Energy Audit Report

Lokpriya Gopinath Bardoloi International (LGBI) Airport
Guwahati- 15, Assam

Conducted By:

Petroleum Conservation Research Association (PCRA), Eastern Region,
Indian Oil Bhavan, 6th. Floor,
2, Gariahat Road South, Dhakuria, Calcutta – 700 068.

CERTIFICATE

TO WHOM IT MAY CONCERN

This is to certify that as per assignment order no. CEIA/EC.10/Pt/818, dated 29.12.2008 of the Assam State Designated Agency(ASDA) an Energy Audit has been carried out at Lokpriya Gopinath Bardoloi International (LGBI) Airport, Guwahati-15, Assam by Petroleum Conservation Research Association, Eastern Region, Indian Oil Bhavan, 6th. Floor,2, Gariahat Road South, Dhakuria, Calcutta – 700 068.

(K.L. Bhutia)

Date: 23.03.2009

Dy. Director,
PCRA, Eastern Region

Acknowledgement:

Petroleum Conservation Research Association (PCRA), Eastern Region, appreciates the interest shown by the management & engineers of LGBI Airport, Guwahati, in carrying out the Energy Audit in the Airport.

Our special thanks are due to LGBI Airport engineers and technicians for their co-operation and the courtesy extended to the visiting energy audit team during the study.

(K. L. Bhutia)
Dy. Director, PCRA-ER

3. Contents:

4. Executive Summary:

PCRA conducted Energy Audit at LGBI Airport, Guwahati during the 2nd week of February 2009.The study could address the status of the Power systems, Energy uses, performance assessment of various facilities like A.C. system, lighting system, Pumps and motors, D.G.sets etc.

PCRA has come up with the existing shortcomings in regard to energy systems and their uses, It has find out techno-commercially implementable solutions so as to improve system efficiency and performance of different equipments and safety level as well.

Summary of recommendations for performance enhancement and energy cost reduction are:

Sl. No.	Process / Activity	Energy Saving /Yr. (KWH)	Energy cost Reduction/Money saving/Year (Rs.)	Cost of Investment (Rs.)	Payback Period
a)	**Decommissioning of 1000 KVA x 2 Transformer**	**143664**	**5,89,022**	**1,00,000**	**2 months**
b)	**Power Factor improvement**	-	**4,99,296**	**3,50,000**	**8.4 months**
c)	**Contractual Power Demand reduction**	-	**7,83,000**	**NIL**	**Immediate**
d)	**Replacement of Conventional Fluorescent Tube Lamps (FTL) by energy efficient FTL.**	**8176**	**33,522**	**26,000**	**9 months**
e)	**Replacement of existing 400 Watt Mercury Vapour Lamps by 250-Watt Metal Halide Lamps (MH).**	**41288**	**1,69,281**	**1,21,500**	**9 months**
f)	**Replacement of existing cast aluminium cooling tower fan blades by FRP fan blades.**	**22484**	**92,164**	**1,20,000**	**16 months**
		215612	**2193285**	**717500**	**4 months**

In addition to performance improvement, an investment of Rs. 7,17,500 can lead to an energy saving of 215612 KWH/Year and a tangible input energy cost reduction amounting to Rs. 21,93,285 per year. The simple pay back period of the capital investment will be 4 months.

5. The Energy Audit Team:

The Energy Audit team was comprised of following members.

1. Mr. K. L. Bhutia, Dy, Director, PCRA
2. Mr. T. K. Guha, BEE certified Energy Auditor,
3. Dr. S. S. Saha, BEE certified Energy Auditor,
4. Mr. A. Mondal,
5. Mr. S. Kar

6. Backdrop:

Lokpriya Gopinath Bordoloi International Airport , also known as Guwahati International Airport and formerly as Borjhar Airport, is the airport of Guwahati, Assam, India. The airport is managed by Airport Authority of India (AAI) and also serves as Indian Air Force base. It is named after Gopinath Bordoloi who was a freedom fighter and also the first CM of Assam after Indian independence.

