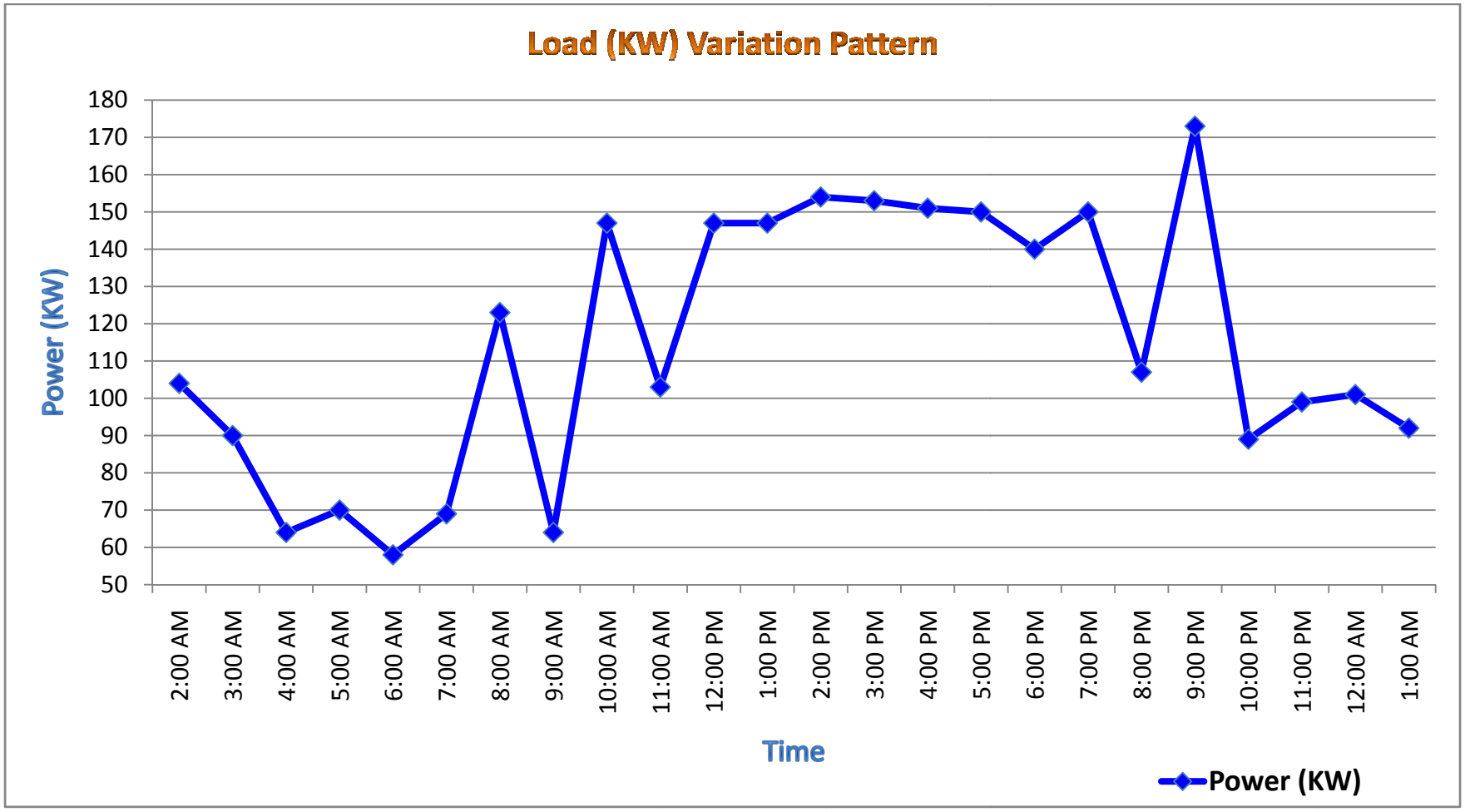
Date: 24.11.2014

Time	Power (KW)	Remarks
2:00 AM	104	
3:00 AM	90	
4:00 AM	64	
5:00 AM	70	
6:00 AM	58	
7:00 AM	69	
8:00 AM	123	
9:00 AM	64	
10:00 AM	147	
11:00 AM	103	
12:00 PM	147	
1:00 PM	147	
2:00 PM	154	
3:00 PM	153	
4:00 PM	151	
5:00 PM	150	
6:00 PM	140	
7:00 PM	150	
8:00 PM	107	
9:00 PM	173	
10:00 PM	89	
11:00 PM	99	
12:00 AM	101	
1:00 AM	92	

Graph # E

Hourly Power (KW) Variation Pattern

Date: 24.11.2014



CHAPTER # F

CHILLERS

F.1 Brief Description

There are 2 Nos., Screw Chillers and these Chillers are as per the latest Technology.

