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UNIT – ITC HOTEL – THE GRAND CENTRAL - MUMBAI

Following are the Energy Conservation Proposals given by U.V.K. Rao and Associates , after the Energy Audit was carried out by them.

There are total six Energy Conservation Projects, which are as follows :

Project Titles

A) Replacement and re-engineering of the chiller plant and auxilliary system

B) Re-engineering and retrofit of HVAC system to reduce overall thermal load

C) Water & waste system improvements For energy load reduction

D) Replacement and retrofitting in Electrical & Lighting

E) Revamping Laundry with energy efficient Machinery and utilities

F) Reengineering and retrofit of boiler and steam system to reduce overall thermal load

Out of these six projects, four projects have been implemented in the year 2006-07, and same have been attached for your reference

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PREFACE OF PROJECTS

EHS division of ITC Hotels limited initiated action to reduce overall energy consumption in all ITC hotels to achieve reduction of CO_2 emission & Energy Conservation from the present levels- Accordingly ITC Hotels have engaged M/s UVK Associates as energy consultant to submit project report for reduction of energy consumption and reduce CO_2 emission- preliminary survey was conducted and they proposed huge energy saving potential from the present operating level by various replacement and retrofitting projects. Detailed descriptions for the all projects suggested have been comprehensively given in the report.

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PROJECT (A)

Replacement and re-engineering of the Chiller plant and auxiliary system.

Present System

- Three Trane Screw chillers each of 350 TR capacity are installed in the hotel for catering to the entire air conditioning load for which 3 primary chilled water pumps of 11 kW each are installed for positive circulation of water in chiller and 4 pairs of chilled water pumps are installed for circulating chilled water to AHUs, TFAs & FCUs. Each pair is dedicated for each of the 4 zones segregated on the basis of usage as per details below:

  Zone A : Guest Rooms (10-20th Floor)
  Zone A1 : Guest Rooms (21-28th Floor)
  Zone B : Lobby Lounge, Mezz. Floor, kitchen spot cooling coffee shop
  Zone C : Ground floor, main kitchen

Also, 3 condenser water pumps, one for each chiller, are installed

- One chiller is operated for continuous requirement and second chiller is operated during peak load requirements (including summer) and one primary pump is operated for each chiller operation and each secondary zone is connected with one pair of pump (working + standby) and one pump per zone is operated continuously for which VFDs are installed
- Average present plant load is around 500 TR. Specific power consumption of screw chiller is around 0.72 kW/TR at 44°F chilled water outlet set point at full load and increases up to 1.0 kW/TR during part load. Presently chilled water set point out let temperature is maintained at 44°F for most of the year and is varied manually by engineering staff depending upon lower ambient conditions.
- Primary pump is operated on constant speed to circulate fixed flow of water across chiller irrespective of load and cooling load in chilled water system increases with higher circulation of water

- Variable Frequency Drives (VFDs) are installed for all secondary chilled water pumps
- Presently the cooling water flow in condenser remains constant irrespective of tonnage of load. The condenser pumps take a load of 40-46 amps (22.8 – 26.5 kW)

Proposed

(UVK) While procuring the chiller, a new pump is also to be procured that would precisely match the known head and flow of the primary chilled water pump as well as enhanced efficiency levels

- Install remote microprocessor based control in the BMS room and operate chillers with set point of 10°C as a standard operating practice
- Increase set point to 11°C during favorable ambient conditions and nights (12 PM to 6 AM)
- Reduce set point to 8°C during high humid period (Rainy season) and peak summer
- The COP of refrigeration system increases and compression work decreases as the evaporator temperature is raised
- Operating chillers at higher set point reduces specific power (kW/TR) consumption besides reduction in thermal loss
- Install on line data logger to monitor specific power consumption of chillers
- Install 350 TR screw chiller with waste heat recovery VFD along with heat recovery system
- Total specific power consumption of proposed screw compressor with suitable pumps is less than 0.75 kW /TR (including Condenser pump& cooling tower fan)
- Also hot water at 40-45°C can be supplied from the system for the required applications
- There will substantial reduction in pumping power as the new chiller requires lower water circulation (Condenser and evaporator)
- Besides power saving demand (kVA) also will reduce drastically
- Operate existing 350 TR chiller only during peak load requirements
- Replace existing primary pump with energy efficient pump matching system head and flow
- New pump may be selected with mechanical seal and energy efficient Motor (EEF1 rating)

- The VFDs will measure load on chiller by measuring differential temperature and vary the pump flow (frequency and speed) accordingly
- Hence the pump flow will be altered to match the actual system requirement
- This will reduce wastage of pumping power
- However care should be taken to maintain minimum water flow across evaporator irrespective of reduced load conditions
- Procure new condenser pumps and matching VFD
- New pumps will have specs of 1050 gpm (380 m^3/hr) and 62 ft head (19 m), 35 hp
- Expected average power consumption with VFD & new pump will be 18 – 19 kW (savings 10 – 15% on existing power) giving a savings of 4-5 kW/pump

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PROJECT (B)

Re-engineering & Retrofit of HVAC system to reduce overall thermal load

Present System

At Grand Central, outside air is drawn into a TFA unit, cooled, dehumidified and saturated air (100 % RH) at 18^{O}C is supplied to guest rooms and corridors in each floor in. The purpose of TFA is to ensure that outside air does not impose additional load on fan coil units which are not designed for such duties Even though air is cooled to 18oC in separate TFAs, this air supplied to guest rooms is not adequately dehumidified

- Fan coil units (FCUs) are installed in all guest rooms for air conditioning
- All FCUs are operated at maximum speed during non-occupancy period. There is no appreciable thermal load in the guest rooms during non-occupancy period and hence high-speed operation during such periods adds avoidable electrical load and thus thermal load to the air-conditioning system

- Two 500 TR induced draft cooling towers are installed for condenser water cooling. Two cooling towers are operated continuously
- The condenser heat load varies with chiller load
- Also ambient temperature plays vital role in cooling tower load
- Presently the total power consumption for all cooling tower fans is around 22 kW

Proposed

- Pre-cool before the air enters the cooling coil and reheat after the air leaves the cooling coil by installing Heat Pipes. The recommended Heat Pipe for TFAs needs to be "U-framed" as a single equipment, enveloping the cooling coil, with a pre-cool section on up-stream side and a re-heat section on down-stream side. Pre-cool section cools incoming ambient air by about 10ºC. Due to this, the cooling coil is able to de-humidify FROM A LOWER temperature than it was doing before and thus saving chiller power .In re-heat section, saturated, overcooled air coming out of cooling coil is heated up by about 10ºC, thus maintaining less than ASHRAE recommended of not more than 70% RH for air leaving the cooling coil. Overcooling and reheating is achieved this way without any additional running cost

    - Install electronic speed varying controls in the room to change over FCU to lowest speed whenever guest room key card is removed (when unoccupied). This will reduce electrical and thermal load to the air conditioning system
    - Install enthalpy based cooling tower (CT)control and operate CT fans based on actual condenser load and ambient conditions
    - Cooling tower outlet water temperature will be measured and fan speed will be controlled accordingly. Ambient temperature also will be measured to obtain best system efficiency

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PROJECT (C)

Water & Waste system improvements for energy load reduction

Present system

- ETP plant is operated to treat 160--180 kl/day hotel discharge waste water from kitchen & laundry
- Two twin lobe blowers are installed for supplying air for aeration tank (1 working +1 std by)
- Present operating blower capacity is 450 m^3/hr at working pressure of 0.5 kg/cm^2g
- Aeration is done with conventional method of releasing air from the bottom of the tank through holes in the perforated pipes
- Aeration is operated on constant air flow rate irrespective of actual dissolved oxygen demand
- Air is continuously leaking from blower dead weight from one of the blowers
- Additional dead weight is fixed to reduce air leakage resulting in operation of blower on higher pressure and hence increased operating power consumption
- Raw effluent from Kitchen, Laundry, Cafeteria etc are transferred to receiving tank in Effluent plant (ETP)
- Inlet pump is installed for pumping effulgent to aeration tank
- Outlet pump is installed for pumping out treated ETP water to storage tank/garden
- Both inlet and out let pumps are of non –clogging self priming pump with very low efficiency (< 35%)
- Actual efficiency is likely to be less due to vintage (<10years)

Proposed

- Reduce speed of Second blower by 30 % to facilitate air supply of 300 m^3/hr instead of present 450 m^3/hr(install one of the existing std by vfd to arrive at suitable speed)
- Install diffusers in the aeration tank to improve oxygen transfer rate

- Check Dissolved oxygen (DO) level and switch off blowers whenever DO level increases is more than required limit
- This results in reduction of wasted power consumption for aeration blowers
- Replace both inlet and out let pumps with optimal sized energy efficient submersible pumps (as per specification enclosed) of high efficiency
- Besides increase in efficiency of New pumps, added advantage of increase in motor efficiency will reduce recurring power consumption for ETP pump

PROJECT (D)

Replacement and retrofitting in Electrical & Lighting

Present System

- Operating voltage in rising mains circuit is above 230 V i.e. 230 to 250 Volts
- Lamps & lighting luminaries are designed to operate between 180 - 230 V
- Operating lighting system at higher voltage leads to excess energy consumption, in addition to reduced life of lamps and accessories
- Widely, twin tube light fittings with T8 lamps are catering the requirement in plant room, car parking, kitchen, back of offices, etc.
- 40 W tubes, 36 W slim tubes and 36 W energy efficient lamps (such as Trulite of Philips make) are in service
- Electronic chokes are also in service in fittings
- Auto power factor control panels are installed in both Transformers
- Overall PF is being maintained well around 0.99
- Certain identified feeders have low PF
- From the data, the readings of the identified Loads / feeder are :

Location	Amps	kW	PF
Chiller Compressor 1	309.8	184.5	0.87
Chiller Compressor 2	334	201.5	0.88
Laundry Panel	57.3	31.95	0.83
Kitchen Panel	44.83	26.22	0.78
Boiler Panel	64.78	37.75	0.93

- 7 W CFL lamps are installed in guest rooms as night lamps
- Existing motors are standard motors
- Motor capacity range (typical) : 1 kW to 20 kW
- Motor are of Standard or eff-2

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UNIT – ITC HOTEL – THE GRAND CENTRAL - MUMBAI

Proposal

- Operate lighting circuit in 200–210 V range by use of Energy Saver in lighting circuit that helps in power saving by reducing applied voltage without a proportionate reduction in illumination level
- In general practice, the three-phase voltage is maintained at 415 Volts as per requirement which means the voltage across phase and neutral will be 239 Volts. This is far above the rated voltage of lamps. Lot of energy is wasted, as the corresponding benefit in terms of illumination is not obtained. Life of the lamps also gets reduced.
- Energy savings are possible by optimising the voltage applied to the lamps to 200 to 210 Volts
- Savings in excess of 20% is common with Energy Savers on a sustained basis and trials and installations amongst ITC hotels have confirmed the same
- Such type of energy savers supplied by M/s. Servomax India Ltd., Hyderabad is already in service in Plant Room, Dakshin Kitchen Lighting Circuits and working satisfactorily in ITC Kakatiya, Hyderabad.
- UVKA have indicated the specific lighting energy saver units to be installed for identified circuits. See Annex E1.1

Location & Feeder	Annual Saving		Energy Saver Rating: kVA	Investment: Rs.	Pay back Months
	Units	Rupees			
Rising Mains 1	71,175	291,818	200	600,000	25
Rising Mains 2	109,500	448,950	140	420,000	11
Main kitchen (MDB G4)	32,850	134,685	60	180,000	16
Total	**213,525**	**875,453**	**400**	**1,200,000**	**16**

Note:
Energy saver for Rising mains 1 = 10 nos of 20 kVA
Energy saver for Rising mains 2 = 7 nos of 20 kVA

- Replace conventional FTL with energy efficient T5 – OSRAM make – PICOSTAR-R ; FH 28 W Combi
- The consumption of T5 fitting is 28 W & these are direct matching with the existing fixtures
- Electronic ballast of T5 consumes power of 2 W and operates at PF of above 0.95

- This improved PF helps in reduction of current and hence losses in the lighting circuits
- T5 lamps gives more Illumination i.e. around 100 lm/watt, compared to 65 lm/watt of T8. i.e 50 % more illumination with 25 % lesser power consumption
- This can be applicable in B1 & B2 car parking areas and back of offices. Illumination in car parking is in the range of 30 to 120 Lux. This is much on the higher side and illumination in the range of around 50 lux is sufficient
- In our case, using of one FTL of T5 in place of twin T8 FTLs will reduce the energy consumption further to the tune of 40 % with out suffering the minimum Illumination requirement
- Osram make T5 fittings are installed in Marriott Welcom Hotel, New Delhi in car parking, back offices, etc. and these are working satisfactorily
- These are applicable in all locations leaving a few task specific locations such as offices, stores, control rooms, etc.

