International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 3 Issue 9, September- 2014

Comprehensive Energy Audit for Bank
(Technical and Cost Analysis)

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***Abstract*— An energy audit is a key for developing an energy management program. Although energy audits have various degrees of complexity and can vary widely from one organization to another, every audit typically involves- data collection and review, plant surveys and system measurements, observation and review of operating practices, data analysis. In short, the audit is designed to determine where, when, why and how energy is being used. This information can then be used to identify opportunities to improve efficiency, decrease energy costs and reduce greenhouse gas emissions that contribute to climate change. Energy audits can also verify the effectiveness of Energy Management Opportunities (EMOs) after they have been implemented.**

***Keywords*— Introduction, Overview of Energy Auditing, Detailed Analysis, Technical Supplement.**

I. INTRODUCTION

An energy audit identifies where and how the energy is consumed in an existing facility, building or structure. Information gathered from the energy audit can be used to introduce Energy Conservation Measures (ECM) or appropriate energy-saving technologies, such as electronic control systems, in the form of retrofits. Energy audits identify economical justification, cost-saving opportunities that result in significantly lowered electrical, water and operating costs. An energy audit, therefore, is a detailed examination of a facility's energy uses and costs that generates recommendations to reduce those uses and costs by implementing equipment and operational changes. An important part of energy auditing is energy accounting/bill auditing. Energy accounting is a process of collecting, organizing and analyzing energy data.

For electricity accounts, usage data normally are tracked and should include metered kilowatt-hour consumption, metered peak demand, billed demand, and rate schedules. All of this information can be obtained by analyzing typical energy bills. Creating energy accounting records and performing bill audits can be done internally without hiring outside consulting firms. Also, while energy audits as a whole will identify excessive energy use and cost-effective conservation projects. Bill auditing will assist in identifying errors in utility company bills, beneficial rate and service options. It could provide an excellent opportunity to generate savings without any capital investment. In addition, accurate data from energy accounting/bill auditing is crucial to making informed energy purchasing decisions in a deregulated energy market.

II. TYPES OF ENERGY AUDIT

There are three types of audits that are described below.

A. Walk-through (Preliminary) Audit.

This is the least expensive. It involves an examination of the building or facility, which includes a visual inspection of each of the associated systems. Historic energy usage data are reviewed to analyze patterns of energy use and compare them with benchmarks for similar structures. The walk-through audit provides an initial estimate of potential savings and generates a menu of inexpensive savings options usually involving incremental improvements in Operation and Maintenance.

B. Detailed (Comprehensive) Audit

This involves a more comprehensive and highly detailed evaluation. Facilities, equipment, operational systems and conditions are assessed thoroughly and on-site measurements and testing are conducted to arrive at a careful quantification of energy use with associated losses. The energy efficiencies of the various systems are determined using accepted energy engineering computational techniques. Technical changes and improvements in each of the systems are analyzed to determine the corresponding potential energy and cost savings. In addition, the standard audit will include an economic analysis of the proposed technological improvements and ECM.

III. DETAILED ENERGY AUDIT

A. Time of the Day Tariff (Applicable for Maharashtra State Only).

I. Present Situation:

Electricity Consumption (from Feb -13 to Nov – 13)

a. From monthly Electricity Bill, it was found that Power Factor (p.f.) is maintained at (1.00) unity and hence, Bank is applicable for p.f. incentives (i.e., 7% of monthly Electricity Bill).

b. For water pumping, there were two 3HP pumps (1 working and 1 standby).

c. All electricity bills paid on or before date to avoid the penalty charges in current electricity bill.

d. In Bank, Office, Loan Processing Section and Streetlights, almost all types of luminaries are of Compact Fluorescent Lamp (CFL), Fluorescent tube light (FTL). During Audit it was observed that, installed capacity of some lights was oversized but the lumens output was not effective with respect to watts/ lumens consumption. Details are shown in tables below-