PCRA has conducted Energy Audit at LGBI Airport, Guwahati vide assignment order no.CEIA/EC.10/Pt/818, dated 29.12.2008.

The objective of the study is to establish the existing status of energy resources and their uses, find shortcomings and recommend for cost effective solutions to improve the energy system performance and energy efficiency so as to conserve energy.

PCRA has conducted the study during 2nd week of February 2009.

This report is the outcome of the Energy Audit based on historic data collection, physical measurement of existing systems and operational and economic parameters etc. at various activity areas, analytical study, discussion with Maintenance Engineers and Engineer- in –Charge.

7. Introduction:

Availability and utilisation of energy determines the growth of economy and advancement of any country. And thus, the demand of energy is increasing day by day. The world wide mounting energy crisis with galloping cost hike, concern for environmental protection and open market competitive economy possesses serious challenge to Indian industry to survive and grow.

Increasing all type of energy demands, OPEC prices hike and the energy sector reforms in India are increasing the cost of energy. In current market recession every organization need to cut down their cost to sustain in the market.

The easier available option for survival is 'energy conservation' thereby cost reduction through strategic energy management. It also gives a positive orientation to energy cost reduction, preventive maintenance and quality control programs. This is the translation of conservation ideas into reality by blending techno-economically feasible solutions within a specified time frame.

Energy conservation is a worldwide objective. The energy policy of the Government of India calls for conservation of energy. With the enactment of Energy Conservation Act-2001 amongst others has emphasized upon the power of the appropriate Govt. to enforce efficient use of energy and its conservation.

The study has mapped power system parameters at the source, transformers and various equipments. It has also mapped illumination level at various activity areas in the Airport complex, where the team was permitted to enter for the study. The study could identify concerned problem areas, barriers towards maintaining right use of available facilities and come out with cost effective solutions. It also recommends cost effective and fast pay back solutions for performance improvement of all the systems.

8. Scope of the study:

1. Review of present electricity, fuel oil & estimation of energy consumption in various load centers like lighting, air-conditioning, water pumping etc.
2. Review of present electrical distribution like single line Diagram, Transformer loading, cable loading, normal & emergency loads, electricity distribution in various areas/floors etc.
3. Study of Reactive Power Management and option for power factor improvement.
4. Study of power quality issues like harmonics, current unbalance, voltage unbalance etc.
5. Review of present lighting system, lighting inventories etc.
6. HVAC system analysis.
7. Review of Diesel Generator set and performance assessment.
8. Motor load survey of drives to estimate the percentage loading.

9. Focus areas of the study:

- Auditing existing power system and electricity bills.
- illumination level at various places of the Airport where the audit team was permitted .
- Preparation of inventory and recording of data of various energy system equipments.
- Factors contributing to higher energy consumption,
- Operation and maintenance practices Vs. energy consumption,
- Requirement vis-à-vis existing power distribution system.
- Scope for proper illumination system & control system improvement, use of energy efficient lamps replacing poor, aged & inefficient lamps and fans.

Note: A.C.System was in maintenance and overhaul, so it was off and therefore could be studied.

10. Limitations of the study:

1. Since the Airport Authority has not permitted the energy audit team to enter and study power system and various utilities located at high security zone or with the apprehension that essential services may hamper during instrumental measurements, some utilities could not been audited.

2. The HVAC system was under repair and overhaul so no physical measurements on psychometrical parameters at the command zone of the HVAC system could be carried out.

3. The energy audit team had persuaded concerned engineering in-charge to allow the team to audit with the assurance that noninvasive and portable instruments will be used for various measurements on line without any interruption and outage of services but failed to pursue.

4. Since around 10 to 15% of lamps at various places/ locations were non-burning/out of order so power demand and illumination system could be studied with avail luminaries only.

5. The existing energy accounting / monitoring and Energy Management Information System (EMIS) is most inadequate for historical/present data documentation and analysis, trend analysis, control and management decision-making process.

Based on above limitations and given scope of the study following are recommendations of the Energy Audit team so that during the next course of energy audit the audit study could be carried out in complete and comprehensive manner:

- For estimation of energy consumption in various load centers like lighting, air-conditioning, water pumping etc. energy accounting systems need be installed.