- It is recommended to connect capacitor to certain identified feeders
- This helps in correcting the PF in the respective circuits
- Connecting PF correction capacitors at load end / feeder will help to :
    - Improve the PF; Reduce the feeder current
    - Reduce the maximum demand proportionately; Reduce the line losses
    - Saving of energy through reduced losses

- Replace 7 W CFL with LED based night lamp. LED night lamps consumes 1 W power and life is more than 50,000 working hours
- Replace select motors with energy efficient 1 (eff1) motors
- Typically, eff1 motors offer 3-6% higher efficiency than standard motors
- Recommended to replace enclosed list of motors with EEF1 motor
- This is a proven energy saving proposal and must be encouraged even if the payback is higher since it gives perennial saving beyond the payback period
- New motors are also with same frame size and suit same foundation

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PROJECT (E)

Revamping Laundry with energy efficient

Machinery and utilities

Present System

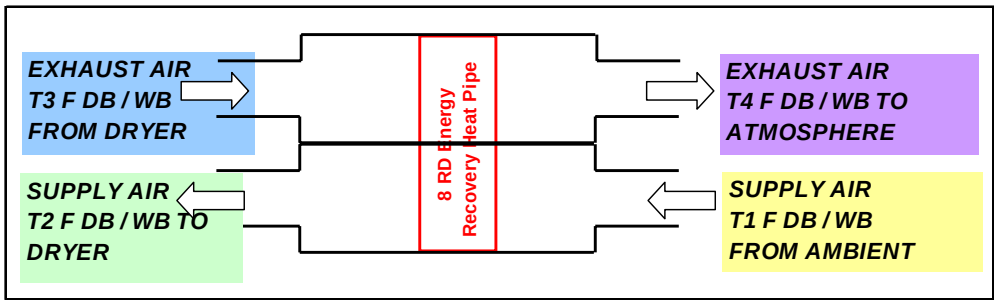
The hot and humid air from the Tumbler Dryers in Laundry section is being vented out to the atmosphere. This exhaust air which is at an average temperature of 75o C has a lot of heat content in it. Both tumbler dryers work for 19 hours a day

- Two Atlas Copco air cooled screw compressors are installed for laundry operation
- One is operated continuously working on start an stop mode
- Compressors are operated up to maximum working pressure of 10 kg/cm^{2}g and the user requirement is up to only 5.5-6.0 kg/cm^{2}g

Proposed

Recover heat energy from the exhaust air of the Tumbler Dryers by means of a Heat exchanger known as Heat Pipes and use this heat to pre-heat intake air to the dryers and thereby reduce steam consumption and hence reduce PNG fuel cost.

Energy recovery Heat Pipe is an air to air Heat Exchanger, separated into two sections for two different streams of air in opposed flows.



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Standard Heat Pipe specifications for 2 Nos Tumbler Dryers

- Heat pipes are proposed for all the Tumbler Dryers to recover energy from exhaust and use this for pre-heating intake fresh air.
- The Heat Pipes shall have 12.7 mm O.D. x 0.4 mm wall seamless copper tubes with internal enhanced surface 0.15 mm aluminium sine wave fins. Tubes shall be mechanically expanded into fin collars for an interference fit to provide maximum thermal transfer.
- Framework materials shall be galvanized steel not less than 1.5 mm thick.
- Fasteners shall be stainless steel.
- The working fluid inside the heat pipe shall be suitably selected and shall not be HCFCs.
- The heat pipes shall be flat type construction with two clearly demarcated sections – one for exhaust air and another for intake air with air tight partitions between the sections.
- The face area, Row deep and fins per inch of the heat pipes shall not be less than the following dimensions: 508 mm (20") height x 762 mm (30.0") long total (381 mm for exhaust + 381 mm for intake) x 8 RD x 12 FPI for 35 Kg tumbler dryers – each section shall handle 1275 CMH air at a low pr. Drop - Qty: 2 Nos
- Install 500 liters compact Air receiver in the system and operate compressor from 5.5 to 7.5 kg/cm^{2}g
- Install pulsation tank nearer to the user points
- Install heavy duty air pressure regulator in the Air receiver outlet to maintain uniform pressure on the user points

PROJECT (F)

Re-engineering and retrofit of Boiler & Steam System to reduce over all thermal load

Present system

- Hot water required in high zones & low zones
- Low zone requirement is met by preheating using the return condensate
- High zone requirement is met by passing through hot water boiler (primary & secondary stage circulation)
- Existing condensate return system consists of flash vessel and a plate heat exchanger arrangement to recover heat from condensate.Expected flash steam quantity around 30–40 kg/hr (based on an assumed steam flow of 550 – 600 kg/hr)
- Entire condensate at around 70oC is drained at present as this cannot be used as boiler feed due to limitations of boiler feed pump

Proposal – Stage I

- Provide suitable pipeline arrangements to bring the flash steam to the existing plate heat exchanger (BP13)
- Return water coming from high zone will have to be passed through this plate heat exchanger
- Joint survey along with Mark Engineers, Mumbai (who have confirmed to provide turnkey completion of the proposed scheme)
- Proposed system should have a 3-way valve, along with a temperature controller, which will vent the flash steam in case the temperature of hot water exceeds preset limit (presently 52^{o}C)

Monitoring Protocol

1) Power consumption in KWH for all three chiller plants need to be monitored for daily basis.
2) Chiller plant regular parameters need to be monitored e.g. return temperature and Chilled water set point.
3) Energy consumption for the primary and secondary chilled water pumps to be monitored.
4) Energy consumption for the condenser water pumps to be monitored.
5) All the Air handling units where we have VFDs, energy consumption need to be monitored.
6) Energy consumption to be monitored at the guest floors.
7) Fuel consumption for the steam boilers & hot water generators to be monitored through the Fuel Flow Meters.
8) Power consumption to be monitored for all the areas where lighting system would be re-engineered.
9) Power consumption to be monitored for the water pumping systems.
10) Water consumption to be monitored.
11) Chillers and AHUs to be integrated with the existing BMS system for close monitoring of the data.

RECORDS MAINTAINED

- Energy consumption data to be recorded in hard copy for Chillers and AHUs.
- Hotel Occupancy details to be recorded.
- Fuel Consumption to be recorded in hard copies.
- Monthly performance to be reviewed for the Chillers based on the data collection.

REASON FOR SELECTION

- Reducing the specific power consumption of chiller plant.
- Reduction in the emission of the CO_2.
- Reducing the HVAC load.
- Reducing the Fuel consumption and further reduction in the CO_2 level.
- Reducing the water consumption by avoiding the wastage of the water.
- To improve the overall efficiency of the Chiller system, Lighting system, Steam generation system, Water pumping system and HVAC system.

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SAVING & INVESTMENT STATISTICS

Project	Cost Saving per Year (Lacs)	Energy saved per year (KWH)	Capital Cost (Rs. Lacs)	Life of Equipment
Project (A)	38,00,000	2,55,000.00	78,00,000.00	
Project (B)	20,00,000.00	4,83,000.00	49,00,000.00	
Project (C)	1,74,000.00	42,000.00	6,00,000.00	
Project (D)	27,00,000.00	3,24,000.00	64,00,000.00	
Project (E)	3,25,000.00		5,10,000.00	
Project (F)	80,000.00		3,00,000.00	

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IMPLEMENTED PROJECTS

Install automation in FCUs to reduce speed automatically during unoccupied period

Present system

- Fan coil units (FCUs) are installed in all guest rooms for air conditioning
- All FCUs are operated at maximum speed during non-occupancy period
- Though two-way and three-way valves are installed in the chilled water circuit of all FCUs, some quantity of water is always circulated due to defective control valves or improper seating of valves
- There is no appreciable thermal load in the guest rooms during non-occupancy period and hence high-speed operation during such periods adds avoidable electrical load and thus thermal load to the air-conditioning system

Proposal

- Install electronic speed varying controls in the room to change over FCU to lowest speed whenever guest room key card is removed (when unoccupied)
- This will reduce electrical and thermal load to the air conditioning system
- Similar controls are provided in several recent hospitality facilities

Utilise flash steam from return condensate to preheat high zone hot water

Present system

- Hot water required in high zones & low zones
- Low zone requirement is met by preheating using the return condensate
- High zone requirement is met by passing through hot water boiler (primary & secondary stage circulation)
- Existing condensate return system consists of flash vessel and a plate heat exchanger arrangement to recover heat from condensate, but flash steam presently vented without being put into use
- Expected flash steam quantity around 30–40 kg/hr (based on an assumed steam flow of 550 – 600 kg/hr)
- Entire condensate at around 70oC is drained at present as this cannot be used as boiler feed due to limitations of boiler feed pump

Proposal – Stage I

- Provide suitable pipeline arrangements to bring the flash steam to the existing plate heat exchanger (BP13)
- Return water coming from high zone will have to be passed through this plate heat exchanger
- Joint survey along with Mark Engineers, Mumbai (who have confirmed to provide turnkey completion of the proposed scheme)
- Proposed system should have a 3-way valve, along with a temperature controller, which will vent the flash steam in case the temperature of hot water exceeds preset limit (presently 52^{o}C)

Provide annual maintenance contract to boiler to optimise efficiency

Present system

- Three non-IBR boilers, each of 600 kg/hr, HSD-fired, in operation (one at a time)
- Flue gas temperature quite high at 185-190oC, indicating possibility of lower efficiency of combustion
- High excess air levels of 60% (O2 level 8% measured during normal operation) in flue gas
- Average HSD consumption per day is around 1000 litres

Proposal

- Flue gas oxygen level influences boiler fuel consumption
- Present oxygen level can be suitably brought down & sustained at 5–6%
- One positive approach can be by bringing the boilers on AMC through Thermax, who can assure optimum excess air / oxygen levels in the boiler flue gas, and also desoot the lines
- Minimum savings of 2% can be expected with AMC

Specifications

- Boiler flue gas : Nominal oxygen level : 5-6%
- Nominal flue gas temperature with economiser : 150-160Oc

Use energy efficient T5 fluorescent lamps with electronic ballast in place of conventional fluorescent lamps

Present system

- Widely, twin tube light fittings with T8 lamps are catering the requirement in plant room, car parking, kitchen, back of offices, etc.
- 40 W tubes, 36 W slim tubes and 36 W energy efficient lamps (such as Trulite of Philips make) are in service
- Electronic chokes are also in service in fittings

Proposal

- Replace conventional FTL with energy efficient T5 – OSRAM make – PICOSTAR-R ; FH 28 W Combi
- The consumption of T5 fitting is 28 W & these are direct matching with the existing fixtures
- Electronic ballast of T5 consumes power of 2 W and operates at PF of above 0.95
- This improved PF helps in reduction of current and hence losses in the lighting circuits
- T5 lamps gives more Illumination i.e. around 100 lm/watt, compared to 65 lm/watt of T8. i.e 50 % more illumination with 25 % lesser power consumption
- This can be applicable in B1 & B2 car parking areas and back of offices. Illumination in car parking is in the range of 30 to 120 Lux. This is much on the higher side and illumination in the range of around 50 lux is sufficient
- In our case, using of one FTL of T5 in place of twin T8 FTLs will reduce the energy consumption further to the tune of 40 % with out suffering the minimum Illumination requirement
- Osram make T5 fittings are installed in Marriott Welcom Hotel, New Delhi in car parking, back offices, etc. and these are working satisfactorily
- These are applicable in all locations leaving a few task specific locations such as offices, stores, control rooms, etc.

Installation of Occupancy Sensors in Bathrooms of Guest Rooms & Public Area Rest Rooms (WIP)


Condensate Recovery System Installed to
Heat up the Guest Floor Hot Water

Condensate Recovery System Installed to Heat up the Guest Floor Hot Water

Replaced twin tube fixtures of T12 lamps with Energy Efficient T5 Lamps

Replaced twin tube fixtures of T12 lamps with Energy Efficient T5 Lamps

FOLLOWING ARE THE PROJECTS TO BE

IMPLEMENTED DURING THE FINANCIAL YEAR

2007-08, AS PROPOSED BY ITC ENERGY

AUDITORS U.V.K. RAO & ASSOCIATES

Energy Savings in Electrical & Lighting System

EXECUTIVE SUMMARY

Annual Recurring Savings : Rs. 42 lacs

One-time investment : Rs. 57 lacs

Average Payback : 16 months

Energy Savings in Electrical & Lighting System

TEM Nos. & Proposal Description	Recurring Annual Savings Rs. lacs	One-time Cost of Implementa-tion Rs. lacs	Pay back Months
TEM E1N: Optimise lighting voltage to 215-220V by installing energy saver	9.11	15.60	21
TEM E2N: Use energy efficient T5 fluorescent lamps with electronic ballast in place of conventional fluorescent lamps	8.43	2.25	3
TEM E3: Connect capacitors at load / feeder ends	1.71	1.48	10
TEM E4: Replace existing 7W night lamps in guest rooms with low LED lamps	3.45	0.60	2
TEM E5: Remove motor cooling fans in AHUs & TFAs		-	
TEM E6: Replace existing motors with energy efficient motors at select places	1.35	2.43	22
TEM E7N: Replace 12 V / 50 W halogen lamps with energy efficient 12 V / 35 W IRC lamps	4.68	5.57	14
TEM E8N: Install occupancy lighting sensors in identified locations	8.25	18.61	27
TEM E9: Replace existing lamps with energy- efficient lamps in identified places	5.30	9.94	23
Total	**42.28**	**56.48**	**16**

Electrical System : Background

- Incoming supply11 kV, stepped down to 433 V, 3 phase, 4 wire
- DG sets are provided for backup
- Contracted Maximum Demand (CMD): 1500 kVA
- Minimum Billing MD : 1125 kVA (75% of CMD)

BASE DATA

- Hotel provided electricity Consumption and energy data
- Studied the HT & LT system
- Power measurements taken for various motors
- Studied illumination levels and lighting system
- Power tariff: Rs 7.70 /kWh (per typical EB bill: Sep '07)