Brief Specifications:-

Make	: Mc Quay
Type	: Screw Chiller (Water Cooled)
Rated Capacity	**: 414 TR**
Nominal Cooling Capacity	: 1406 KW ≈ **400TR**
Refrigerant Type	: R134a

F.2 Annual Operating Hours

Since, occupancy of the Building is still on very much lower side, all efforts are being made to operate these Chillers for minimum durations.

Generally, 1 No., Chiller is operated. Each Chiller has 3 Nos., Compressors. Nos. of Compressors is being controlled automatically as per the cooling requirement.

Monthly operating hours, since the beginning has been tabulated in **TABLE # 11.**

Based upon single Compressors, annual operating hours since the Commissioning date:-

Chiller # 1 : **84 Hours**

Chiller # 2 : **87 Hours**

- **Conclusion**

Operating hours of the Chillers is **minimum possible**.

Table # 11

Chillers Compressors Total Operating Hours

(As on 19.11.2014)

Particulars	Compressor # 1	Compressor # 2	Compressor # 3
Chiller # 1	27 Hrs.	29 Hrs.	28 Hrs.
Chiller # 2	20 Hrs.	34 Hrs.	33 Hrs.
Remarks			

F.3 CHILLER Performance

Chillers are being operated for less than one hour daily. In favorable season, Chiller remains totally OFF.

Following parameters measured for all the Chillers; on different days:-

a) **Power Parameters**

i) Voltage

ii) Load Current

iii) Power Consumption – KW

iv) P.F.

b) **Chilled Water Temperature**

i) Inlet Temperature – ^{o}C

ii) Outlet Temperature – ^{o}C

iii) At – ^{o}C

c) **Condenser Water Temperature**

i) Inlet Temperature – ^{o}C

ii) Outlet Temperature – ^{o}C

iii) Δt – ° C

d) **Head Loss – Evaporator**

i) Evaporator – Inlet Pressure (P_1)

ii) Evaporator – Outlet Pressure (P_2)

iii) Head loss = 10 x (P_1 – P_2) – M

e) **Head Loss – Condenser**

i) Condenser – Inlet Pressure (P_3)

ii) Condenser – Outlet Pressure (P_4)

iii) Head loss = 10 x (P_3 – P_4) – M

Output of Chiller = $\frac{Q \; x \; 1000 \; x \; \Delta t}{3024}$ TR

Where,

Q = Chilled Water Flow through the Chiller in M^3/ H

Summary of all the performance Data has been tabulated in **Table # 12.**

Table # 12

Chillers Performance Data

Date: 19.11.2014

Sl. No.	Particulars	Chiller # 2
1.	Location	Plant Room
2.	Capacity (TR)	400 TR
3.	Make	Mc Quay
4.	Voltage, V	412
5.	Load Current, A	236
6.	Power Consumption, KW	**138**
7.	P.F.	0.82
8.	Suction Pressure – KPa	279
9.	Discharge Pressure –KPa	696
10.	Chilled Water Inlet Temp., ^{o}C	18.4
11.	Chilled Water Outlet Temp., ^{o}C	15.1
12.	Chilled Water # Δt ^{o}C	**3.3**
13.	Cooling Water Inlet Temp., ^{o}C	26.2
14	Cooling Water Outlet Temp., ^{o}C	30.7
15	Cooling Water# Δ t ^{o}C	**4.5**
16	Chilled Water Inlet Pressure, Kg/cm^2	4.8
17	Chilled Water Outlet Pressure, Kg/cm^2	4.2
18	Evaporator Head Loss - M	6M
19	Cooling Water Inlet Pressure, Kg/cm^2	5.2
20	Cooling Water Outlet Pressure,	4.3
21	Condenser Head Loss - M	9M
22.	Remarks	Only 1 out of 3 Nos. Compressors is operating

F.4 Output – TR

Chilled Water Temperature

Inlet Temperature = 18.4 ^{o}C

Outlet Temperature = 15.1 ^{o}C

Δt = 18.4 – 15.1 = **3.3 ^{o}C**

Q = Chilled Water Flow of the rated Capacity of Primary Chilled Water Pump

= 226 M^3 /Hr

Output of the Chiller $= \frac{Q \times 1000 \times \Delta t}{3024}$ TR

$= \frac{226 \times 1000 \times 3.3}{3024}$ TR

= 246.6 TR ≈ **247 TR**

Input Power = 138 KW

Sp. Power Consumptions $= \frac{\text{Input Power}}{\text{Output TR}}$

$= \frac{138 \text{ KW}}{247 \text{ TR}}$

= 0.56 KW /TR (**Very Good**)

COP $= \frac{\text{Output of Chiller in KW}}{\text{Input Power in KW}}$

$= \frac{867.1 \text{ KW}}{138 \text{ KW}}$

= 6.28 (**Very Good**)

Conclusion

Performance of Chiller – **Very Good**

CHAPTER # G

PUMPS for CHILLERS

G.A.1 Brief Descriptions

There are 4 Nos., Primary Chilled Water Pumps for 2 Nos., Chillers. 1 No., Primary Chilled Water Pump is being operated for one Chiller.