- Energy system inventory records may buildup and regularly upgraded and all such documents should be available with concerned department during energy audit. Energy management policy and systems may be designed and entrusted to a suitable in house department with fixing duties and responsibilities.

- For HVAC system analysis next audit may be conducted when said system will be operative during adverse weather conditions.

- Installation of on line mechanical type water flow metering and pressure gauge to monitor review water pumping, storage and distribution systems.

- Energy Auditors should be allowed to access the power distribution boards (PDB) or motor locations for measurement towards Motor load survey of drives to estimate the percentage loading etc.

11. Insight to the report:

This Energy Audit report in LGBI Airport, Guwahati highlights the Power and energy utilization status vis-à-vis problem areas based on detail study through collection of available historical data and instrumental measurements, analysis of available parameters and in participation / discussion and collaboration of site Engineers/Supervisors/Technicians.

It has an endeavor to reach the genesis of the problem with an objective to address the optimal solution for cost effective energy management and cnservation thereof. This report within its scope and limitations of study deals with those problems areas and suggests corrective measures, which are implementable within the cost-effective economic domain. It has indicated scope for further study for continuous improvement.

12 . Study Methodology:

- The Energy Audit Team comprising of Certified Energy Auditors and engineers of PCRA studied different service and utility areas of the Airport, where the team was allowed for the study.
- It has studied the power system and associated equipment like distribution transformers, power distribution boards, DG sets, air conditioning system, arrival and departure lounges, cooling towers etc.
- Measured / observed data were analyzed for understanding operational status, deviations and shortcomings and finding cost effective solutions and recommendation thereof.

13. The Power System:

The LGBI Airport receives electrical power at their indoor type receiving sub-station through 11 KV single circuit from Lower Assam Electricity Distribution Company Ltd. (LAEDCL) under the tariff code – HT Bulk OTHER and having a contractual power demand of 800 KVA. Received power at 1kV is stepped down to 0.415 kVA for utilization at various utilities.

The Airport has 1000 kVA x 3 nos. 11/0.433 KVA, DYn-11 transformers. In addition to purchased power the Airport has also 750 KVA x 3 no. DG sets as (stand by) for catering essential process purposes in the event of grid power outage.

The power is distributed from the main PDB to various sub-PDBs and loads by radial feeder through underground cables. Power consuming equipments are feed from those sub-PDBs. Single Line diagram of Power distribution system is attached in annexure-I.

Out of 3 Transformers one is only feeding power to the Centralized A. C. system. Other two are used are for remaining power consuming systems. Transformer particulars are given in the table below:

Transformer Particulars	Trans.-1	Trans.-2	Trans.-3
Capacity (kVA)	1000	1000	1000
Voltage (V) (at no load)	HV- 11000	HV- 11000	HV- 11000
	LV- 433	LV- 433	LV- 433
Current (A)	HV- 52.5	HV- 52.5	HV- 52.5
	LV-1334	LV-1334	LV-1334
Impedance Volt (%)	5.35	5.35	5.14
Connection symbol	Dyn-11	Dyn-11	Dyn-11
Type of cooling	ONAN	ONAN	ONAN
Frequency (Hz)	50	50	50
Total weight (kg)	3250	3250	3060
Oil quantity (Lit)	850	850	520
Make, year	Crompton Greaves, 1996	Crompton Greaves, 1996	ALSTOM, 2000
Design No.	ROM 2001	ROM 2001	A-327686

2 Years Electricity Bill data for the consumption month Dec. 06 to Dec. 08 period and analytical findings are given below:

Sl. No.	Consumption Month	Consumption (KWH)	Energy Charge (Rs)	Actual Max. Demand (KVA)	Billed Max. Demand (kVA)	P.F. (Avg).	Total Amount (Rs.)