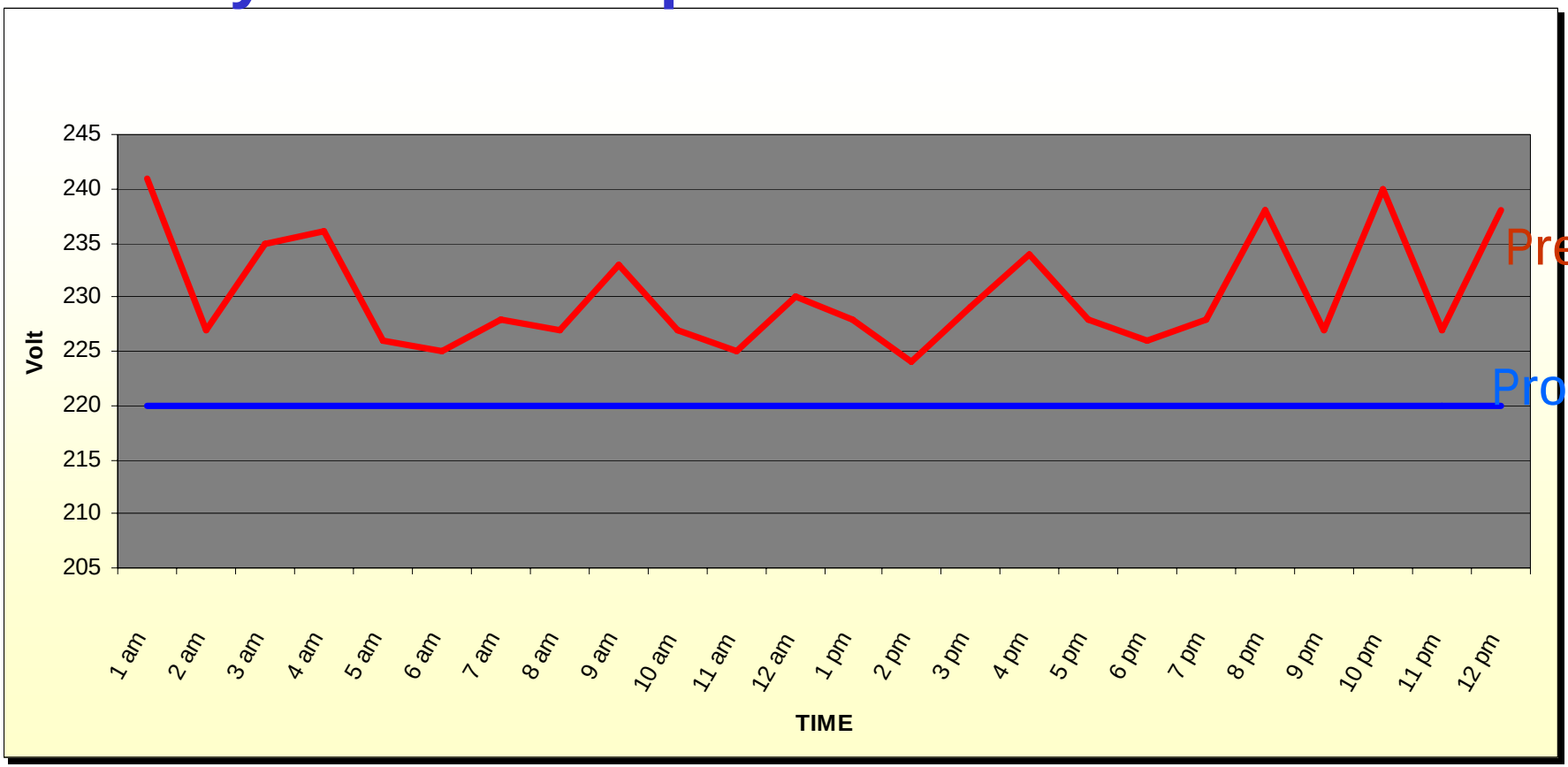
TEM E1N: Optimise lighting voltage to 215-220V by installing energy saver

Present System

- Lighting load comprises fluorescent lamps, CFLs, incandescent lamps and halogen lamps
- Measured, user-end lighting voltage is in range of 220-240 V
- Energy voltage trend was done and collated from past log data
- No control gears like voltage regulators / stabilizers exist for lighting except dimmers in restaurants and banquet halls
- Providing voltage higher than rated results in :
    - Wastage of power
    - Reduction in lamp life
    - Premature lamp failures

TEM E1N: Optimise lighting voltage to 215-220V by installing energy saver

Present system vs Proposal



TEM E1N: Optimise lighting voltage to 215-220V by installing energy saver

Proposal

- Instal energy savers of following ratings, in lighting circuits to get constant output voltage:
  - Rising Main 1 (10 x 20 kVA) : 200 kVA
  - Rising Main 2 (7 x 20 kVA) : 140 kVA
  - Main Kitchen MDBG4 : 60 kVA
- Lighting energy saver employs a combination of impedance & capacitance to reduce excessive current in circuit, and reduces ballast loss and shifts wastage into useful energy
- Maintaining 210-215 V will give a guaranteed 10 % savings and reduction in lux level will be 4 to 5 % which is not perceptible
- Voltage can be maintained constant (220 V) or at any desired level with help of the proposed equipment

TEM E1N: Optimise lighting voltage to 215-220V by installing energy saver

Proposal

- Advantages of proposed energy saver:-
  - Gives a stabilized output
  - Improves power factor of lighting system
  - Filters harmonics
  - Saves upto 10 % energy
  - Improves life of lighting equipment
  - Reduces maintenance costs
  - Reduces premature lamp failures

TEM E1N: Optimise lighting voltage to 215-220V by installing energy saver

Proposal

- Savings in excess of 10 % is common with Energy Savers on a sustained basis and trials and installations amongst ITC hotels have confirmed the same
- Lighting energy savers are successfully working at ITC Kakatiya and ITC Windsor
- Availability of space for installing these lighting energy savers in the proposed locations was jointly explored by Central-UVKA audit team and confirmed
- Dedicated, on-line metering to monitor savings through energy savers are recommended
- Specification of the proposed lighting energy saver units for identified circuits is given in Annex E1N.1

TEM E1N: Optimise lighting voltage to 215-220V by installing energy saver

Benefits

Recurring Annual Savings	: Rs. 9,11,000
One-time Cost of Implementation	: Rs.15,62,000
Payback	: 21 months
Champions' Recommendation	: Yes
CE's Approval for implementation	: Yes
Savings Measurement	: Direct. Measure energy before and after installing energy saver

TEM E1N: Optimise lighting voltage to 215-220V by installing energy saver

Summary

Location & Feeder	Annual Saving		Energy Saver Rating: kVA	Investment: Rs.	Pay back Months
	kWh	Rs.			
Rising Mains 1	37,960	292,292	200	710,000	29
Rising Mains 2	58,400	449,680	140	497,000	13
Main kitchen (MDB G4)	21,900	168,630	60	213,000	15
Contingency 10%				142,000	
Total	**118,260**	**910,602**	**400**	**1,562,000**	**21**

TEM E1N: Optimise lighting voltage to 215-220V by installing energy saver

Description	Unit	Formula	Value
As per energy meter readings, average daily energy consumption of the Rising Mains 1	kWh	A	1,300
Expected power saving	%	B	10
No. of days	days	B1	365
Number of days / year taken for energy saver operation (based on average occupancy of 80%)	Nos.	C = B1 x 80%	292
Energy cost per unit	Rs	D	7.70
Recurring annual savings	kWh	E = A* B* C	37,960
Recurring annual saving	**Rs.**	**F = E * D**	**292,292**
Rating of energy saver requirement	**kVA**		200
One time cost of implementation (Basis: Turnkey offers received)	**Rs.**	**G**	**710,000**
Pay back	months	H = G *12/F	29

TEM E1N: Optimise lighting voltage to 215-220V by installing energy saver

Description	Unit	Formula	Value
As per energy meter readings, average daily energy consumption of Rising Mains 2 feeder	kWh	A	2,000
Expected power saving	%	B	10
Number of days / year (based on average occupancy of 80%)	Nos.	C	292
Energy cost per unit	Rs	D	7.70
Recurring annual Savings	kWh	E = A* B* C	58,400
Recurring annual saving	**Rs.**	**F = E * D**	**449,680**
Rating of energy saver requirement	kVA		140
One time cost of implementation (Basis: Turnkey offers received)	**Rs.**	**G**	**497,000**
Pay back	months	H = G *12/F	13

TEM E1N: Optimise lighting voltage to 215-220V by installing energy saver

Description	Unit	Formula	Value
As per energy meter readings, average daily energy consumption of Main Kitchen - MDB G4 - feeder	kWh	A	600
Expected power saving	%	B	10
Number of days / year	Nos.	C	365
Energy cost per unit	Rs	D	7.70
Recurring annual savings	kWh	E = A*B*C	21,900
Recurring annual saving	**Rs.**	**F = E * D**	**168,630**
Rating of energy saver requirement	kVA		60
One time cost of implementation (Basis: Turnkey offers received)	**Rs.**	**G**	**213,000**
Pay back	months	*12/F	15

TEM E1N: Optimise lighting voltage to 215-220V by installing energy saver

Vendors

Servomax India Ltd
Hyderabad
Energy Saving Division
+919848462496
Mr PV Pavan Kumar
Mumbai Contact:
Mr. V. L. Murthi
98672 30060

Shepherd Transformer Inds. Ltd.,
C / 132, Gatkopar Indl. Estate, LSB Marg,
Gatkopar (W), Mumbai - 400 086
Phone : 022 2500 8480 / 5596 9179
Email : shepherd@bom3.vsnl.net.in

E.S. Electronics India Pvt Ltd
438, 4th Main Road, Nagendra Block
B.S.K 1stage, Banglore-560050
Telefax 080-2672 7836
Phone : 080-2642 0623; Cell: 098441 36209
Email: eleindia@bgl.vsnl.net.in
Website:www.es25.net

TEM E1N: Optimise lighting voltage to 215-220V by installing energy saver

Specifications

Annex E1N.1

Parameter Specifications	Range
Operating voltage	3 Phase, 415 V AC irrespective of input fluctuations output is maintained constant at 215 - 220 (microprocessor based thyristor / power contactors control tap changer)
Input voltage line frequency	50 Hz
Operating temperature	45°C
Climatic conditions	95% RH
Insulation Class	B/F
Output current per kVA	4.3 A
Duty cycle	Continuous 24/7

TEM E1N: Optimise lighting voltage to 215-220V by installing energy saver

Specifications

Parameter Specifications	Range
Weight per kVA	≤ 15 kgs (Approximately)
Power saving approx %	Min. 10% above
Temp rise	45°C
Over load percentage	120% for 30 mts
V, I, PF, KVA/kWh meter	Yes with RS 232 port. Also, Voltmeter only on output
MCB / MCCB's inside	Yes. Branded
Power factor improvement system	Above 0.9
System construction	Forced air cooling for above 10 kVA
No load losses	≤ 0.75 %

TEM E1N: Optimise lighting voltage to 215-220V by installing energy saver

Specifications

Parameter Specifications	Range
Full load losses	≤ 1.25%
Efficiency	>98%
Warranty Period	3 Years
By-Pass system	On load bypass
Short circuit and over load protection	Required
High voltage test 2.5 kV for 60sec	Yes
Core material	CRGO with 98% eff.
Enclosure	CRCA sheet steel powder coated free standing
Winding copper wire	Electrolyte double insulated annealed copper more than 99.3%

TEM E1N: Optimise lighting voltage to 215-220V by installing energy saver

Specifications

Parameter Specifications	Range
Cable gland	Double compression glands. Top / Bottom / Side entry according to site requirement
Cable	Poly cab / Universal / Finolex with crimped legs for connections as per the site requirement
Terminal	Provision for connecting the existing cable size freely. Any bypass circuits are to be provided with separate connections as per site conditions
Harmonic reduction	Required reduction more than 20% from the existing THD valve
Earthing	Should be done according to site with 25 x 5 mm GI strip
Bypass	Automatic bypass over the rated kVA of the Unit
Any additional requirement will be given according to site conditions	

TEM E1N: Optimise lighting voltage to 215-220V by installing energy saver

Implementation Plan

Activity	Weeks											
	1	2	3	4	5	6	7	8	9	10	11	12
Collecting vendor quotes												
Baseline establishment / Data Reconfimation												
Technical discussion & Finalisation												
order placement												
Material receipt												
Installtion & commisioning												
Measurement of savings												
Certification of savings												

Grand Central to implement this proposal with vendor assistance. UVKA will render any additional necessary assistance for implementation and achieving savings

TEM E1N: Optimise lighting voltage to 215-220V by installing energy saver

Measurement & Verification of Savings

Description		Before implementation	After implementation
Measured energy consumption	kWh/day		
No. of working days per year	days		
Annual energy consumption	kWh		
Recurring annual energy saving	kWh		
Average tariff	Rs./kWh		
Recurring annual savings	Rs.		