Table 1. Detailed Lighting Breakup: Bank

Area	Fitting Type	Fitting (Watts)	Qty.	Load (W)	Lux Levels
Corridor	CFL (36X2)	72	2	144	220
Bank Premises	CFL (36X2)	72	41	2952	220, 160, 130, 147, 142, 207, 256, 214, 108, 192, 193, 169, 152
	CFL (18X2)	36	6	216	240, 140
	CFL (18X1)	18	17	306	140, 256, 214, 220, 219, 200, 252, 168
Cabin -1	CFL (36X2)	72	2	144	347
	CFL (18X2)	36	2	72	
Cabin -2	CFL (36X2)	72	2	144	275
	CFL (18X2)	36	6	216	
Cabin -3	CFL (36X2)	72	2	144	249
Cabin - 4	Tube Light + Chock (36W) + (15W)	51	2	102	109
System Room	CFL (36X2)	72	2	144	124, 169
	CFL(18X2)	36	2	72	135
	CFL(18X1)	18	1	18	
Deputy Manager (Cash)	CFL (36X2)	72	4	288	223, 224
Locker Room	CFL(36X2)	72	2	144	190
Record Room - 1	Tube Light + Chock (36W) + (6W)	42	5	210	260, 340, 270
Record Room - 2	Tube Light + Chock (36W) + (15W)	51	6	306	138, 35
Stationary Room	Tube Light + Chock (36W) + (15W)	51	4	204	156, 135
Staff Canteen	CFL (18X2)	18	6	108	246
Bathroom	Tube Light (36W + 6W)	42	4	168	245
	CFL (18W)	18	1	18	214
			Total KW	6.12	

[1]Table 2: Detailed Lighting Breakup: OFFICE

Area	Fitting Type	Fitting (Watts)	Qty.	Load (W)	Lux Levels
Corridor	Tube Light + Chock (36W) + (6W)	42	2	84	300
Office Premises	CFL (36W X2)	72	47	3384	240
	CFL (13 W)	13	45	585	133
System Room	Tube Light + Chock (36W) + (6W)	42	2	84	137
Record Room	Tube Light + Chock (36W) + (6W)	42	4	168	106
Canteen	Tube Light + Chock (36W) + (6W)	42	7	294	184
Distribution Panel	Tube Light + Chock (36W) + (6W)	42	1	42	109
			Total Load (KW)	4.641	

Table 3: Detailed Lighting Breakup: Street Lights

Area	Fitting Type	Fitting (Watts)	Qty.	Load	Lux Levels
Street Lights	Tube Light (28W)	28	7	196	115
	Tube Light + Chock (36W + 6W)	42	2	84	72
	CFL (30W)	30	22	660	107
			Total kW	0.94	

Table 4: Detailed Lighting Breakup: ATM

Area	Fitting Type	Fitting (Watts)	Qty.	Load	Lux Levels
ATM Luminaries	Tube Light + Choke (36W + 6W)	42	1	42	104
	CFL (30W)	30	1	30	372
	CFL (18W)	18	8	144	
	CFL (5W)	5	8	40	
			Total kW	0.256	

e. . It was also observed that, almost all Duct Air Conditioners (ACs) (5 in nos. and has a capacity of 5.5 TR - Ton of Refrigeration each) operated below 20 ^{0} C which is wrong practice, this may happen due to inadequate cooling effect with respect to the area. Only 4 ACs were in operation. One of AC was not in Operation / under maintenance. It is therefore needs proper maintenance on regular basis to get the designed cooling effect.

Table 5. Detailed breakup of AC consumption

Area	AC Type	Qty.	Rated TR/Unit	Total TR	Rated EER
Bank	Split AC	5	1.5	7.5	2.35
	Cassette AC	5	5.5	27.5	2.35
OFFICE	Split AC	19	1.5	28.5	2.69
ATM	Split AC	2	1.5	3	2.35
Loan Processing Section	Split AC	3	1.5	4.5	3.00
Total		34		71	

f. In almost all cabins ACs are ON and doors were found open continuously and the set temperature was found 22^{0}C - 23 ^{0}C.

g. It was analyzed that in energy consumption in C-Zone & D-Zone is more than that of A-Zone & B-Zone (as shown in Table 1). Bank has to pay more charges from Evening 06:00 p.m. to 10:00 p.m. of 80 paisa/unit (applicable for the units consumed in this zone only).