YEAR- 1 [Dec_06 to Dec_07]							
1	Dec_06	142230	584095.05	144	800	80.6	710977
2	Jan_07	129170	528780.15	137	800	81	647258
3	Feb_07	144840	610067.7	147	800	78	737270
4	March_07	148530	619593.3	174	800	79	739193
5	April_07	161430	660328.2	223	800	81	788151
6	May_07	174930	701383.05	215	800	83	838803
7	June_07	181830	729048.6	212	800	83	866720
8	July_07	192090	785744.55	215	800	81	917096
9	Aug_07	232620	942111	224	800	82	1092764
10	Sep_07	182490	716910.75	223	800	85	850423
11	Oct_07	173550	690206.3	224	800	85	822851
12	Nov_07	149220	605680.7	186	800	83	732403
13	Dec_07	153840	643359.7	156	800	80	786443
						Total amount Rs.	**1,05,30,352**
YEAR- 2 [Jan_08 to Dec_08]							
14	Jan_08	157830	653572.8	149	800	81	793045
15	Feb_08	144150	591015	152	800	82	713520
16	March_08	167730	680817.3	177	800	83	817093
17	April_08	196110	787970.8	212	800	84	938441
18	May_08	162300	645467.1	212	800	85	761579
19	June_08	190560	750041.7	208	800	86	884146
20	July_08	229080	901659.76	222	800	86	1054903
21	Aug_08	181500	721825.5	217	800	85	851381
22	Sep_08	246930	971917.3	274	800	86	1128289
23	Oct_08	271590	1113519	259	800	82	1256488
24	Nov_08	231420	958309.4	229	800	81	1093633
25	Dec_08	256380	1051158	217	800	82	1196467
						Total amount Rs.	**1,14,88,985**

Critical observations and recommendations on Power System:

1. Recommendation for energy cost reduction by decommissioning of 1000 KVA x 2 Transformer:

Installed Power system capacity vis-à-vis Power demand:

i) The Installed capacity of the step down substation is **3000 KVA** whereas maximum demand as recorded was **259 KVA.**

ii) Therefore capacity utilization is very poor i.e. within 10%. Also since all the transformers are used to in commissioned mode but lightly loaded those used to cause energy loss as their constant demand to the tune of around 2% of their capacity.

iii) No load power demand of all the 3 transformer = 3000 KVA x 0.01 (Approx. N. Load demand) x 0.82 (P.F) = **24.6 KW**

iv) Energy consumption / year (8760 hours in a year) = 49.2 KW x 8760 = **215496 KWH**

v) So cost of electricity that all the transformers are consuming = 215496 KWH x Rs. 4.10 (av. Cost/KWH) = **Rs. 8,83,534**

vi) Energy Saving option/year by decommissioning of 1000 KVA x 2 nos. transformer = 215496 KWH x 2/3 = 143664 KWH

vii) Energy cost saving opportunity = 143664 KWH x Rs. 4.10 (av. Cost/KWH) = **Rs. 5,89,022 / year**

Note: i) Considering power system reliability and energy cost saving all the loads may be feed from one 1000 KVA transformer only but Other one 1000 KVA transformer may be kept decommissioned but in a healthy state so that alternately/cyclically it could be commissioned.

ii) The 3rd. 1000 KVA decommissioned transformer may be preserved in sealed condition so that the insulation resistance of the transformer may not deteriorate or may suitably utilized else where.

iii) Before taking proposed action the Airport authority need to consider whether there will be any new project/s may come up in the near future, if yes estimate future demand hike and accordingly take decision.

iv) Investment for action i) above would require say Rs. 1,00,000.

v) Payback Period : within 2 months.