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TEM E2N: Use energy efficient T5 fluorescent lamps with electronic ballast in place of conventional fluorescent lamps

Present system

- Twin-tube fluorescent light fittings (FTL) with T8 lamps are widely catering the lighting requirements in plant room, car parking, kitchen, back-of-house office areas and 36 w slim tubes and 36 w energy efficient lamps (such as Trulite of Philips make) are in service
- Electronic ballasts are also in service in FTL fittings

TEM E2N: Use energy efficient T5 fluorescent lamps with electronic ballast in place of conventional fluorescent lamps

Proposal

- Replace conventional FTL with energy efficient T5 lamp and electronic ballast. For example, T5 – OSRAM make – PICOSTAR-R ; FH 28 w Combi
- T5 lamps gives more illumination i.e., around 100 lm/watt, compared to 65 lm/watt of T8. i.e., 50 % more illumination with 25 % lesser power consumption
- Lamp consumes 28 W
- Electronic ballast of T5 consumes 2 W and this lamp can be directly fixed in existing fixtures without need for any modifications and operates at PF of above 0.95
- This improved PF helps in reduction of current and hence losses in the lighting circuits

TEM E2N: Use energy efficient T5 fluorescent lamps with electronic ballast in place of conventional fluorescent lamps

Proposal

- This can be applicable in B1 & B2 car parking areas and back-of-the house areas. Illumination in car parking is about 120 Lux. This is much on the higher side and illumination in the range of around 50 lux is sufficient
- Also, using of one FTL of T5 in place of twin T8 FTLs will reduce the energy consumption further by 40 % without affecting minimum illumination requirement
- Osram make T5 fittings are installed at Welcom Sheraton, New Delhi in car parking, back-of-the-house and reported as working satisfactorily
- These are applicable in all locations leaving a few task specific locations such as offices, stores, control rooms

TEM E2N: Use energy efficient T5 fluorescent lamps with electronic ballast in place of conventional fluorescent lamps

Benefits

Recurring Annual Savings	: Rs. 843,000
One-time Cost of Implementation	: Rs. 2.25 / 10.5 L
Payback	: 3 / 15 months
Champions' Recommendation	: Yes
CE's Approval for implementation	: Yes
Savings Measurement	: Direct

TEM E2N: Use energy efficient T5 fluorescent lamps with electronic ballast in place of conventional fluorescent lamps

Description	Unit	Formula	Value
Power consumption of Existing 36 W TLs - twin lamp fittings	W	A	80
Power consumption of Proposed T 5 TL - single	W	B	30
Power savings per Lamp	W	C = A - B	50
No of hours per year	hrs	D	7,300
Total no.of fittings considered	nos.	E	300
Annual Power Savings	kWh	F = C*D*E/1000	109,500
Power cost per unit	Rs.	H	7.70
Recurring annual savings	**Rs.**	**I= G*H**	**843,150**
Cost of T5 Lamps	**Rs.**	**J**	**750**
One time cost of Implementation	**Rs.**	**K = E * J**	**225,000**
Pay back Period	months	L = K *12 / I	3

TEM E2N: Use energy efficient T5 fluorescent lamps with electronic ballast in place of conventional fluorescent lamps

Alternatively, Instead of replacing twin bulbs with single, replacing the entire fitting i.e. replacing the entire twin tube fixture with single T5 fixture to maintain aesthetics.

Description	Unit	Formula	Value
Power consumption of existing 36 W TLs - twin lamps	W	A	80
Power consumption of proposed T 5 TL - single	W	B	30
Power savings per fitting	W	C = A - B	50
No of hours per year	hrs	D	7,300
Total no.of fittings considered	nos.	E	300
Annual Power Savings	kWh	F = C*D*E/1000	109,500
Power cost per unit	Rs.	H	7.70
Recurring annual savings	**Rs.**	**I = G*H**	**843,150**
Cost of T5 Lamps	**Rs.**	**J**	**3,500**
One time cost of Implementation	**Rs.**	**K = E * J**	**1,050,000**
Pay back Period	month	L = K *12 / I	15

TEM E2N: Use energy efficient T5 fluorescent lamps with electronic ballast in place of conventional fluorescent lamps

Vendors

OSRAM India Pvt ltd

201, Residency Chambers

78, Residency Road,

Bangalore - 560025

Tel : 25594283

Fax : 25594294

Cell : 93437 09724(Mr Har Kumar)

For GE T5 tube, Asian Electronics Ballasts

M/s Bombay Electrical Projects & Supplies

C-17, Kilfire House, Dalia Industrial Area

New Link Road, Andheri (W), MUMBAI
Phone : 022 32940469 / 72 / 26731163

Fax : 26735176

Philips Electronics India Limited

Technopolis Knowledge Park

Mahakali Caves Road

Chakala, Andheri (East)

MUMBAI 400 093

Phone : 022 66912399; Fax : 669112389

Email : nehal.shah@philips.com

TEM E2N: Use energy efficient T5 fluorescent lamps with electronic ballast in place of conventional fluorescent lamps

Implementation Plan

Activity	Weeks											
	1	2	3	4	5	6	7	8	9	10	11	12
Collecting vendor quotes												
Baseline establishment / Data Reconfimation												
Technical discussion & Finalisation												
order placement												
Material receipt												
Installtion & commisioning												
Measurement of savings												
Certification of savings												

Grand Central to implement this proposal with vendor assistance. UVKA will render any additional necessary assistance for implementation and achieving savings

TEM E2N: Use energy efficient T5 fluorescent lamps with electronic ballast in place of conventional fluorescent lamps

Measurement & Verification of Savings

Description		Before implementation	After implementation
Measured energy consumption	kWh/day		
No. of working days per year	days		
Annual energy consumption	kWh		
Recurring annual energy saving	kWh		
Average tariff	Rs./kWh		
Recurring annual savings	Rs.		

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TEM E3: Connect PF improvement capacitor at identified load end / feeders

Present system

- Auto power factor control panels are installed in both Transformers
- Overall PF is being maintained well around 0.99
- Certain identified feeders have low PF
- From the data, the readings of the identified Loads / feeder are :

Location	Amps	kW	PF
Chiller Compressor 1	309.8	184.5	0.87
Chiller Compressor 2	334	201.5	0.88
Laundry Panel	no place available engg		
Kitchen Panel	,,		
Boiler Panel	,,		

TEM E3: Connect PF improvement capacitor at identified load end / feeders

Proposal

- It is recommended to connect capacitor to certain identified feeders
- This helps in correcting the PF in the respective circuits
- Connecting PF correction capacitors at load end / feeder will help to :
  - ✓Improve the PF; Reduce the feeder current
  - ✓Reduce the maximum demand proportionately; Reduce the line losses
  - ✓Saving of energy through reduced losses

TEM E3: Connect PF improvement capacitor at identified load end / feeders

Benefits

Recurring Annual Savings : Rs. 117,000

One-time Cost of Implementation : Rs. 120,000

Payback : 13 months

Champions' Recommendation :yes

CE's Approval for implementation :

Savings Measurement : Direct. **(Measure power, PF before and after implementation)**

TEM E3: Connect PF improvement capacitor at identified Load end / feeders

Implementation Plan

Implementation Plan												
Activity	Weeks											
	1	2	3	4	5	6	7	8	9	10	11	12
Collecting vendor quotes												
Baseline establishment / Data Reconfimation												
Technical discussion & Finalisation												
order placement												
Material receipt												
Installtion & commisioning												
Measurement of savings												
Certification of savings												

Grand Central to implement this proposal with vendor assistance UVKA will render any additional necessary assistance for implementation and achieving savings

TEM E3: Connect PF improvement capacitor at identified Load end / feeders

Measurement & Verification Certificate

Description		Before implementation	After implementation
Measured energy consumption	kWh/day		
No. of working days per year	days		
Annual energy consumption	kWh		
Recurring annual energy saving	kWh		
Average tariff	Rs./kWh		
Recurring annual savings	Rs.		

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TEM E3: Connect PF improvement capacitor at identified load end / feeders

See sample calculation in Annex E3.1

Location	Amps	kW	PF	Capacitor rating kVAR	Impr. PF	Exp.annual Savings	
						Units	Rs.
Chiller compressor2	309.8	184.5	0.87	50	0.96	7702	59305
Chiller compressor1	334	201.5	0.88	50	0.96	7518	57889
Chiller compressor3				50			
Laundry Panel	57.3	31.95	space constrain				
Kitchen panel	44.83	26.22	,,				
Boiler Panel	64.78	37.75	,,	difficult to inpliment			
				150		15220	117194

Note: Operating hours considered for chiller compressors is 16 hrs.
Operating hours considered for other panels is 20 hrs.

TEM E3: Connect PF improvement capacitor at identified load end / feeders

Annex E3.1

Sample Calculation

Connect one no. of 50 kVAr Capacitor with suitable Contactor controls
At Chiller compressor

0.87 PF will improve to 0.96
309.8 A reduces to 280.7 Amps. Reduction in Current = 9.4 %
Corresponding reduction in Losses = 17.9 %

Generally distribution losses will be in the range of 4 to 6 % in case of medium Industries.

In our case considering 4 % as Losses and Considering 16 hrs of operation & 365 days
Then, expected annual Energy Saving = 17.9 % x 4 % x 184.5 x 16 x 365 = 7715 Units

in Rupees @ Rs. 7.70 Per Unit = Rs. 59405

Investment: Rs. 800 per kVAr for Capacitors & control Gears suitable for Capacitor Controls.

for Total 50 kVAr = Rs. 40,000

Payback = 40000 x 12 / 59405 = 9 months.

TEM E4: Replace existing 7W night lamps in guest rooms with low LED lamps

Present system

- 7 w CFL lamps are installed in guest rooms as night lamps

Proposal

- Replace 7 w CFL with LED based night lamp. LED night lamps consumes 1 W power and life is more than 50,000 working hours

TEM E4: Replace existing 7W night lamps in guest rooms with low LED lamps

Benefits

Recurring Annual Savings	: Rs. 345,000
One-time Cost of Implementation	: Rs. 60,000
Payback	: 2 months
Champions' Recommendation	: Yes
CE's Approval for implementation	:
Savings Measurement	: Direct. (Measure power, PF before and after implementation)

TEM E4: Replace existing 7W night lamps in guest rooms with low LED lamps

Backup Calculations

Description	Units	Formula	Value
Power consumption by CFL night lamp	W	A	9
Power consumption by LED night lamp	W	B	1
Saving per lamp	W	C = A - B	8
No. of rooms	no.	D	240
No. of night lamps	no.	E	240
No. of working hours per day	hrs	F	8
Occupancy rate	%	G	80
Annual energy saving	unit	H = C x F x 365 x G x D	44,851
Power cost	Rs.	I	7.70
Recurring annual saving	**Rs.**	**J = H x I**	**345,354**
One-time cost of implementation (@ Rs.250/lamp)	**Rs.**	**K**	**60,000**
Payback	months	L = K/J x 12	2

TEM E4: Replace existing 7W night lamps in guest rooms with low LED lamps

Vendors

SPA
2/9, Jaykar Smruti, Aarey Road
Goregaon (W)
MUMBAI 400 062
Phone : 5575 3502; Fax : 2686 6203
Email : jpravin2001@yahoo.com

TEM E4: Replace existing 7W night lamps in guest rooms with low LED lamps

Implementation Plan

Implementation Plan										
Activity	Weeks									
	1	2	3	4	5	6	7	8	9	10
Collecting vendor quotes										
Data Reconfimation										
Technical discussion & Finalisation										
order placement										
Material receipt										
Installtion & commisioning										
Measurement of savings										
Certification of savings										

Grand Central to implement this proposal with vendor assistance UVKA will render any additional necessary assistance for implementation and achieving savings

TEM E4: Replace existing 7W night lamps in guest rooms with low LED lamps

Measurement & Verification Certificate

Description	Before implementation	After implementation
Measured energy consumption (kWh / day)		
No. of working days per year		
Annual energy consumption (kWh)		
Recurring annual energy saving (kWh)		
Average tariff (Rs./kWh)		
Recurring annual savings (Rs.)		

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TEM E5: Remove motor cooling fans in AHUs & TFAs

Present system

- All AHU motors are fitted with fans in the motor shaft end to force air circulation over the motor body fins
- Purpose of fans is to remove heat from the motor body
- This fan consumes typically 3-5% of the motor full load power
- There is circulation of cooled air over the motor body in AHUs and TFAs
- Also, working temperature is maintained less than 22°C inside the closed shell of AHU/TFA

TEM E5: Remove motor cooling fans in AHUs & TFAs

Proposal

- Remove all cooling fans in the AHU motors
- Besides reduction in power consumption , there will be reduction in heat load due to reduced motor power
- This is implemented jointly by UVKA and Grand Central Team already in all AHUs and TFAs and savings are being achieved

TEM E5: Remove motor cooling fans in AHUs & TFAs

Benefits

Recurring Annual Savings	:	Rs. 96,000
One-time Cost of Implementation	:	Nil
Payback	:	Immediate
Champions' Recommendation	:	not accepted
CE's Approval for implementation	:	not accepted
Savings Measurement	:	

TEM E5: Remove motor cooling fans in AHUs & TFAs

Backup Calculations

S. No.	Equipment		Motor rating	Running hrs/day	Annual savings @ 1.5% of rated power
A	B	C	D	E	F = D X 0.015 X E X 365 X 7.7
1	Cafeteria wash	LWHA 053B	2.2	8	742
2	Cafeteria dining	LWHA 023B	2.2	8	742
3	Personnel	LWHA 053B	2.2	12	1,113
4	Finance	LWHA 053B	2.2	12	1,113
5	Kebab & Curries	DWAA 1008	10	18	7,588
6	Dublin	DWAA 1008	10	10	4,216
7	Shanghai club	DWAA 1008	10	12	5,059
8	Banquet 1	DWAA 1006	10	12	5,059
9	Banquet 2	DWAA 1006	10	12	5,059
10	Banquet 3	DWAA 1006	10	12	5,059
11	FD Lounge	DWAA 1006H	7.5	12	3,794
12	Lobby	DWAA 1006H	7.5	24	7,588
13	Coffee shop	DWAA 1109	15	20	12,647
14	TFAs 10-12, 15-23 (12 Nos.)	DWAA 503 H	3	24	36,424
	TOTAL				**96,203**

TEM E5: Remove motor cooling fans in AHUs & TFAs

Implementation Plan

Activity	Implementation Plan Weeks						
	1	2	3	4	5	6	7
Collecting vendor quotes							
Baseline establishment / Data Reconfimation							
Technical discussion & Finalisation							
Installtion & commisioning							
Measurement of savings							
Certification of savings							

Grand Central to implement this proposal with vendor assistance. UVKA will render any additional necessary assistance for implementation and achieving savings

TEM E5: Remove motor cooling fans in AHUs & TFAs

Measurement & Verification Certificate

Description		Before implementation	After implementation
Energy consumption for AHU & TFA	kWh/day		
No. of working days per year	days		
Annual energy consumption	kWh		
Recurring annual energy saving	kWh		
Power cost	Rs./kWh		
Recurring annual savings	Rs.		