G.A.2 Specification

Make : Kirloskar Brothers

Model : DB – 125 /26

Rated Flow : **226 M^3 /Hr**

Rated Head : 13 M

Motor : 15 KW, 1450 rpm

G.A.3 Measurement Data

Power parameters measured and summary of all the measurement data is tabulated in **TABLE # 13.**

Power Consumptions

Pump # 2 : 14.3 KW

Pump # 3 : 14.3 KW

Throttling : Nil

G.A.4 Performance Curve

Performance curve of the Primary Chilled Water Pump is enclosed vide

CURVE # A.

From Performance Curve,

Pumping Efficiency = 78 %

Performance : **Very Good**

Table # 13

Primary Chilled Water Pumps

Date: 19.11.2014

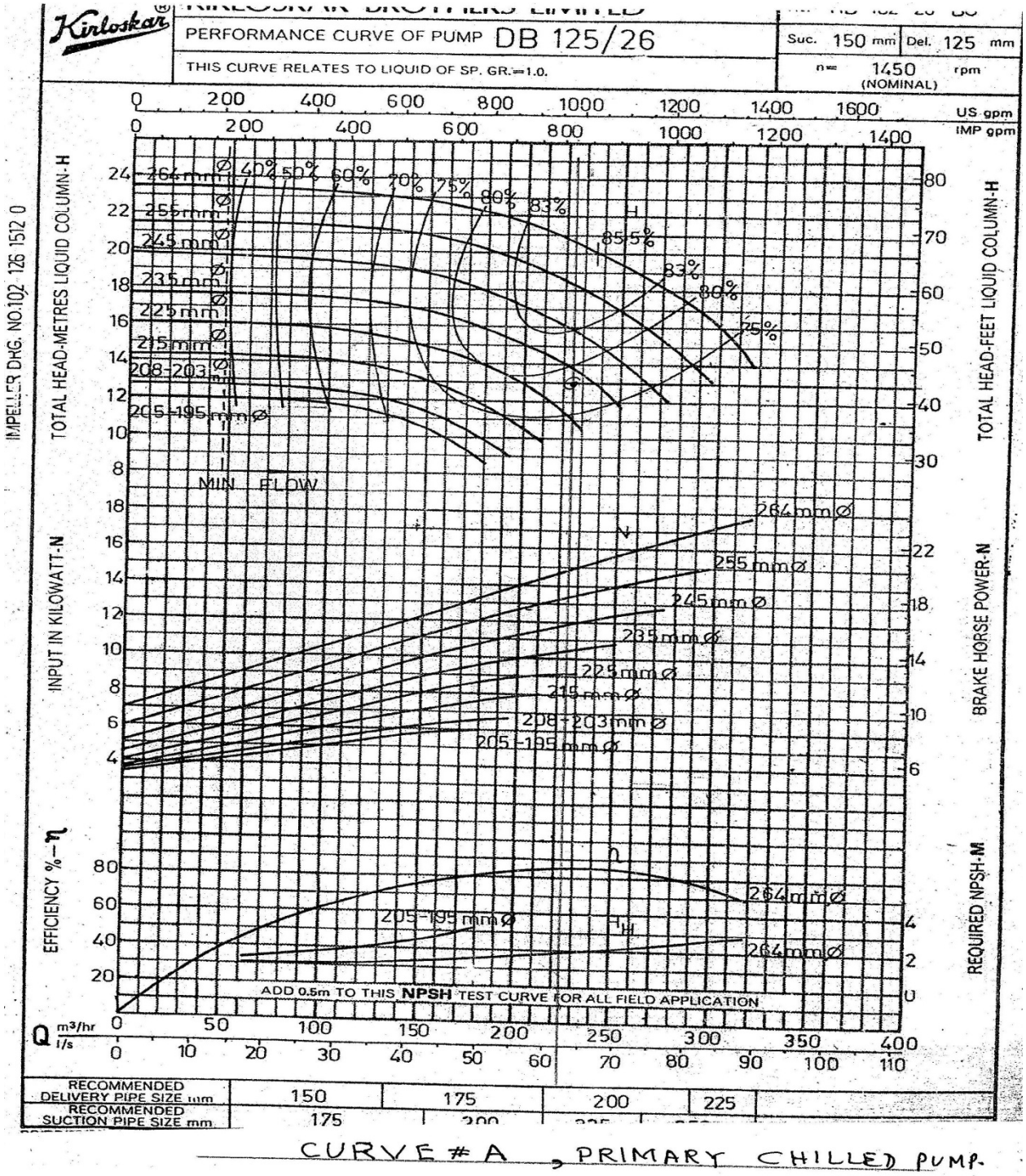
Sl. No.	Parameters	Pump # 2	Pump # 3
1.	Make	Kirloskar Brothers Ltd.	Kirloskar Brothers Ltd.
2.	Model	**DB – 125 /26**	**DB – 125 /26**
3.	Rated Flow, M^3/ Hr	226	226
4.	Rated Head, M	**13**	**13**
5.	Motor - KW	15 (1450 rpm)	15
6.	Voltage	416	417
7.	Load current, A	23.3	22.9
8.	Power, KW	**14.3**	**14.3**
9.	P.F.	0.85	0.86
10.	Throttling	Nil	Nil
11.	Remarks	**O.K.**	**O.K.**