2. Recommendation for Power Factor improvement and energy bill reduction:

i) The average power factor at the point of LAEDCL metering was as low as **0.82 (Av.)** as per electricity bill**.** But the lowest p.f. as was measured at some load ends were found as poor as 0.39 causing demand side current and apparent power demand is on the higher side. This higher circuit current causing uhigher loading of the transformer, cable, bus bar and switches etc. This has also caused higher energy loss in the distribution system conductor etc.

ii) In the existing installation there has one 150 kVAr + 50 kVAr power factor improvement switched shunt capacitor system but either in a non working or in a defanged stage.

iii) This phenomenon reveals that there has a potential scope for demand charge reduction, power quality improvement at users points, energy savings in distribution system, improve transformer performance and in fine energy cost reduction by installation of automatic power factor controllers at the L.V. side of the main PDB and fixed capacitors at major motor ends.

iv) Energy Cost saving opportunity by Installation of a) 150 KVAr, 12 step automatic power factor controllers (APFC) at the L.V. incomer side of the main PDB and b) fixed capacitors at major motor ends base on motor operational PF totaling about 75 kVAr..

v) Computation of elimination of low PF. Penalty and Rebate in improved power factor [As per Assam Electricity Regulatory Commission Tariff Order FY 2007-08]

a)	Average kWH consumption /month	202965	**Power factor penalty and rebate:** **(a) Power factor penalty:** In case average power factor in a month for a consumer falls below 85%, a penalty @1% for every 1% fall in power factor from 85% to 60%; plus 2% for every 1% fall below 60% to 30% upto and including 30% shall be levied on total unit consumption. Power factor penalty shall be levied on those consumers where power factor is recorded electronically. **(b) Power factor rebate:** In case average power factor as maintained by the consumer is more than 85%, a rebate of 1% and if power factor is above 95%, a rebate of 2% on unit consumption shall be applicable. Power factor rebate shall be allowed on those consumers where power factor is recorded electronically.
b)	Present Av. Power Factor	0.82	
c)	Proposed improved Av. Power Factor	0.98	
	Low PF penalty reduction = 202965 kWH x 3% x Rs. 4.10	Rs. 24,965	
	PF rebate/month= 202965x2% x Rs. 4.10	Rs. 16,643	
	Total Money Saving / year	**Rs. 4,99,296**	

Following advantages may be obtained from the power factor improvement at load ends:

- Line copper loss (I^2R) decreases.
- Improve the system voltage.
- Efficiency of motors, pumps, transformers, switchgears will improve.
- Demand of the Airport will be reduced.
- The KVA or MVA capacity of the transformers and lines will be increased.
- More power factor rebate can be obtained from utility. Overall cost per unit of energy decreases.

3. Electricity 'Contractual Demand' reduction and Cost savings Opportunity:

The LGBI Airport, Guwahati has a contractual demand of 800 kVA. But the maximum demand as per the electricity Bill varies from 137 to 274 kVA. So there is a potential opportunity to save the demand charge by reduction of the existing contractual demand.

The Contractual demand can be reduced to 350 kVA. In the event of future power demand hike the contractual power demand could be a enhanced accordingly.

Therefore Demand charge saving @ Rs.145/kVA/month= 450 x Rs. 145= Rs. 65,250 /month.
Demand charge saving / Year = Rs. 65,250 x 12 = Rs. 7,83,000 / year

Investment for the 'Contractual Demand' reduction = Nil.

"Extract from the Assam Electricity Regulatory Commission Tariff Order FY 2007-08 CHAPTER 10" :

HT BULK: (ii) Others

Energy Charge and Fixed Charge: **For all consumption: Rs 4.10/kWh & Rs 145/KVA/month.**

Contract Demand: The Contract Demand shall be between 70% to 105% as declared by the consumer of the Connected Load converted to KVA at 0.85 power factor. In case declaration /option is not made by the consumer within the stipulated time, 100% of the Connected Load converted to KVA shall be the contracted demand.

(d) **Billable Demand**: Billing demand shall be 100% of Contracted Demand or Recorded Demand, whichever is higher. In case the meter remains defective in a month, billing demand shall be considered as per clause 4.2.2.4 of AERC (Supply Code and Related Matters) Regulations, 2004, Procedure for Assessment of Consumption in case of incorrect or stopped meter for seasonal consumer.

Problems with the transformer and power system:

During the study some deficiency was found with the transformers and power system hardware.

- Present temperature sensor cum controller setting for TR-1 (120 ^{0}C) is incorrect. It should set to 65 ^{0}C to 70 ^{0}C.
- Breather oil pot is not provided on TR-3.
- The 33kV isolator is not at a safe distance. The jumper wire may touch the pole structure leading to accident.