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TEM E6: Replace existing motors with energy efficient motors at select places

Present system

- Existing motors are standard motors
- Motor capacity range (typical) : 1 kW to 20 kW
- Motor are of Standard or eff-2

TEM E6: Replace existing motors with energy efficient motors at select places

Proposal

- Replace select motors with energy efficient 1 (eff1) motors
- Typically, eff1 motors offer 3-6% higher efficiency than standard motors
- Recommended to replace enclosed list of motors with EEF1 motor
- This is a proven energy saving proposal and must be encouraged even if the payback is higher since it gives perennial saving beyond the payback period
- New motors are also with same frame size and suit same foundation

TEM E6: Replace existing motors with energy efficient motors at select places

Benefits

Recurring Annual Savings	: Rs. 135,000
One-time Cost of Implementation	: Rs. 243,000
Payback	: 22 months
Champions' Recommendation	: Yes
CE's Approval for implementation	:
Savings Measurement	: Direct. Measure power before and after replacement of motors

TEM E6: Replace existing motors with energy efficient motors at select places

Advantages

- Advancements in material science and awareness / prudence of electrical energy usage, led to manufacture of energy efficient motors, classified as eff1 and eff2
- Highest efficiency is provided by eff1 motors, conforming to IS 12615 and compared to standard motors, the inherent features are :
  - ✓ dependent on size, efficiency is higher by 6 % to 9% for comparable capacity
  - ✓ power factor of eff1 motors is also higher
  - ✓ efficiency between 50 % and 100% loading is constant

TEM E6: Replace existing motors with energy efficient motors at select places

Advantages

- The losses in the eff1 motors are lower due to :
  - ✓ Quality sheet material (low watt loss)
  - ✓ More active material (Iron, Copper etc)
  - ✓ Optimized bearing and ventilation systems, and
  - ✓ Optimized design
- Other benefits of eff1motors include:
  - ✓ Reduced max demand (kVA)
  - ✓ Low heat losses
  - ✓ Low CO_2 emission

TEM E6: Replace existing motors with energy efficient motors at select places

Backup Calculations

S. No.	Equipment	Rated power	Measured power	Rated efficiency of existing motor	Efficiency of new motor	Savings	Running hrs/day	Recurring annual savings	One time cost of implementation
		kW	kW	%	%	kW	hrs/day	Rs.	Rs.
A	B	C	D	E	F	G = D x (1-E/F)	H	I = G x H x 7.7x 365	J
1	Main kitchen exhaust fan	15	12.1	88.6	91	0.32	22	19,732	30,000
2	Laundry fresh air fan	7.5	7.33	86	90	0.33	22	20,143	14,405
3	ETP blower 1 (2900 mm)	7.5	5.5	86	89.5	0.22	12	7,254	14,405
4	ETP blower 2 (2900 mm)	7.5	5.5	86	89.5	0.22	12	7,254	14,405
5	Fix plant fresh air fan	2.2	1.2	78	86.4	0.12	18	5,902	7,000
6	TFA fans (12 Nos.)	2.2	1.2	82.3	86.4	0.06	24	46,092	84,000
7	Boiler fresh air fan	2.2	1.2	78	86.4	0.12	22	7,214	7,000
8	Main kitchen fresh air fan	11	5.78	89	91	0.13	22	7,855	23,850
9	HVAC exhaust fan	11	5.5	89	91	0.12	20	6,795	23,850
10	HVAC fresh air fan	11	5.5	89	91	0.12	20	6,795	23,850
	TOTAL							**135,034**	**242,765**

	Recurring annual savings			**Rs.**	**135,034**				
	One-time cost of implementation			**Rs.**	**242,765**				
	Payback			months	22				

TEM E6: Replace existing motors with energy efficient motors at select places

Vendors

1. Bharat Bijlee Ltd
   Post Box no. 100
   Tane Belapur Road,
   Thane – 400 601.
   Tel: 27632 733, 2763 7283
   FAX: 2763 7430
   e-mail: dpn@bharatbijlee.com

2. Siemens ltd
   Tower B/701-705,
   ICC trade Tower
   403A, SenaptiBapat Road
   Pune-411016
   Tel: 25706000, Fax: 25706060.
   e-mail: motors.in@siemens.com

3. Entex Private Ltd
   T-54, II Floor, IIIAvenue, Anna Nagar, Chennai
   email: entex@vsnl.com
   Tel No: 2622 1335, 26193828
   Mobile: 094443 91791

TEM E6: Replace existing motors with energy efficient motors at select places

Specifications

All name plate details as same as Existing motor , but motors are with EFF-1 category.

TEM E6: Replace existing motors with energy efficient motors at select places

Implementation Plan

Implementation Plan	Weeks														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Baseline data establishment															
Proposal implementation starting time															
Proposal completion target															
Confirm energy meter reading															
Certify savings achieved															
First Week starts after receiving conformation from hotel															

Grand Central to implement this proposal with vendor assistance UVKA will render any additional necessary assistance for implementation and achieving savings

TEM E6: Replace existing motors with energy efficient motors at select places

Measurement & Verification of Savings

Description		Before implementation	After implementation
Measured energy consumption for selected motor	kWh/day		
No. of working days per year	days		
Annual energy consumption	kWh		
Recurring annual energy saving	kWh		
Average tariff	Rs./kWh		
Recurring annual savings	Rs.		

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Chief Engineer
Grand Central

TEM E7N: Replace 12 V / 50 W halogen lamps with energy efficient 12 V / 35 W IRC lamps

Present System

- 50 W, 36^0, 12 V, warm daylight, Osram or Philips make, GU 5.3 base standard halogen lamps with electronic transformer as control gear are used in
  - Guest rooms
  - Restaurants
  - Ball rooms
  - Public areas such as rest rooms, guest floor corridors
  - External facade lighting area
- See Annex E1.1A for lamp wise data
- Halogen lamps produce intense heat which adds to the expensive air-conditioning load apart from being heat-radiant to inmates and appurtenant materials
- Short life of halogen lamps, i.e., 2000 hours necessitates frequent replacements and thus environment-unfriendly

TEM E7N: Replace 12 V / 50 W halogen lamps with energy efficient 12 V / 35 W IRC lamps

Location	No of lamps	Operating hours
Guest rooms ITC One	204	6
Guest rooms EC rooms	1338	6
Irish Pub	42	12
Shopping Complex	61	12
Lobby area	114	24
Coffee shop	218	12
Fedrikee Lounge	44	12
Sky Lounge Terrace	15	12
Total	**2036**	

TEM E7N: Replace 12 V / 50 W halogen lamps with energy efficient 12 V / 35 W IRC lamps

Proposal

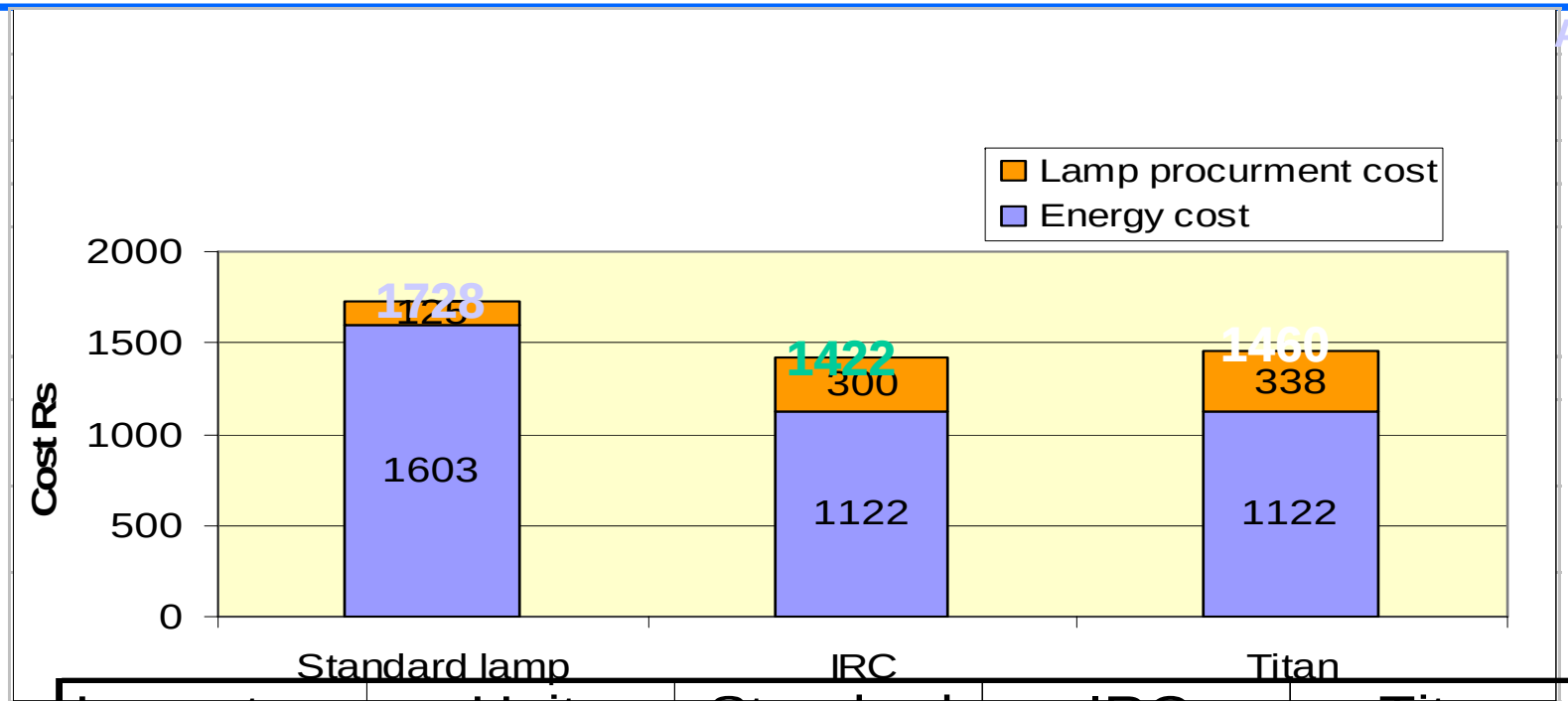
- There are efficient alternatives for the existing halogen lamps
- Following annexes provide the necessary background and analysis for arriving at energy-efficient and economic replacement:
  - Annex E1.1.B - Comparison of power and life of present and proposed lamps
  - Annex E1.1.C - Lifecycle cost comparison of present and alternative lamps
  - Annex E1.1.D - Costs & benefits comparison of recommended option

TEM E7N: Replace 12 V / 50 W halogen lamps with energy efficient 12 V / 35 W IRC lamps

Description	Power	Angle	Light output	Life	Efficacy	Initial/cost
Formula	A	B	C	D	E=C/A	F
Unit	w	deg	Candla(cd)	hours	cd/watt	Rs/lamp
Standard Present	50	36	1500	2000	30	50
Alternative 1 IRC Proposed	35	36	2200	5000	63	300
Alternative 2 Titan	35	36	1500	4000	43	270

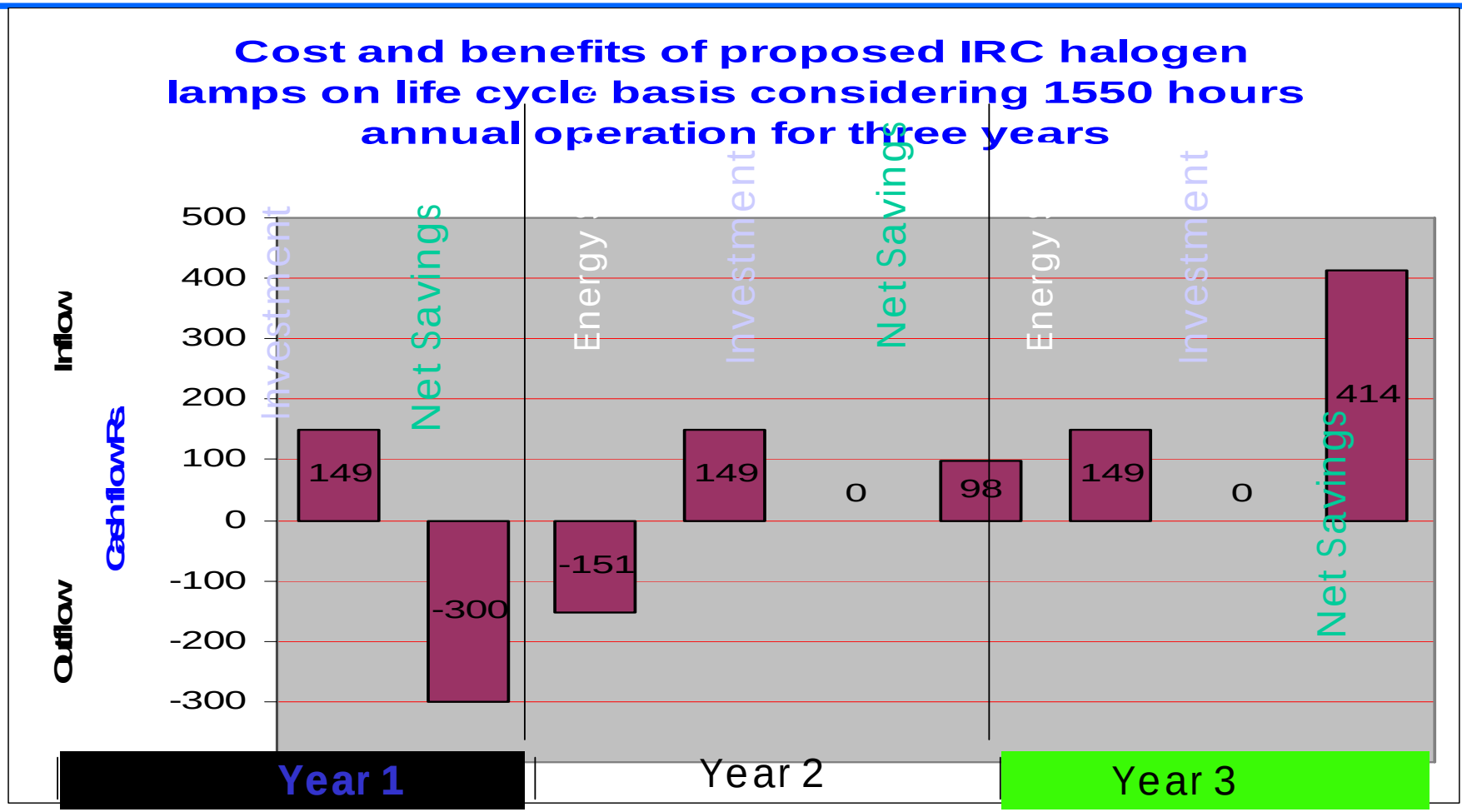
TEM E7N: Replace 12 V / 50 W halogen lamps with energy efficient 12 V / 35 W IRC lamps