Note:-

- Total 3 Nos., Primary Chilled Water Pumps.
- Pump # 4 is out for maintenance.
- Primary Chilled Water Pump # 2 was operated along with Secondary Chilled Water Pump # 2 & Condenser Water Pump # 2

CURVE # A

Performance Curve – Primary Chilled Water Pump



CURVE # A → PRIMARY CHILLED PUMP.

G.B Secondary Chilled Water Pumps

There are 4 Nos., Secondary Chilled Water Pumps.

Technical specifications have been tabulated in **TABLE # 14.**

Rated Flow = 226 M^3 /Hr

VFD has been provided to control Chilled Water Flow as per cooling requirement.

Pump Speed can be controlled by VFD.

Power $\propto$ (Speed)^3

19.11.2014

Summary of all the measurement data has been tabulated in **TABLE # 14.**

Operating Hours of Secondary Chilled Water Pumps – is also very less.

Power Consumptions = 23.0 KW

- **Steps Already Undertaken for Energy Saving**

VFD has already been provided, as per the latest Technology for Energy Saving.

Table # 14

Secondary Chilled Water Pumps

Date: 19.11.2014

Sl. No.	Parameters	Pump # 2
1.	Make	Bell & Gossett
2.	Model	1510 – 5G
3.	Rated Flow, M^3/ Hr	226 (1450 rpm)
4.	Rated Head, M	26
5.	Motor - KW	22
6.	Voltage	419
7.	Load current, A	37.7
8.	Power, KW	**23.0**
9.	P.F.	0.88
10.	Throttling	Nil
11.	Remarks	VFD already provided

Note:-

- Total 4 Nos., **Secondary Chilled Water Pumps.**

G.C Condenser Water Pumps

There are 4 Nos., Condenser Water Pumps. One Pump is operated for one Chiller.

Power Measurement Data

Summary of all the measurement data is tabulated in **TABLE # 15.**

Power Consumptions

Pump # 2 : 41.5 KW

Pump # 3 : 40.6 KW

- **Conclusion**

Pump – performance O.K.

No corrective step is necessary.

Table # 15

Condenser Chilled Water Pumps

Date: 19.11.2014

Sl. No.	Parameters	Pump # 2	Pump # 3
1.	Make	Kirloskar Brothers Ltd.	Kirloskar Brothers Ltd.
2.	Model	DB – 150 /32	DB – 125 /26
3.	Rated Flow, M^3/ Hr	359 (1450 rpm)	226 (1450 rpm)
4.	Rated Head, M	26	13
5.	Motor - KW	37	15
6.	Voltage	410	418
7.	Load current, A	64.5	62.0
8.	Power, KW	**41.5**	**40.6**
9.	P.F.	0.90	0.91
10.	Throttling	Nil	Nil
11.	Remarks	**O.K.**	**O.K.**

Note:-

- Total 4 Nos., Condenser Water Pumps.

CHAPTER # H

COOLING TOWERS

H.1 Cooling Tower

Cooling Tower is operated as per the operation of the Chiller. Operating hours of the Chillers is already tabulated in **TABLE # 11.**

During the Audit period, both Chiller and Cooling Tower was mostly OFF.

Inspections : **Very Good Conditions**

H.2 C.T. Fans

CT Fans were operated and Power parameters measured.

Summary of all the measurement data is tabulated in **TABLE # 16.**

- **Data Analysis**

Power Consumptions is O. K.

\

Table # 16

Cooling Tower Fans

Power Measurement Data

Date: 19.11.2014

Sl. No.	Particulars	Voltage	Load Current	Power KW	P.F.	Remarks
1.	CT Fan # 3	408	3.9	1.3	0.45	
2.	CT Fan # 4	408	4.3	1.7	0.54	
3.	CT Fan # 5	409	4.7	2.0	0.60	

CHAPTER # I

LIGHTING

I.1 MAIN OBSERVATIONS

Lighting has been studied with elaborate details for common – areas. Lighting under the common areas is under the control of the Building – Management.