14. Lighting system:

While addressing energy conservation and savings in the existing illumination systems for efficacy and economy, there lies enough scope for planning the same in conjunction with viewing comfort, safety and productivity improvement.

Lighting load is one of the major loads in the airport. Energy Audit Team has measured the illumination level of various Buildings where permitted. The team has also assessed the total lighting loads. The detail of lighting assessment is as follows:

LIGHTING DETAIL

Location	Area (m^2)	No. of Lamps	Type of Light	Wattage (Watt)	No. of Fans	Type of Fan	Wattage (Watt)	Avg. Lux	Remarks
A.C.Plant RM	392	26+1	T.L.+ M.H.	(56x26)+250 = 1706	3+1	C.F.+ W.F.	(100x3)+120= 420	57	Very less day light
Pump Room	36	4	T.L.	56x4 = 224	2	C.F.	100x2=200	350	Enough Daylight
D.G.Room	1000	36	T.L.	56x36=2016	7	Ex. Fan		300	Enough Daylight
Office & corridor	200	10	T.L.	56x10= 560	3	C.F	100x3= 300	60	
Office Str. lights		9	S.V.	-	-	-	-		
33kV control Rm.	25	4	T.L.	56x4= 224	1	C.F	100x1= 100	200	Enough Daylight
H.T. Panel Room	30	5	T.L.	56x5= 280	1	C.F	100x1= 100	148	Enough daylight
Transformer-3 Rm	25	4	T.L.	(56x1)+(44x3) = 188	1	C.F.	100x1= 100	170	Enough Daylight
Transformer-2 Rm	25	2	T.L.	56x2= 112	1	C.F.	100x1= 100	170	Enough Daylight
Tr-1 Room	25	2	T.L.	56x2= 112	1	C.F.	100x1= 100	175	Enough Daylight
Panel Room	96	14	T.L.	(56x9)+(44x5)= 824	2	C.F.	100x2= 200	80	Enough Daylight
Out door	-	3	T.L.	56x3= 168	-	-	-		
Airport Departure Lounge	1500	13+27+38	M.V.+M.H+T.L.	(400x13)+(250x27)+(44x38)= 13622	-	-	-	249.5	
Arrival Lounge	1500	9+23+124	M.V.+M.H+T.L.	(400x9)+(250x23)+(44x124)= 14806	-	-	-	163.5	
Central Concourse	1500	12+16+54	M.V.+M.H+T.L.	(400x12)+(250x16)+(44x54)= 11176	-	-	-	240.5	
Outside Terminal Building		85+34	Mercury +T.L	N.A.+ (44x34).					Should be on only at night time.

[T.L: Tube Lights, S.V: Sodium vapour; M.V: Mercury Vapour; C.F: Ceiling Fan; Ex. fan: Exhaust Fan; W.F: Wall Fan]

Present Energy Consumption in Lighting / Year = 49,134 watts x 365 days x 14 hrs/day =251074740Watt= 251075 kWh.

Total Amount (considering Rs.4.1 unit) = 251075 x 4.1 = Rs. 10,29,407 (Approx.)

Recommendations:

1. Replace all (40+16) W. Conventional Tube lights with (36+4) W, Philips make True lights (Philips make).
2. Replace 400Watts Mercury Vapour (M.V.) with 250 Watts Metal Halide (MH) Lamps.
3. There is enough natural light at daytime. So switch off the light at daytime in most of the places.
4. Reflector should be fitted in every tube fittings.
5. Old type of Fans of higher energy consumption which are used in different locations should be replaced by some new type Energy efficient lower wattage Fans.
6. In general luminaries at out door locations were found covered with dust. General maintenance of luminaries needs to be improved to get better illumination out of available capacity.

Payback Period:

A) Replacement of Conventional Fluorescent Tube Lamps (FTL) by energy efficient FTL.

Power consumption of 40W tube lights with ballast= 40+16= 56Watt.

Power consumption by trulite with ballast= 36+4= 40Watt.