Annex E1.1 C



Lamp type	Unit	Standard	IRC	Titan
Power	W	50	35	35
Life	hrs	2000	5000	4000
Cost	Rs/lamp	50	300	270

TEM E7N: Replace 12 V / 50 W halogen lamps with energy efficient 12 V / 35 W IRC lamps



TEM E7N: Replace 12 V / 50 W halogen lamps with energy efficient 12 V / 35 W IRC lamps

Proposal

- Replace with 35 W, $36^{0,}$ 12V IRC Osram Decostar or equivalent which provide following advantages:
  - Color rendering index (CRI) and acceptable luminance are retained
  - Lighting power savings of 15 W per lamp (30%)
  - 40 % increased light output. And, using available dimmer, can be dimmed to desirable level with additional power saving of 3 to 5W (however, this supplementary savings not considered in enclosed calculation)
  - Savings in air-conditioning load
  - Dimmability feature retained
  - Enhanced life of 5000 hours compared to present 2000 hours
  - Lesser wastage of resources due to longer life - hence environmentally-friendly
  - Can be used in existing lamp holders as-is, lamp being of same shape and size
- This concept is successfully implemented in other UVKA luxury hotel clients like Grand Maratha, Maurya Sheraton

TEM E7N: Replace 12 V / 50 W halogen lamps with energy efficient 12 V / 35 W IRC lamps

Proposal

Based on operating hours savings are worked out for different locations after verifying positive impact based on lifecycle cost analysis:

Area	Recurring Annual Savings Rs lacs	Investment Rs. lacs	Payback Months	Reference
Lobby & Public Area	1.15	0.35	4	**See Back-up A**
Restaurant, Portigo	1.36	0.59	5	See Back-up B
Guest room	2.17	4.63	27	**See Back-up C**
Total	**4.68**	**5.57**	**14**	

Note: In the above table, only incremental investment is shown. However, for budgetary purposes, full investment is noted in the next slide

TEM E7N: Replace 12 V / 50 W halogen lamps with energy efficient 12 V / 35 W IRC lamps

Benefits

Recurring Annual Savings	: Rs. 4.68 lacs
One time Cost of Implementation	: Rs. 5.57 lacs
Payback	: 14 months
Savings Measurement	: Direct
Champions' Recommendation	: Yes
TEM MR Approval for implementation	: Yes
Concept Acceptance	: Yes

TEM E7N: Replace 12 V / 50 W halogen lamps with energy efficient 12 V / 35 W IRC lamps

Lobby & Public area - Replacement of 50 W, 36 ^{0}, warm white halogen lamp with 35 W , 36 ^{0} halogen lamp

Description	Unit	Formula	Existing	Proposal
Type of lamp			Halogen50 W, 36 ^{o}	Halogen35 W, 36 ^{o}
Model			Decostar Standard	IRC
Wattage	W	A	50	35
Lamp life	hours	B	2000	5000
Annual energy consumption for 8760 hours	kWh	C=Ax8760/1000	438	307
AC load corresponding to the wattage of lamp*** (80 % of rated wattage is considered for exisiting lamps and 60 % for new lamps)	TR hr/8760 hours	D=C x 860 x 0.8 /(3024)	100	52
Electrical equivalent of TR savings, @ 0.85 kW/TR	kWh/8760 hrs	E=Dx0.85	84.7	44.5
Total energy consumption	kWh/8760 hrs	F=C+E	523	351
Energy cost	Rs./kWh	G	7.70	7.70
Energy cost for 8760 hours operation	**Rs**	**H=GxF**	**4025**	**2703**
No. of lamps required for 8760 hours operation	Nos.	I	4.4	1.8
Cost per lamp	Rs./No.	J	50	300
Procurement cost of lamps for 8760 hours	Rs.	K=IxJ	219	526
Total cost of operation (incl. lamp cost)	Rs/ hours	L=K+H	4244	3229
Net monetary savings/lamp	**Rs/8760 hours**	**M=L1-L2**	**0**	**1015**
No. of lamps considered	Nos.	N	114	114
Recurring annual savings	Rs./yr	O=NxJ2		**115,708**
Investment for new lamps	Rs	P		34952
Simple payback	Months	Q=Px12/O		4

***** Air conditioining load = kW x 860(kcal/hr/kW) x 0.85 (kW/TR) / 3024 (kcal/TR)1 kW = 860 kcal/hr, sp. Power consumption in chiller system = 0.85 kW/TR, 1 TR = 3024 kcal/hr**

TEM E7N: Replace 12 V / 50 W halogen lamps with energy efficient 12 V / 35 W IRC lamps

Portico, Restaurants - Replacement of 50 W 36 ^{0}, warm white halogen lamp with 35 W , 36 ^{0} warm white halogen lamp

Description	Unit	Formula	Existing	Proposal
Type of lamp			Halogen 50 W , 36 o	Halogen 35 W , 36 o
Model			Decostar Standard	IRC
Wattage	W	A	50	35
Lamp life	hours	B	2000	5000
Annual energy consumption for 4380 hours	kWh	C=A x 4380/1000	219	153.3
Energy cost	Rs./kWh	D	7.70	7.70
Energy cost for 4380 hours operation	**Rs**	**E=C x D**	**1686**	**1180**
No. of lamps required for 4380 hours operation	Nos.	F=4380/B	2.2	0.9
Cost per lamp	Rs./No.	G	50	300
Procurement cost of lamps for 4380hours	Rs.	H=FxG	110	263
Total cost of operation (incl. lamp cost)	Rs/ hours	I=E+H	1796	1443
Net monetary savings/lamp	**Rs/4380 hours**	**J=I1-I2**	**0**	**353**
No. of lamps considered	Nos.	K	385	385
Recurring annual savings	Rs./yr	L=JxK		**135,747**
Additional investment for new lamps	Rs	M		**59,021**
Simple payback	Months	N=Mx12/L		5

TEM E7N: Replace 12 V / 50 W halogen lamps with energy efficient 12 V / 35 W IRC lamps

ITC One, EC Guest Room - Replacement of 50 W 36 ^{0}, warm white halogen lamp with 35 W , 36 ^{0} warm white halogen lamp

Description	Unit	Formula	Existing	Proposal
Type of lamp			Halogen 50 W , 36 ^{o}	Halogen 35 W , 36 ^{o}
Model			Decostar Standard	IRC
Wattage	W	A	50	35
Lamp life	hours	B	2000	5000
Annual energy consumption for 6 hours occuppancy 80% = 1750 hours	kWh	C=A x 1750/1000	87.5	61.25
Energy cost	Rs./kWh	D	7.70	7.70
Energy cost for 1750 hours operation	**Rs**	**E=C x D**	**674**	**472**
No. of lamps required for 1750 hours operation	Nos.	F=1750/B	0.9	0.4
Cost per lamp	Rs./No.	G	50	300
Procurement cost of lamps for 1750 hours	Rs.	H=FxG	44	105
Total cost of operation (incl. lamp cost)	Rs/ hours	I=E+H	718	577
Net monetary savings/lamp	**Rs/1750 hours**	**J=I1-I2**	**0**	**141**
No. of lamps considered	Nos.	K	1542	1542
Recurring annual savings	Rs./yr	L=KX300		**217,229**
Additional investment for new lamps	Rs	M		**462,600**
Simple payback	Months	N=Mx12/L		26

TEM E7N: Replace 12 V / 50 W halogen lamps with energy efficient 12 V / 35 W IRC lamps

Specification

Power	: 35 W
Voltage	: 12 V AC
Base	: GU 5.3 ,51 mm
Luminance	: 2200 cd
Burning hours	: 5000 hours
Angle	: 36^{O}
Typical recommendation	: Osram IRC

TEM E7N: Replace 12 V / 50 W halogen lamps with energy efficient 12 V / 35 W IRC lamps

Implementation Plan

Activity	Weeks								
	1	2	3	4	5	6	7	8	9
Collecting vendor quotes									
Baseline establishment / Data confimation									
Technical discussion & Finalisation									
Order placement									
Material receipt									
Installtion & commisioning									
Measurement of savings									
Certification of savings									

ITC Grand Central to implement this proposal with vendor assistance. UVKA will render any additional necessary assistance for implementation and achieving savings

TEM E7N: Replace 12 V / 50 W halogen lamps with energy efficient 12 V / 35 W IRC lamps

Measurement & Verification Certificate

Description	Before implementation	After implementation
Measured energy consumption (kWh / day)		
No. of working days per year		
Annual energy consumption (kWh)		
Recurring annual energy saving (kWh)		
Average tariff (Rs./kWh)		
Recurring annual savings (Rs.)		

Electrical Champion
Grand Central

Chief Engineer
Grand Central

TEM E8N: Instal occupancy lighting sensors in identified locations

Present system

GUEST ROOM-BATHROOMS

- Each of the 242 Guest room- bath rooms each have 2 x13 W CFLs on either side of the mirror and 3 x 35 W halogen lamps – one above WC, one above bath tub and one in centre of bathroom
- Average effective occupancy of bathroom per day is 4 hours (guesstimated) out of total of 13-14 hours guest-room occupancy
- Lights in bathroom are always ‘on’typically irrespective of occupancy of bathroom
- This has been confirmed by house-keeping and engineering personnel

TEM E8NA: Install occupancy lighting sensors in identified locations

Proposal

GUEST ROOM-BATHROOMS

- Install movement sensor with directional control to switch off the lights when there is no occupancy
- Link three halogen lamps with the proposed control device so that the lights come ‘on’ whenever guest enters and uses the bathroom and to turn ‘off’ when the guest leaves the bathroom
- Two mirror lamps will be outside the sensor as per the KOP of ITC to keep these lights continuously “on”
- Install “light-loggers” to log the sensor controlled lighting and savings thereof
- Extensive trials were conducted in guest bathrooms with sensors at other ITCHotels (Maurya & Maratha) and at Grand Central which reconfirmed the sensor application relevance, reliable working and savings through this concept

TEM E8NB: Instal occupancy lighting sensors in identified locations

Present system

UTILITY ROOMS, PUBLIC & BACK-OF-THE HOUSE AREAS

- At several locations, lights are always ‘on’ continuously irrespective of occupancy. See Annex AE8N.1 for identified locations
- Average occupancy is around 10-12 hrs/day (guesstimated)
- The average consumption is more than 18 hrs/day

TEM E8NB: Install occupancy lighting sensors in identified locations

Proposal

UTILITY ROOMS, PUBLIC & BACK-OF-THE HOUSE AREAS

- Install movement sensor with directional control to dim the light when no movement is there
- Link 66% lights with the proposed control device (and leaving some lighting out side control of the sensor) so that the lights come ‘on’ when some person enters into the room and to become ‘off’ after the person leaves the room
- For type of sensors for each area, see Annex E8N.1
- Install “light-loggers” to log the sensor controlled lighting and savings thereof

TEM E8N: Install occupancy lighting sensors in identified locations

Benefits

Recurring annual savings	: Rs. 8.25 lacs
One-time cost of implementation	: Rs.18.61 lacs
Payback	: 27 months
Champions' recommendation	: Yes
CE's Approval for implementation	:
Concept acceptance	: Yes
Savings measurement	: Direct. Measure power before and after

TEM E8NA: Install occupancy lighting sensors in identified locations

Guest rooms-Bathroom

Descrption	Unit	Formula	Value
halogens of 35 W each in guest room toilets	kW	A	0.105
Present operating hours/day : 13 considered out of 14 guesstimated hours)	hrs	B	13
Expected operating hours per day after installing sensor	hrs	C	4
Total hours saved per day per bathroom	hrs	D = (B-C)	9
Annual operating days	days	F	365.000
Annual operating days considering @ 80% occupancy (2006-07) average	hrs	F1 = F x 80%	290
Expected annual energy savings for 242 rooms	kW	G = D x A x F1 x 242	66,320
Unit power cost	Rs/kWh	H	7.70
Recurring annual savings	**Rs.lacs**	**I=GxH**	**5.11**
One time cost of implementation (indicative)	**Rs.lacs**	**J=5500*242**	**13.31**
Pay back period	Months	K=J/IX12	31