II.PROPOSED SITUATION:

a. Automatic Power Saver reduces the voltage of about 5% that does not cause a proportional reduction in light output. The light output reduced is marginally by 2%, but there is a substantial reduction of about 10-25% in power consumption. Similarly, a higher voltage does not give proportionally higher light output, but the power consumed is substantially high.

b. Level controller should operate when the level goes down below the prescribed limit; due to that sometimes it avoided operating in peak hrs. (i.e., C-Zone and D-Zone). Bank can make the schedule in such a way that, water tank should be fulfilled during off peak hrs. (i.e., Table 2: Water Pump from 10 p.m. to 9 a.m. or from 12 noon to 06 p.m.) On regular basis. Detailed analysis along with saving as shown in table below-

Table 6: Analysis of Water pumps

Area	Water Pump
Nos.	2
Details / Pump	3 HP (2.238 kW)
Operating Hrs./ Day	2
Units Consumed / Month	112
Monthly Savings Rs.	212.61
Annualized Savings in Rs.	2551.32

c. It was found that Bank had paid the entire monthly electricity bill before date and eligible for the prompt payment incentives.

d. Old and inefficient lights can be replaced by energy efficient lights (LED lights) which can save power (Watts) and gives more light compared with existing luminaries. Occupancy sensor can also provide the best suited solution for the less occupied areas or for the cabins. Detailed analysis of savings by using energy efficient lighting as shown in table below-

Table 7: Energy saving by using Energy Efficient Lights

Sectors	Existing				Replace by			
	Type	Watt/ Light	Nos.	Total Watts	Type	Watts	Nos.	Total Watts
Bank	FTL (36W +15W)	51	16	816	LED	22	13	286
	FTL (36W + 6W)	42	9	378	LED	22	7	154
	CFL Fitting (36W X 2)	72	57	4104	LED	40	57	2280
	CFL	18	63	1134	LED	9	50	450
ATM	CFL	30	1	30	LED	15	1	15
	CFL	18	8	144	LED	9	4	36
	CFL	5	8	40	LED	3	0	0
	FTL	42	1	42	LED	22	1	22
Street Lights	FTL	42	2	84	LED	22	2	44
	CFL	30	22	660	LED	15	22	330
	CFL	28	7	196	LED	15	7	105
OFFICE	CFL	13	45	585	LED	8	45	360
	CFL (36X2)	72	47	3384	LED	25	47	1175
	FTL	42	16	672	LED	22	16	352
Loan Processing Build.	FTL (40W + 15W)	55	5	275	LED	22	4	88
	FTL (36W + 6W)	51	3	153	LED	22	2	44
	CFL	20	1	20	LED	22	1	22
Canteen -1	CFL	18	12	216	LED	9	12	108
Canteen – 2	FTL	42	7	294	LED	22	5	110
			330	13227			296	5981
	Hrs. of Operation is Considered as 8 Hrs. Per Day & 25 Days per month.							

Total kWh /month	2645.4	
Total kWh consumed / year	31744.8	
Total kWh / month	1196.2	
Total KWh consumed / year	14354.4	
Annualized Savings in KWh	17390.4	kW
Annualized Savings in Rs.	189729.3	Rs.
Investment for LED Lights	358860	Rs.
Simple Pay Back Period	1.9	Yrs.

e. The effective BEE star rating of HVAC system (Split units & Cassette ACs) based on EER of 2.35 Voltas, 2.69 Logicool. Following table shows types of ACs, designed TR & EER capacity:

Table 8: Analysis of AC consumption - Bank

Area	AC Type	Qty.	Rated TR/Unit	Total TR	Rated EER
Bank	Split AC	5	1.5	7.5	2.35
	Cassette AC	5	5.5	27.5	3.0
	Total	10		35	
Floor Area				4500	ft2
Installed TR/unit area				0.0078	TR/ft2
Total Recorded Power (22 TR Load)				27.26	kW/Hr
Avg. Measured kW/TR				1.24	kW/TR
Avg. Measured EER				2.83	EER