Main Observations

Mostly efficient Lighting has been provided. Our aim is to work out further potential for Energy Saving in Lighting.

I.2 Lighting in the Basement

All the Light Fittings have been checked and following details prepared:-

i) Location wise
ii) Type of Light Fittings
iii) Nos. of total lighting installed
iv) Nos. of Lighting – 'ON'
v) Illumination level measurement data

Summary of all the measurement data has been tabulated as following:-

SL. No.	Are	Table #
1.	Lower Basement	**# 17** **# 17A**
2.	Upper Basement	**# 18** **# 18A**

I.3 DATA Analysis

Summary of Lighting

Particulars	Type # 1		Type # 2	Type # 3		Type # 4
Lighting Type	FTL – 36W		FTL – 28W (T5)	CFL (18 W)		HPSV (150 Watt)
Choke Type	Electronic		-	-		-
Total Count	654		108	520		12
Total Glowing	5	272	0	30	85	0
Glowing Hours per day	8	24	0	8	24	0

1) Several places, CFL lamps have been provided.
2) Most of the places, lights are being kept – OFF, as occupancy level is very low.
3) **36W Tube Lights**
   Several places lighting is by 36W, Tube Lights with Electronic Chokes.

I.4 Proposal for Energy Saving

To begin with all 36 Watt, Tube Lights, which are kept glowing on 24 hours basis, should be replaced by 18 Watt, LED lamp. This replacement would be one to one basis for Tubes only.

I.4.1 Expected Saving

Reference **TABLE # 17 & # 18,** total nos. of 36 Watts, glowing on 24 hours, works out as following:-

Sl. No.	Area	Nos. of Tubes glowing on 24 Hours	Remarks
1.	Lower Basement	149 Nos.	
2.	Upper Basement	123 Nos.	
3.	**Total**	**272 Nos.**	

Existing Power Consumptions

36 Watt Tube light with Electronic Chokes consumes = 38 Watt

Estimated Power Consumptions

$$= \frac{272 \text{ x } 38 \text{ Watt}}{1000}$$

= 10.34 KW

Expected Power Consumption in the proposed LED Tube lamps

$$= \frac{272 \text{ x } 18 \text{ Watt}}{1000}$$ **= 4.9 KW**

Expected Power Saving = 10.34 – 4.9 KW

= 5.44 KW

Expected Annual Saving = 5.44 KW x 24 Hrs. x 360 Units

= 47,000 Units

@ Rs. 7.08 per Unit, **= Rs. 3.33 Lac**

Estimated Cost

Estimated Cost @ Rs. 1050/- per LED tube = 272 x Rs. 1050/-

= Rs. 2.86 Lac

Simple Payback Period **= 10.3 months**

Table # 17

Lighting Details – Lower Basement

(Running Hours = 24 Hours)

Sl. No.	Locations	Lighting (Type)	Wattage	Total Count	Total Lights 'ON'	Lux Level	Remarks
1.	STP Room	FTL	(36W x 1) x 1 No. (36W x 2) x 6 Nos.	13	11	31, 32	2 FTL (36W) are switched OFF for saving
2.	Basement Parking	FTL	(36W x 1) x 147 Nos.	147	56	42 to 63	
3.	LT Room	FTL	(36W x 1) x 8 Nos. (36W x 2) x 1 No.	10	10	71	
4.	DG Room	FTL	(36W x 2) x 16 Nos.	32	26	64, 65	HPMV remains OFF
		HPMV	(150 x 1) x 6 Nos.	6	0		
5.	HVAC Room	FTL	(36W x 1) x 7 Nos. (36W x 2) x 12 Nos.	31	17	44	
6.	Lift Lobby Room	FTL	(36W x 2) x 30 Nos.	60	28	54,87	
7.	House Keeping Store	FTL	(36W x 1) x 1 No.	1	1	-	

***Note**: Lighting Fitting = (Light Wattage x No. of Lights per fixture) x Nos. of Fixtures*

Table # 17 A

Lighting Details – Lower Basement

(Running Hours = 24 Hours)

Sl. No.	Locations	Lighting (Type)	Wattage	Total Count	Total Lights 'ON'	Lux Level	Remarks
8.	FFU – 01	FTL	(36W x 2) x 3 Nos.	6	-	-	Lights are put ON as per requirement. Usually, they remain OFF.
9.	EFU – 01	FTL	(36W x 2) x 4 Nos.	8	-	-	
10.	FFU – 02	FTL	(36W x 2) x 5 Nos.	10	-	-	
11.	FES – 03	FTL	(36W x 2) x 4 Nos.	5	-	-	
12.	FFU – 03	FTL	(36W x 2) x 2 Nos.	4	-	-	
13.	EFS – 04	FTL	(36W x 2) x 4 Nos.	8	-	-	
14.	FFU – 04	FTL	(36W x 2) x 2 Nos.	4	-	-	
15.	EFS	FTL	(36W x 2) x 4 Nos.	8	-	-	