TEM E8NB: Install occupancy lighting controls/key card in identified locations

Public area, utility rooms with key card and switch control

Descrption			Value
Present total power consumption of select area		A	5.8
Present operating hours/day		B	18
Expected operating hours per day after control system installation	hrs	C	10
Expected savings per day	kWh	D=Ax(B-C)	46
Annual operating days	hrs	E	365
Expected annual energy savings	kWh	F=DxE	16,936
Unit power cost	Rs/kWh	G	7.70
Recurring annual savings	**Rs.lacs**	**H=FxG**	**1.30**
One time cost of implementation (guestimate)	**Rs.lacs**	**I = 4500 x 25**	**1.13**
Pay back period	Months	J=Ix12/H	10
Note: - Already implimented by grand central Engg Team			

TEM E8NC: Install occupancy lighting sensors in identified locations

Public area, utility rooms

Descrption	Unit	Formula	Value
Present total power consumption of select area	kW	A	1.2
Present operating hours/day	hrs	B	18
Expected operating hours per day after sensor installation	hrs	C	10
Expected savings per day	kWh	D=Ax(B-C)	10
Annual operating days	hrs	E	365
Expected annual energy savings	kWh	F=DxE	3,504
Unit power cost	Rs/kWh	G	7.70
Recurring annual savings	**Rs.lacs**	**H=FxG**	**0.27**
One time cost of implementation (guestimate)	**Rs.lacs**	**I= 5500x20**	**1.10**
Pay back period	Months	J=Ix12/H	49

TEM E8ND: Install occupancy lighting sensors in identified locations

Service Lift Areas

Descrption	Unit	Formula	Value
Present total power consumption of select area	kW	A	2.7
Present operating hours/day	hrs	B	24
Expected operating hours per day after sensor installation	hrs	C	12
Expected savings per day	kWh	D=Ax(B-C)	32
Annual operating days	hrs	E	365
Expected annual energy savings	kWh	F=DxE	11,826
Unit power cost	Rs/kWh	G	7.70
Recurring annual savings	**Rs.lacs**	**H=FxG**	**0.91**
One time cost of implementation (guestimate)	**Rs.lacs**	**I = 5500 x 19**	**1.05**
Pay back period	Months	J=Ix12/H	14

TEM E8NE: Install occupancy lighting sensors in identified locations

Staff and Public Rest Rooms with 50% dimming facility

Descrption	Unit	Formula	Value
Present total power consumption of select area	kW	A	3.9
Present operating hours/day	hrs	B	24
Expected power savings per day after sensor installation with 50% dimming (3.9 x 50%)	hrs	C = A x 50%	1.95
Expected operating hours after sensor installation	hrs	D	12
Expected savings per day	kWh	E=C x D	23
Annual operating days	hrs	F	365
Expected annual energy savings	kWh	G=ExF	8,541
Unit power cost	Rs/kWh	H	7.70
Recurring annual savings	**Rs.lacs**	**I=GxH**	**0.66**
One time cost of implementation (guestimate)	**Rs.lacs**	**J = 23 x 880(**	**2.02**
Pay back period	Months	J=Ix12/H	37

TEM E8NA: Install occupancy lighting sensors in identified locations

Investment Breakup

Description	Guest room Toilet Rs.	Public Area with Key Card and switch Rs.	Public area Utility room with sensors Rs.	Service lift areas Rs.	Staff & public rest rooms with 50% dimming
Basic equipment cost - sensor	2700	2000	2700	2700	5000
Customs Duty 3%	81	60	81	81	150
Excise duty : 16.4%	456	338	456	456	845
Other expenses 7% (Transport 2%, Octeroi 5%;)	189	140	189	189	350
Total landed cost	3237	2398	3237	3237	5995
Installation & Commissioning charges	1300	1300	1300	1300	1300
Service Tax 12.24%	159	159	159	159	159
Contingency 10%	812	639	812	812	1380
Total	**5508**	**4496**	**5508**	**5508**	**8834**

TEM E8: Install occupancy lighting sensors in identified locations

Vendors

For Steinil Sensors

Pammvi Group of Companies
C501, Remi Bizcourt
9, Shah Indl. Estate
Veera Desai Road, Andheri (W)
MUMBAI 400 053
Phone : 022 2673 1052
Fax : 022 2673 1901
Email : viveck.guptaa@pamvi.com
Website : www.pammvi.com

For Lutron Sensors

Alok Hada
Director
Anusha Technovision Pvt. Ltd
Distributor of Lutron Lighting Controls
259, Trivedi Building, Flat No. 1
Yagnik Marg, Sion (East), MUMBAI 400 022
Phone : 65764366; Fax : 24085925
Mobile : 9892588300
Email : alokhada@anushagroup.com

Wipro Lighting

5th Floor, Godrej Eternia Building-C
Old Pune - Mumbai Road, Shivajinagar
Pune - 411 005
Tel: 020-56098700 Fax: 020-56098777
E-mail: helpdesk.lighting@wipro.com

TEM E8N: Install occupancy lighting sensors in identified locations

Specification sensor

Power Consumption : 1 W

Voltage : 230-240 V AC 50 Hz

Reach : 8 meters (continuously adjustable)

Type of sensor : High Frequency/ Passive Infrared.
See Annex E8N.1 for individual areas

Angle : 360^{O}

Height of installation : Upto 2.5 meters

TEM E8N: Install occupancy lighting sensors in identified locations

Specification for data loggers

Power consumption	:	<2 Watts
Parameters of measurement	:	Lights on, occupancy at ti recorded
Storage	:	Should be able to store 2 months of information at 2 minute intervals
Area	:	Minimum 8 sqm (PIR)
Tabulations	:	Should be presented in a user-friendly analysis with stopper

TEM E8NA: Install occupancy lighting sensors in identified locations

Implementation Plan-Guest rooms bathroom

Activity	Weeks							
	1	2	3	4	5	6	7	8
Collecting vendor quotes								
Base Data confimation								
Technical discussion & Finalisation								
Order placement								
Material receipt								
Installtion & commisioning								
Measurement of savings								
Certification								

ITC to implement this proposal on their own. UVKA will render any additional necessary assistance for implementation and achieving savings

TEM E8B : Install occupancy lighting sensors in identified locations

Implementation Plan-Other sensors

Activity	Weeks							
	1	2	3	4	5	6	7	8
Collecting vendor quotes								
Base Data confimation								
Technical discussion & Finalisation								
Order placement								
Material receipt								
Installtion & commisioning								
Measurement of savings								
Certification								

ITC to implement this proposal on their own. UVKA will render any additional necessary assistance for implementation and achieving savings

TEM E8: Install occupancy lighting sensors in identified locations

Measurement & Verification Certificate

Description	Before implementation	After implementation
Operating hours /day/room		
Measured energy consumption/day/room (kWh)		
Annual energy consumption (kWh)		
Recurring annual energy saving (kWh)		
Average tariff (Rs./kWh)		

Electrical Champion
Grand Central

Chief Engineer
Grand Central.

TEM E9: Replace existing lamps with energy- efficient lamps in identified places

Present System

- The milli square area has 2 x 160 W garden lamp post fixtures
- The existing lamps are Metal halide 160 W
- They are energy intensive
- The lumen output is 5000 lumens

TEM E9: Replace existing lamps with energy- efficient lamps in identified places

Proposal: *For replacing Osram make Decostar standard model, 50 W, 36^0 halogen lamps*

Replace with 35 W Titan 36^0 which provide the following advantages:

- The color rendering index (CRI) and acceptable luminance are retained
- Lighting power savings of 15 W per lamp (30%)
- Savings in air-conditioning load
- Dimmability feature retained
- Enhanced life of 4000 hours compared to 2000 hours at present
- Lesser wastage of resources due to longer life, and hence environmentally-friendly
- Can be used in the existing lamp holders as-is, the lamp being of same shape and size
- Continued compliance of IEC code 60598-1

TEM E9: Replace existing lamps with energy- efficient lamps in identified places

Comparison of wattage vs life-50 W standard halogen lamp with 35 W IRC & Titan lamp

		Wattage	Angle	Lumens	Life	Specific lumens	Initial/ cost
		A	B	C	D	E=C/A	Rs/lamp
		w	deg	Cd	hours	lumens/ watt	
		50 W, 36^0 Vs 35 W 36^o					
Present	Standard	50	36	1500	2000	30	50
Proposed	Titan	35	36	1500	4000	43	200
	IRC	35	36	2200	4000	63	300
	BLV	35	36	1300	4000	38	120

TEM E9: Replace existing lamps with energy- efficient lamps in identified places

Proposal

- **Replace the existing incandescent lamps with CFLs in guest rooms**
  - Proposed to replace the existing 100 W and 60 W incandescent lamps with energy efficient 21 W CFLs in guest rooms
  - Life of proposed CFL lamp is 8,000 hours as against 1,000 hours
  - Power savings is around 85% per lamp
  - Proposed lamp can be installed in the same fixture
  - CFL is instant flicker free warm start
  - Heat emission of CFL is less and thus results in AC load reduction

TEM E9: Replace existing lamps with energy- efficient lamps in identified places

Proposal

- **Replace the existing incandescent night lamps with LEDs or CFLs in guest rooms**

  - Proposed to replace existing 15 W night lamps with 1 W LED
  - Life of proposed LED lamp is 100,000 hours as against 1,000 hours of incandescent lamps
  - Power savings is around 95% per lamp
  - Heat emission of LED is negligible and thus result in AC load reduction

  - Proposed to replace existing 15 W night lamps with 3 W CFL
  - Power savings is around 80% per lamp
  - CFL is instant flicker free warm start
  - Life of proposed CFL lamp is 8,000 hours as against 1,000 hours of incandescent
  - Heat emission of CFL is less and thus results in AC load reduction

TEM E9: Replace existing lamps with energy- efficient lamps in identified places

Proposal

- **Replace the existing conventional copper choke in 36 W FTLs with energy efficient electronic ballast and reflector to retain same light output**
  - Power savings of 10 W per lamp
  - Improvement in lamp life and lumen output due to electronic ballast
  - Savings in air-conditioning load
  - Total harmonic distortion (THD) of proposed electronic ballast is less than 10%
  - Specifications and features are given in specification slide

TEM E9: Replace existing lamps with energy- efficient lamps in identified places

Proposal

- **Replace the existing double ended halogen lamps with metal halide lamps in exterior façade lighting**
  - Life of metal halide lamp is 15,000 as against 1,000 hours
  - Power savings is around 85% per lamp
  - Metal halide lamp requires additional ballast unit to ignition

- **NOTE: This proposal was discussed during the first visit of Energy Audit and implementation is completed. The Mughal Engineering Team deserve appreciation for this speedy action**

TEM E9: Replace existing lamps with energy- efficient lamps in identified places

Proposal

- **Replace the existing mercury vapour (MLL) lamps with 50 W metal halide lamps**

  - Life of metal halide lamp is 12,000 as against 6,000 hours of existing lamp
  - Power savings is around 60 % per lamp
  - Metal halide lamp and control gear can be installed in the same fixture.
  - Mercury content of metal halide lamp is less compared to mercury vapour lamp

TEM E9: Replace existing lamps with energy- efficient lamps in identified places

Benefits

Recurring Annual Savings	: Rs. 5.30 lacs
One-time Cost of Implementation	: Rs. 9.94 lacs
Payback	: 23 months
Champions' Recommendation	: Yes
CE's Approval for implementation	:
Concept Acceptance	:
Savings Measurement	: Direct

TEM E9: Replace existing lamps with energy-efficient lamps in identified places

Guest rooms - Replacement of 50 W, 36 °, warm white HL with 35 W , 36 ° warm white HL

Description	Units	Formula	Existing	Proposal
Type of lamp		A	Halogen 50 W , 36 °	Halogen 35 W , 36 °
Make/Typical recommendation		B	Osram	Osram
Type			Decostar Standard	Titan
Wattage	W	C	50	35
Lamp life	hours	D	2000	4000
Energy consumption for 4000 hours	kWh	E=C x 4000/1000	200	140
AC load corresponding to wattage of lamp*** (80 % of rated wattage considered for halogen lamps)	TR hr / 4000 hrs	F=E x 860 x 0.8 /(3024)	45.5	31.9
Electrical equivalent of TR savings, @ 0.9 kW/TR	kWh/ 4000 hrs	G=Fx0.9	41.0	28.7
Total energy consumption	kWh/ 4000 hrs	H=E +G	241	169
Energy cost	Rs./kWh	I	3.93	3.93
Energy cost for 4000 hours operation	**Rs**	**J=H x I**	**947**	**663**
No. of lamps required for 4000 hours operation	Nos.	K	2	1
Cost per lamp	Rs./No.	L	50	200
Procurement cost of lamps for 4000 hours	Rs.	M=KxL	100	200
Total cost of operation (incl. lamp cost)	Rs/4000 hrs	N=M+J	1047	863
Net monetary annual savings/lamp(200 days/yr, 8 hrs/day).Based on 2006-07 room nights data	**Rs./ 1600 hrs**	**O=(N1-N2)*1600/4000**	**0**	**74**
No. of lamps considered	Nos.	P	750	750
Recurring annual savings	**Rs./yr**	**Q=PxO**		**55,225**
Investment for new lamps	**Rs**	**R**		**150,000**
Simple payback	Months	S=Rx12/Q		33

TEM E9: Replace existing lamps with energy-efficient lamps in identified places

Guest rooms - Replacement of 100 W GLS table lamps with 21 W CFL

			Existing	Proposal	Existing	Proposal
Type of lamp		A	GLS	CFL	GLS	CFL
Wattage	W	C	100	21	60	21
Lamp life	hours	D	1,000	8,000	1,000	8,000
Energy consumption for 8,000 hours	kWh	E=C x 8,000/1,000	800	168	480	168
Airconditioining load corresponding to the wattage of lamp*** (80 % of rated wattage is considered as for GLS lamps,30% for CFLs)	TR hr/8,000 hours	F=E x 860 x 0.8 /(3024)	182.0	14.3	109.2	14.3
Electrical equivalent of TR savings, @ 0.75 kw/TR	kwh/ 8,000 hrs	G=Fx0.75	136.5	10.8	81.9	10.8
Total energy consumption	kwh/ 8,000 hrs	H=E +G	937	179	562	179
Energy cost	Rs./ kWh	I	3.93	3.93	3.93	3.93
Energy cost for 8,000 hours operation	**Rs**	**J=H x I**	**3680**	**702**	**2208**	**702**
No. of lamps required for 8,000 hours operation	Nos.	K	8	1	8	1
Cost per lamp	Rs./No.	L	15	200	15	200
Procurement cost of lamps for 8,000 hours	Rs.	M=KxL	120	200	120	200
Total cost of operation (incl. lamp cost)	Rs/8,000 hours	N=M+J	3800	902	2328	902
Net monetary savings/lamp(4 hours/day, 200 days/year)	**Rs/ 800 hours**	**O=(N1-N2)*800/8,000**	**0**	**290**	**0**	**143**
No. of lamps considered	Nos.	P	1272	1272	370	370
Recurring annual savings	**Rs./yr**	**Q=PxO**		**368,624**		**52,755**
Investment for new lamps	**Rs**	**R=Px4,000**		**254400**		**74000**
Simple payback	Months	S=Rx12/Q		8		17

Note:Operating hours is based on 2006-07 room night sold data.