Table 9: Analysis of AC Consumption – Office

Area	AC Type	Qty.	Rated TR/Unit	Total TR	Rated EER
Bank	Split AC	5	1.5	7.5	2.35
	Cassette AC	5	5.5	27.5	3.0
	Total	10		35	
Floor Area				4500	ft2
Installed TR/unit area				0.0078	TR/ft2
Total Recorded Power (22 TR Load)				27.26	kW/Hr
Avg. Measured kW/TR				1.24	kW/TR
Avg. Measured EER				2.83	EER

Table 10: Saving Analysis

Area		Bank	OFFICE
Bank and Office	AC Type	Cassette	Split
	Qty.	4	11
	Rated TR/Unit	5.5	1.5
	Total TR	22	16.5
	Rated EER	3	2.69
	Measured EER	2.83	2.65
	Difference in EER	0.17	0.04
	Saving in kW	1.64	0.32996
	Annualized Saving in Rs.	53596	10800
	Total Annualized Saving	64396	Rs.

f. It was suggested that all the doors should remain closed when ACs are in operation and the temperature should be set to 24–25^0 C. As if by increasing 1^0 C temperatures thereby we can save Rs. 1 per hour.

g. It is proposed, that reduce / stop consumption in C-Zone & D-Zone (i.e., from 18:00 to 22:00 Hrs).

Table 11: Present situation of C & D zone consumption Analysis

Month	C Zone			D Zone		
	09-12 hrs.			18-22 hrs.		
	0.80 (Rs. /kWh)			1.10 (Rs. /kWh)		
	Demand	Units Consumed	Charges (Rs.)	Demand	Units Consumed	Charges (Rs.)
FEB 13	47	1622	1297.6	28	1628	1790.8
Mar 13	67	2372	1897.6	36	1885	2073.5
April 13	72	2950	2360	48	2620	2882
May 13	96	3791	3032.8	67	2293	25522
June 13	86	3084	2467.2	47	2066	2272.6
July 13	61	2583	2066.4	50	1794	1973.4
Aug 13	55	2288	1830.4	29	1513	1664.3
Sep 13	68	3106	2484.8	52	1874	2061.4
Oct 13	65	2890	2312	48	1850	2035
Nov13	60	2328	1862	38	1594	1753.4
Total		27014	21610		19117	44028
Total Units Consumed in Zone (B & C)		46131	Total Charges (Rs.) paid		65639	
Stopping of units/ month from C-Zone					476	
Stopping of units from D-Zone to A – Zone					3434	
Total Units Shifting / Month					3910	
Total Charges (Rs.) Saved by units shifting / month					42658	
Annualized Saving (Rs.)					511897	
Investment					Nil	

In the Bank, Office & Loan processing , major loads comprises of AC units (5.5 Ton each, 1.5 ton) can be operate only in 12 p.m. to 18 p.m. which saves lot of energy by shifting AC consumption from C- Zone (i.e., from 9 a.m. to 12 p.m.) to B-zone (i.e., 12 p.m. to 18 p.m.). As in the C-zone, SBI has to pay 80 paisa per unit more, whereas operation in the B-zone (i.e., from 12 p.m. to 18 p.m.) Rs. 0 (zero) per unit will be charged. Above table shows the annualized savings due to shifting of load (energy usage) from C-zone (from 9 a.m. to 12 p.m.) & D-zone (from 18 p.m. to 22 p.m.) to A-zone (from 22 p.m. to 6 a.m.) & B-zone (from 6 a.m. to 9 a.m. & 12 p.m. to 18 p.m.).

With the extend of this it was advised that all the PCs (monitor) in bank should turned OFF whenever not required, otherwise the monitor consumes about 10 to 12 Watts / Hr and hence large amount of Energy can be saved with this energy efficient practice.

IV. CONCLUSION

Any Comprehensive Energy Audit was in no case a fault finding exercise but to provide & updates on latest technological developments & energy efficient equipments for which energy efficiency benchmarking has already been established with success. The focus however, must be on NO/LOW investment ideas which should be encashed on top priority. Total annualized saving is Rs. 7,68,575/- with the investment of Rs. 3,58,860/- and payback period is up to six to seven months. Therefore it is conclude that about 45% proposals are without investment proposals and rests proposals having overall payback less than a year.

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