Table # 18

Lighting Details – Upper Basement

(Running Hours = 24 Hours)

Sl. No.	Locations	Lighting (Type)	Wattage	Total Count	Total Lights 'ON'	Lux Level	Remarks
1.	Estate Office	CFL	(18W x 2) x 15 Nos.	30	30	72, 75	Operating for 8 Hrs. only
2.	Estate Office Gallery	FTL	(36W x 2) x 3 Nos.	6	5	125	
3.	Parking Area	FTL	(36W x 1) x 136 Nos.	136	46	35, 48	
4.	Ramp	FTL	(36W x 1) x 16 Nos.	16	16	-	
5.	House Keeping Store	FTL	(36W x 1) x 1 No.	1	1	74, 76	
6.	Common Area Electric Panel	FTL	(36W x 2) x 3 Nos.	6	4	110, 128	
7.	VCB Room	FTL	(36W x 1) x 3 Nos.	3	3	108	
8.	Transformer Area # 1	FTL	(36W x 1) x 3 Nos.	3	1	114	
9.	Transformer Area # 2	FTL	(36W x 1) x 2 Nos.	2	2	118	
10.	Isolator Panel Room	FTL	(36W x 2) x 3 Nos.	6	4	85, 155	

Table # 18A

Lighting Details – Upper Basement

(Running Hours = 24 Hours)

Sl. No.	Locations	Lighting (Type)	Wattage	Total Count	Total Lights 'ON'	Lux Level	Remarks
11.	Pump Room	FTL	(36W x 2) x 5 Nos.	10	6	55, 112	HPMV remains OFF
		HPSV	(150W x 1) x 6 Nos.	6	0		
12.	Driver Toilet	FTL	(36W x 2) x 4 Nos.	8	6	88, 96	
13.	Stair Case	FTL	(36W x 2) x 8 Nos.	16	6	68, 86	
14.	EFS – 7	FTL	(36W x 2) x 3 Nos.	6	0	0	Lights are generally OFF. Put ON during visits only.
15.	EFS – 8	FTL	(36W x 2) x 3 Nos.	6	0	0	
16.	EFS – 9	FTL	(36W x 2) x 2 No.	4	0	0	
17.	DG Air Washer Panel Room	FTL	(36W x 2) x 3 Nos.	6	4	53, 57	
18.	House Keeping Fan Room	FTL	(36W x 2) x 3 Nos.	6	2	36, 77	
19.	Estate Office Fan Room	FTL	(36W x 2) x 2 Nos.	4	2	48, 65	

Table # 18B

Lighting Details – Upper Basement

(Running Hours = 24 Hours)

Sl. No.	Locations	Lighting (Type)	Wattage	Total Count	Total Lights 'ON'	Lux Level	Remarks
20.	M.R. Lift Stair Case	FTL	(36W x 2) x 10 Nos.	20	6	96	
21.	ST – 1 Stair Case	CFL	(18W x 2) x 46	92	0	-	
22.	ST – 2 Lift Lobby	FTL	(36W x 2) x 21 Nos.	42	9	53, 82	
23.	Ground Floor – Guest Lift Lobby	T-5	(28W x 1) x 24 Nos.	24	0	73	Day Light is present in the Guest Lift Lobby.
		CFL	(18W x 2) x 12 Nos.	24	0		
24.	1st Floor – Guest Lift Lobby	T-5	(28W x 1) x 12 Nos.	12	0		
		CFL	(18W x 2) x 6 Nos.	12	0		
25.	2nd Floor – Corridor	CFL	(18W x 2) x 24 Nos.	12	0		
	2nd Floor – Guest Lift lobby	T-5	(28W x 1) x 12 Nos.	12	0		
		CFL	(18W x 2) x 6 Nos.	48	6		
	2nd Floor – Service Lift Lobby	T-5	(28W x 1) x 12 Nos.	12	0		
		CFL	(18W x 2) x 2 Nos.	4	2		

Table # 18C

Lighting Details – Upper Basement

(Running Hours = 24 Hours)