Energy saving/unit of light= 16Watt.

No. of replaceable lights= 100

Working hours= 14 hrs.

Annual Energy saving= 16 x 100 x 14 x 365= 8176 kW.

Payback Period:

Particulars	Value
No. of replaceable Tube lights	100
Energy saving /year (kWH)	8176
Monetary saving (Rs.) @ 4.10/kWh	8176 x 4.10 = **Rs. 33,522**
Cost of Philips make FTL (Rs.)	60
Cost of ballast (Rs.)	200
Total Cost (Rs.)	260
Total investment (Rs.)	100 nos. x 260 =26000
Payback period (months)	**9 (approx.)**

B) **Replacement of existing 400 Watt Mercury Vapour Lamps by 250-Watt Metal Halide Lamps (MH).**

Lux level in most of the places of the Lounge is very high. Replace all 400-Watt Mercury Vapour Lamps (34 nos.) with 250-Watt Metal Halide Lamps (MH).

Average Lux level at the Airport Lounge is 250 (Approx.). In the lounge the Lux level should be around 200.

So, 20% lights can be reduced in the Lounge.

No. of Metal halide required = 34- (34x20%) = 34 - 7 = 27.

Power consumption of 400W Mercury Vapour lights with ballast = 400+60= 460Watt.

Total Power Consumption by M.V. Lamps/year = 460 x 34 x 365 x 14 = 79920 kWH

Power consumption of 250W Metal Halide Lamps with ballast = 250 + 30 = 280 Watt.

Total power consumption by M.H. Lamps/year = 280 x 27 x 365 x 14 = 38632 kWH

Annual energy saving = 79920 – 38632 = 41288 kWH.

Payback Period

Energy saving /year (kWH)	41288
Monetary saving (Rs.) @4.10/kWh	41288 x 4.10 = **Rs. 169281**
No. of Mercury Vapour Lamps	34
No. of proposed Metal Halide required	27
Cost of Metal Halide with ballast (Rs.)	4500
Total Investment (Rs.)	4500 x 27= 1,21,500
Payback Period (months)	**9 (approx.)**

15. Water Pumping System:

Water Pumping system is an important part utility of the airport facility. The detail of pumping system in the Airport is given below:

1. No. of submersible pump: 2 (15HP) for Arrival and Departure Lounge.
2. No. of water filter pump : 2 (10HP).
3. No. of pump for AC water: 2 (5HP).
4. No. of submersible pump: 2 (12.5HP) for other supply like colony.

Out of all above pump sets only power measurement of one 15HP submersible pump could be undertake. The coordinator for the airport authority did not allow the audit team to enter and measure required parameters that are essential for the water system audit. There ware no fluid flow meter and pressure gauge installed with the pumping system. Also there has no nipple in the piping to install pressure gauge. Most of the water pipings are very old and full of rusts etc. So noninvasive ultrasonic type fluid flow meter can't be used for measurement of fluid flow.

Measured power parameters are given below. On the basis of power parameters only no analysis is possible.

It is suggested to install fluid flow meter and pressure gauge with the water pumping systems..

Particulars	**Value**
Voltage (V)	400
Current (A)	39.68
Frequency (Hz)	49.3
Power (kW)	6.04
Power Factor	0.39
THD, Voltage (%)	2
THD, Current (%)	5.5
Water Level Depth (ft.)	6
Storage Tank height (ft.)	50
Running hour	16

16. HVAC System Detail:

The centralized HVAC system is the most important utility power consuming part at LGBI, Guwahati. At the time of audit the compressors were in repair and overhauling state, so the system was in a shut down state. As a result the HVAC system performance could non been studied. Only available and nameplate ratings are given below.

There are three Chiller units in this system out of which two used to runs at a time and the other remains in standby mode.

Chiller Detail:

Chiller unit	Capacity (TR)	Running hours (approx.)
1	225	14
2	225	14
3	225	14

Total capacity= 775 TR.

- Each unit has two screw type compressors of capacity (115 +110) TR.
- Coolant used: CHF_2Cl-R-22 (Chlorofluro-Carbon).
- Microprocessor controlled.