TEM E9: Replace existing lamps with energy-efficient lamps in identified places

Guest rooms - Replacement of 15 W GLS night lamps with 1 W LED

Description	Units	Formula	Existing	Option 1	Option 2
Type of lamp		A	GLS	LED	CFL
Wattage	W	C	15	1	3
Lamp life	hours	D	1000	100,000	8,000
Energy consumption for 100,000 hours	kWh	E=C x 10,000/1000	1500	100	300
Airconditioining load corresponding to the wattage of lamp*** (80 % of rated wattage is considered for GLS lamps)	TR hr/100,000 hours	F=E x 860 x 0.8 /(3024)	341.3		25.6
Electrical equivalent of TR savings, @ 0.9 kW/TR	kWh/ 100,000 hrs	G=Fx0.9	307.1	0.0	23.0
Total energy consumption	kWh/100,000 hrs	H=E +G	1807	100	323
Energy cost	Rs./kWh	I	3.93	3.93	4.93
Energy cost for 100,000 hours operation	**Rs**	**J=H x I**	**7102**	**393**	**1593**
No. of lamps required for 100,000 hours operation	Nos.	K	100	1	13
Cost per lamp	Rs./No.	L	15	1500	150
Procurement cost of lamps for 100,000 hours	Rs.	M=KxL	1500	1500	1875
Total cost of operation (incl. lamp cost)	Rs/100,000 hours	N=M+J	8602	1893	3468
Net monetary savings/lamp(200 days/yr,12hrs/day)	**Rs/ 2400 hours**	**O=(N1-N2)x 2400/100,000**	**0**	**161**	**123**
No. of lamps considered	Nos.	P	286	286	286
Recurring annual savings	**Rs./yr**	**Q=PxO**		**46,051**	**35,243**
Investment for new lamps	**Rs**	**R=P**		**429,000**	**57,200**
Simple payback	Months	S=Rx12/Q		112	19
Note: Occupancy is taken from 2006-07 room night sold data					

TEM E9: Replace existing lamps with energy-efficient lamps in identified places

Basement,Utilities,Back of the office - Replacement of existing conventional chokes with energy efficient ballast and reflector

Description	Units	Formula	Existing	Proposal
Type of lamp		A	36 W FTL, Copper choke	36 W FTL,Electronic ballast
Wattage	W	C	40	30
Lamp life	hours	D	8000	15000
Energy consumption for 15000 hours	kWh	E=C x 15000/1000	600	450
Airconditioining load corresponding to the wattage of lamp*** (30 % of rated wattage is considered as for halogen lamps)	TR hr/15000 hours	F=E x 860 x 0.3 /(3024)	51.2	38.4
Electrical equivalent of TR savings, @ 0.9 kW/TR	kWh/ 15000 hrs	G=Fx0.9	46.1	34.6
Total energy consumption	kWh/15000 hrs	H=E +G	646	485
Energy cost	Rs./kWh	I	3.93	3.93
Energy cost for 15000 hours operation	**Rs**	**J=H x I**	**2539**	**1904**
No. of lamps required for 15000 hours operation	Nos.	K	2	1
Cost per lamp	Rs./No.	L	45	160
Procurement cost of lamps for 15000 hours	Rs.	M=KxL	84	160
Total cost of operation (incl. lamp cost)	Rs/15000 hours	N=M+J	2623	2064
Annual operating hours	hours	O=365x16	5840	5840
Net monetary savings/lamp	**Rs/5840 hours**	**P=(N1-N2)x5840/15000**		**218**
No. of lamps considered	Nos.	Q	411	411
Recurring annual savings	**Rs./yr**	**R**		**89,471**
Investment for new ballasts and reflectors	**Rs**	**S=Qx850**		**349,350**
Simple payback	Months	T=Sx12/R		47

TEM E9: Replace existing lamps with energy-efficient lamps in identified places

Maingate, Tennis court & Courtyard - Replacement of 500 W halogen with 70 W metal halide

Description	Units	Formula	Existing	Proposal
Type of lamp		A	Halogen 500 W	Metal Halide 70 W
Wattage	W	C	500	75
Lamp life	hours	D	1000	8000
Energy consumption for 8000 hours	kWh	E=C x 8000/1000	4000	600
Energy cost	Rs./kWh	F	3.93	3.93
Energy cost for 8000 hours operation	**Rs**	**G=ExF**	**15720**	**2358**
No. of lamps required for 8000 hours operation	Nos.	H	8.0	1.0
Cost per lamp	Rs./No.	I	100	800
Procurement cost of lamps for 8000 hours	Rs.	J=HxI	800	800
Total cost of operation (incl. lamp cost)	Rs/8000 hrs	K=J+G	16520	3158
Net monetary savings/lamp(12 hrs/day, 365 days/yr)	**Rs/4380 hours**	**L=(K1-K2) x 8000/4380**	**0**	**7316**
No. of lamps considered	Nos.	M	10	10
Recurring annual savings	**Rs./yr**	**N=LxM**		**73,157**
Investment for new lamps	**Rs**	**O=8x6000**		**60,000**
Simple payback	Months	P=Ox12/N		10

TEM E9: Replace existing lamps with energy-efficient lamps in identified places

Tennis court & DEK - Replacement of 1000 W halogen with 150 W metal halide

Description	Units	Formula	Existing	Proposal
Type of lamp		A	Halogen 1000 W	Metal Halide 150 W
Wattage	W	C	1000	150
Lamp life	hours	D	1000	8000
Energy consumption for 8000 hours	kWh	E=C x 8000/1000	8000	1200
Energy cost	Rs./kWh	F	3.93	3.93
Energy cost for 8000 hours operation	**Rs**	**G=ExF**	**31440**	**4716**
No. of lamps required for 8000 hours operation	Nos.	H	8.0	1.0
Cost per lamp	Rs./No.	I	100	800
Procurement cost of lamps for 8000 hours	Rs.	J=HxI	800	800
Total cost of operation (incl. lamp cost)	Rs/8000 hrs	K=J+G	32240	5516
Net monetary savings/lamp(12 hrs/day, 365 days/yr)	**Rs/4380 hrs**	**L=(K1-K2) x 8000 /4380**	**0**	**14631**
No. of lamps considered	Nos.	M	7	7
Recurring annual savings	**Rs./yr**	**N=LxM**		**102,420**
Investment for new lamps	**Rs**	**O=8x7000**		**49,000**
Simple payback	Months	P=Ox12/N		6

TEM E9: Replace existing lamps with energy-efficient lamps in identified places

Main porch landscaping- Replace existing halopar 38 lamps with 23 W electrodeless CFL

			Existing	Proposal
Type of lamp		A	halopar 38	Induction CFL
Wattage	W	C	80	23
Lamp life	hours	D	2000	15000
Energy consumption for 15000 hours	kWh	E=C x 15000/1000	1200	345
Energy cost	Rs./ kWh	F	3.93	3.93
Energy cost for 15000 hours operation	**Rs**	**G=ExF**	**4716**	**1356**
No. of lamps required for 15000 hours operation	Nos.	H	7.5	1.0
Cost per lamp	Rs./No.	I	200	1200
Procurement cost of lamps for 15000 hours	Rs.	J=HxI	1500	1200
Total cost of operation (incl. lamp cost)	Rs/15000 hours	K=J+G	6216	2556
Net monetary savings/lamp for 4380 hours	**Rs/4380 hours**	**L=(K1-K2)x4380/15000**	**0**	**1069**
No. of lamps considered	Nos.	M	20	20
Recurring annual savings	**Rs./yr**	**N=LxM**		**21,375**
Investment for new lamps	**Rs**	**O=12x1200**		**24000**
Simple payback	Months	P=Ox12/N		13

TEM E9: Replace existing lamps with energy-efficient lamps in identified places

Gulstan garden,Cycle stand- Replacement of 125 W MVHP with 70 W metal halide

Description	Units	Formula	Existing	Proposal
Type of lamp		A	Mercury Vapour	Metal Halide
Wattage	W	C	125	70
Lamp life	hours	D	6000	12000
Energy consumption for 12000 hours	kWh	E=C x 12000/1000	1500	840
Energy cost	Rs./kWh	F	3.93	3.93
Energy cost for 12000 hours operation	**Rs**	**G=ExF**	**5895**	**3301**
No. of lamps required for 12000 hours operation	Nos.	H	2.0	1.0
Cost per lamp	Rs./No.	I	300	800
Procurement cost of lamps for 12000 hours	Rs.	J=HxI	600	800
Total cost of operation (incl. lamp cost)	Rs/12000 hrs	K=J+G	6495	4101
Net monetary savings/lamp(12 hrs/day, 365 days/yr)	**Rs/4380 hours**	**L=(K1-K2)x 12000/4380**	**0**	**874**
No. of lamps considered	Nos.	M	115	115
Recurring annual savings	**Rs./yr**	**N=LxM**		**100,480**
Investment for new lamps	**Rs**	**O=Mx2000**		**230,000**
Simple payback	Months	P=Ox12/N		27

TEM E9: Replace existing lamps with energy- efficient lamps in identified places

Vendors

For Osram lamps
Osram India Pvt. Ltd.
Signature Towers,
11th floor,Twer-B,South city-1
Gurgaon – 122 001.
Tel : +91-124-408 1581,
Fax : +91-124-408 1577
Email- d.gupta@osram.co.in
Mr. Deepanjan Gupta
Mobile: 09312680925

For CFL & 28 W FTL Opal Electronic ballast
Technolines
No.6,Dr.Subrayan Nagar,8th street,
Kodambakkam,Chennai-600 024.
Phone: 044 2473 4375
Mobile: 0938 10 61 130
E mail:opal@md2vsnl.net.in

For Philips and Osram lamps
Saraswathi Enterprises
G-3,Bheron Bazar Complex,
Belanganj, Agra-4
Phone: 2622 892
Mobile: 09837031345
E mail:saraswathientp@sancharnet.in

TEM E9: Replace existing lamps with energy- efficient lamps in identified places

Specification

Halogen Lamps

Power	: 35 W
Voltage	: 12 V AC
Base	: GU 5.3 ,51 mm
Luminance	: 1500 cd
Burning hours	: 4000 hours
Angle	:36^{O}

Typical recommendation: Osram

CFL lamps for guest rooms

Power	: 21W (retrofit type)
Voltage	: 220+/- 10 % V @ 50Hz
Base	: B22 d
Colour	: 827 warm white
Height	: 150 mm

TEM E9: Replace existing lamps with energy- efficient lamps in identified places

Specifications for T5,T8 lamp and EE electronic ballast

Parameters	36 W lamp+ **Energy Eff. ballast**	T5 28 W
Lamp power	36 W	28 W
Total power(lamp+ballast)	<31 W	<31 W
Colour Rendering Index(CRI)	80 to 89	80 to 89
Mercury Content	<5mg	<5mg
Recyclability	yes	yes
Lamp lumen output	3250	2900
Lamp luminous efficacy (lumen/watt)	90	104
Lamp luminous efficacy including ballast (lumen/watt)		
Warranty on Ballasts	**2 year**	**1 year**
Retrofitability	yes	yes
Spectrum	865	865
THD	<10 %	<10 %

TEM E9: Replace existing lamps with energy- efficient lamps in identified places

Specification

CFL Lamps for landscaping area

Power : 23W (retrofit type)

Base : E27

Colour : 827 clear warm white

Protection : IP 67

Control gear: Embedded with the lamp; dimmable; Total Harmonic Distortion < 10%

Voltage: 240 V, 50 Hz

MH Lamps for car parking and Gulstan garden area

Power : 70W

Base : E27

Colour :942 clear white

TEM E9: Replace existing lamps with energy- efficient lamps in identified places

Implementation Plan

Implementation Plan								
Activity	Weeks							
	1	2	3	4	5	6	7	8
Collecting vendor quotes								
Base Data confimation								
Technical discussion & Finalisation								
Order placement								
Material receipt								
Installtion & commisioning								
Measurement of savings								

ITC to implement this proposal on their own. UVKA will render any additional necessary assistance for implementation and achieving savings

TEM E9: Replace existing lamps with energy- efficient lamps in identified places

Measurement & Verification Certificate

Description	Before implementation	After implementation
Measured energy consumption (kWh / day)		
No. of working days per year		
Annual energy consumption (kWh)		
Recurring annual energy saving (kWh)		
Average tariff (Rs./kWh)		
Recurring annual savings (Rs.)		

Electrical Champion
Hotel

Chief Engineer
Hotel