Sl. No.	Locations	Lighting (Type)	Wattage	Total Count	Total Lights 'ON'	Lux Level	Remarks
26.	3rd Floor – Corridor	CFL	(18W x 2) x 23 Nos.	46	12	45, 60, 70	Day Light is present in the Guest Lift Lobby.
	3rd Floor – Guest Lift Lobby	T-5	(28W x 1) x 12 Nos.	12	0		
		CFL	(18W x 2) x 6 Nos.	12	6		
	3rd Floor – Service Lift Lobby	T-5	(28W x 1) x 12 Nos.	12	0		
		CFL	(18W x 2) x 2 Nos.	4	2		
27.	4th Floor – Corridor	CFL	(18W x 2) x 23 Nos.	46	2	-	
	4th Floor – Guest Lift Lobby	T-5	(28W x 1) x 12 Nos.	12	0		
		CFL	(18W x 2) x 6 Nos.	12	6		
	4th Floor – Service Lift Lobby	T- 5	(28W x 1) x 12 Nos.	12	0		
		CFL	(18W x 2) x 2 Nos.	4	2		
28.	5th Floor – Corridor	CFL	(18W x 2) x 26 Nos.	52	2		
	5th Floor – Corridor	T - 5	(28W x 1) x 12 Nos.	12	0		
		CFL	(18W x 2) x 6 Nos.	12	6		
	5th Floor – Service Lift Lobby	T -5	(28W x 1) x 12 Nos.	12	0		
		CFL	(18W x 2) x 2 Nos.	4	2		

Table # 18 D

Lighting Details – Upper Basement

(Running Hours = 24 Hours)

Sl. No.	Locations	Lighting (Type)	Wattage	Total Count	Total Lights 'ON'	Lux Level	Remarks
29.	6th Floor – Corridor	CFL	(18W x 2) x 26 Nos.	52	26	72	Day Light is present in the Guest Lift Lobby.
	6th Floor – Guest Lift Lobby	T - 5	(28W x 1) x 12 Nos.	12	0		
		CFL	(18W x 2) x 6 Nos.	12	6		
	6th Floor – Service Lift Lobby	T - 5	(28W x 1) x 12 Nos.	12	0		
		CFL	(18W x 2) x 2 Nos.	4	3		
30.	7th Floor – Corridor	CFL	(18W x 2) x 24 Nos.	48	1	-	
	7th Floor – Guest Lift Lobby	T - 5	(28W x 1) x 12 Nos.	12	0		
		CFL	(18W x 2) x 6 Nos.	12	1		
	7th Floor – Service Lift Lobby	T - 5	(28W x 1) x 12 Nos.	12	0		
		CFL	(18W x 2) x 2 Nos.	4	0		

I.5 Outside Lighting

Summary of Outside Lighting

Particulars	Type # 1	Type # 2	Type # 3
Lighting Type	MH Lamp	Solar Light	LED Lamps
Wattage	150	12	3
Total Count	34	10	183
Total Glowing during **Night Only**	24	10	183
Glowing Hours per day	12	12	12

a) LED Lamps

Lighting for corridors is by 3 Watt, LED lamps.

Total nos. of LED lamps = 183 Nos.

These are Very Efficient Lighting.

b) Solar Lighting

10 Nos., Solar Light fittings, with 12 Watt, LED lamps have been provided for outside lighting.

This deserves all the **APPRECIATION.**

c) Metal Halide Lamps

There are 34 Nos., each 150 Watt Metal Halide Lamps.

Normally, 10 Nos., Solar Lights with 12 Watt LED is being used, during night hours

As such, only 24 Nos., Metal Halide Lamps are being used, during the night hours.

- **Proposal**

  These MH lamps are quite new and fairly efficient. As such, we are not making proposal for the replacement, at this stage.

  However, in future these 24 Nos., 150 Watt MH Lamps should be replaced by 60 Watt, LED lamp fittings.

CHAPTER # J

LIFTS

J.1 Brief Description

There are 2 categories of Lifts

i)	Passenger Lifts	: 3 Nos.
ii)	Service Lifts	: 2 Nos.
	Total	**: 5 Nos.**

J.2 Main Observations

Main observations are as following:-

1. **Occupancy Level** : Since, presently occupancy level is very less in this building, actual operation is also being controlled, **very effectively**, on account of in- built Technology.
2. **Latest Technology**: - All these lifts are as per the latest Technology.
3. **VFD for Power saving**: each Lift has been provided with VFD to take care of the Power Consumptions as per the actual.

J.3 Power Measurement Data

We selected 2 Nos., Lifts for detailed studies:-

i) Passenger Lift # 1
ii) Passenger Lift # 2

We measured power condition in three situations:-

a) Lift moving upward
b) Lift moving downward
c) Lift at No-Load

Summary of all the measurement data is tabulated as follows:-

Sl. No.	Type of Lifts	Table #
1.	Passenger Lifts	# 19
2.	Service Lift	# 20

J.3.1 DATA Analysis for Passenger Lift

I) Power Consumption is at the low level

II) No-Load Power Consumption ≤ 0.5 KW

Conclusions

The lifts are operating Very efficiently.