Chilled Water pump detail(3 nos.)

Particulars	Unit	Value
Motor capacity	kW	30
Capacity	M3/hr	155
Type	-	4AD 14
Total Head	Meter	40
Speed	RPM	1450
Drive H.P.	H.P	40
Test Pressure	Kg/cm2	8

Condenser pump detail (3 nos.):

Particulars	Unit	Value
Motor capacity	kW	18.5
Capacity	M3/hr	185
Type		4AD 14
Total Head	Meter	26
Speed	RPM	1450
Drive H.P.	H.P	25
Test Pressure	Kg/cm2	6

17 . Cooling Tower Details and Recommendations:

There are three no. Cooling Towers associated with the HVAC system.

Capacity of each motors = 7.5 H.P. (5.5 kW).

Energy Savings Proposals:

Replacement of existing cast aluminium cooling tower fan blades by FRP fan blades.
Around 15 to 20% fan power consumption could be reduced.

Existing System: At present the cooling towers have aluminium-casting blades.

Proposed System: It is recommended to replace this blade by energy efficient FRP blade.

Cost saving calculation:

DESCRIPTION	UNIT	QUANTITY
No. of Cooling Towers(CT)	No.	3
No. of CT Fan in operation	No.	6
Rated Motor Power	kW	5.5
Nominal Savings Potential	%	2 x 20%
Savings of Power	kW	4.4
Operating hour	Hour	14
Yearly Operating Days	Days	365
Savings of Energy	kWh	22484
Monitory Savings @ 4.10 /kWh	Lacs Rs.	0.9218
Investment	Lacks Rs.	1.2
Pay back period	Month	16

18. D.G.Set Details and calculations:

In LGBI Airport, D.G. set stand by power system plays a very important role in the airport considering all wake of essential services.

At LGBI Airport there are three nos. of D.G. sets installed in the month of December 2008 having a capacity of 750 kVA each.

The details of D.G.sets are given in the table below:

D.G.set reference	Capacity (kVA)	Speed (rpm)	Power Factor	Electricity generated (kWh)	Fuel consumption (lt.)	Specific fuel consumption (lt./kWh)
DG- 1	750	1500	0.85	3396.97	1130	0.33
DG- 2	750	1500	-	-	-	-
DG- 3	750	1500	0.83	2400.6	880	0.37

The data are from 18-12-08 to 14-02-09 as available from the logbook from the Department. The data of DG-2 was not available. Most of the time the DG sets are in stand by condition and during Audit it was also in off condition. For the audit purpose the energy audit team had requested the representative of the airport but on load study was not possible for non operation of D.G. sets.

DG-1 & DG-2 used to operate for feeding all loads other than the HVAC system where as the DG-3 exclusively used for catering load of the HVAC system in the event of non availability of grid power.

General Recommendations:

1. Calibrate fuel injection pumps frequently.
2. Ensure steady load conditions, avoiding fluctuations, imbalance in phases, harmonic loads.
3. Consider parallel operation among the DG sets for improved loading and fuel economy thereof.
4. Carryout regular field trials to monitor DG set performance, and maintenance planning as per requirements

***19. General Recommendation*:**

- Lights/fans/Cooling Systems/computers should be kept off not required.
- Misuse of Running Water at different locations of the building should be stopped through conducting awareness programme. ‘Occupancy Sensors’ may be provided at Staff & visitors toilets to prevent wastage of water.
- Northern side glass and west side glass of the Departure Lounge should be double walled glazed glass to reduce Cooling Load power demand.
- 4 nos. of entry/exit gates should be changed to double door auto closing/opening gates to reduce the A.C.Load.
- All types of Meters, Gauges, Recorders etc must be calibrated at a certain & regular interval to maintain and get the proper & accurate results.
- Hoardings/Banners related to the Energy Conservation awareness should be used in large no.
- Energy meters should be used in all sections & all sub sections to access the major Energy Consuming areas & to take proper measures to reduce the Energy Consumption by the application of Modern Energy Efficient Technologies.

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