J.3.2 Data – Analysis – Service Lift

I) Power Consumption is at the low level

II) No-Load Power Consumption ≤ 0.5 KW

Conclusions

The lifts are operating Very efficiently.

Table # 19

Passenger Lifts # Power Measurement Data

(Make: KONE)

Date: 19.11.2014

Sl. No.	Particulars	Rated KW	Voltage	Load Current	Power – KW	P.F.	Remarks
1.	Passenger Lift # 1	20	404	19.5	10.3	0.75	On Load Moving Upward
2.	Passenger Lift # 1	20	405	44.8	26.6	0.88	On Load Moving Downward
3.	Passenger Lift # 1	20	410	1.5	0.5	0.43	No Load
4.	Passenger Lift # 2	20	407	15.7	8.3	0.75	On Load Moving Upward
5.	Passenger Lift # 2	20	404	45.9	26.3	0.82	On Load Moving Downward
6.	Passenger Lift # 2	20	409	1.0	0.2	0.25	No Load

Table # 20

Service Lifts # Power Measurement Data

(Make: KONE)

Date: 19.11.2014

Sl. No.	Particulars	Rated KW	Voltage	Load Current	Power – KW	P.F.	Remarks
1.	Service Lift # 1	11	407	14.9	8.1	0.77	On Load Moving Upward
2.	Service Lift # 1	11	404	31.7	17.5	0.79	On Load Moving Downward
3.	Service Lift # 1	11	404	1.3	0.5	0.64	No Load

CHAPTER # K

BUILDING MATERIALS WITH U & R FACTOR

Building Materials studied for 'U' and 'R' Factors.

Summary of DATA

Sl. No.	Building Material with U & R Values	'R' Values (in Sq. M. Deg C /Watt)	'U' Values (Watts per in Sq. M. Deg C)	Solar Heat Gain Factor
1.	**WALL** Brick Wall (230 mm thick), both side thick sand cement plaster (12 – 18 mm) with insulation	3.52	0.28	0.30
2.	**ROOF** 200 mm RCC slab with mud phuska & clay tiles with 75 mm insulation.	1.22	0.81	0.45

CHAPTER # L

D.G. SETS

L.1 Brief Description

There are 3 Nos. D.G. Sets

Brief specification is as follows:-

Particulars	DG # 1	DG # 2	DG # 3
Make	Cummins	Cummins	Cummins
AC Generator Make	Stamford	Stamford	Stamford
Rated Capacity, KVA	750	1010	320
Voltage	415	415	415
Current, Amp.	1043	1405	445
Speed, RPM	1500	1500	1500
P.F.	0.80	0.80	0.80
Frequency, Hz	50	50	50
Remarks			

L.2 Main Purpose

During power failure from the grid, D.G. Sets will generate for the following purposes:-

a) Emergency services like lifts
b) Emergency lighting
c) Power supply as per requirement

L.3 Power Measurement Data

On 11.11.2014, there was total Power Failure from Grid.

D.G. Set # 3 (Rated Capacity = 320 KVA) was being operated.

Terminal Voltage, Load Current, Power Consumption – KW and P.F. was measured.

Summary of all the measurement data is tabulated in **TABLE # 21.**

L.3.1 Data Analysis

All the measurement data is being analysed.

a) Supply Voltage = 414 Volt (**Balanced Voltage)**

b) **Power Consumptions**

Average power Consumption = 181 KW

c) P.F> = 0.96

d) Frequency = 50.5 c/s

- **Conclusion**

1) D.G. Sets are being operated as and only when needed.
2) Operated parameters – well within the norms.

Table # 21

D.G. Set # Power Measurement Data

Date: 11.11.2014 (11:45 AM)

Sl. No.	Particulars	Rated KVA	Voltage	Load Current, Amp.	Power – KW	P.F.	Power - KVA	Freq. – Hz	Remarks
1.	D.G. Set # 3	320	414	283 255 234	200 182 160	0.96	211 194 169	50.5	

Note:-

- Due to Power Failure, whole Building load on D.G. Set # 3 only.

CHAPTER # M

SEWAGE TREATMENT PLANT

STP of Capacity 100 KL per day is installed & operating in perfect condition. Since the occupation of the building is less than 20%, STP is highly over capacity. We measured Power Consumption of STP Blowers.

Table # 22

Power Measurement Data

Sl. No.	Particulars	Rated KW	Voltage	Load Current	Power (KW)	P.F.	Remarks
1.	STP Blower	3.7	410	5.1	3.1	0.85	
2.	Filter Feed Pump	2.2	411	2.7	1.6	0.81	
3.	Treated Water Pump	3.7	412	5.0	2.9	0.82	