

ITC HOTELS LTD

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 all projects, now all are implemented 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 CO₂ 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 CO₂ 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

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- 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)

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- 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 m³/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°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 18°C 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

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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 10°C. 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 10°C, 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 m³/hr at working pressure of 0.5 kg/cm²g
- 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 effluent to aeration tank
- Outlet pump is installed for pumping out treated ETP water to storage tank/garden
- Both inlet and outlet 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 m³/hr instead of present 450 m³/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

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- 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

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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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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

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- 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

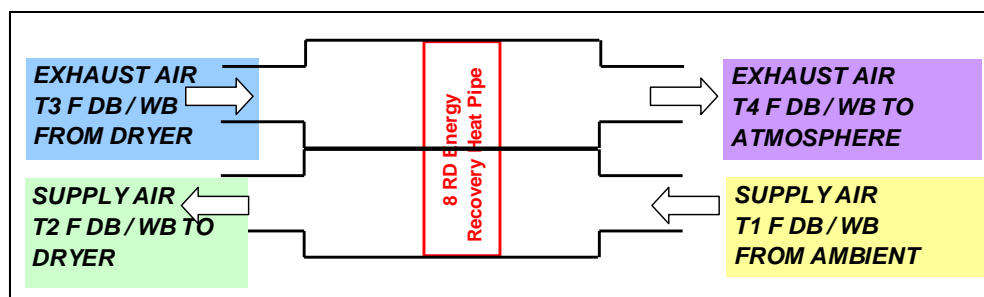
The hot and humid air from the Tumbler Dryers in Laundry section is being vented out to the atmosphere. This exhaust air which is at an average temperature of 75o C has a lot of heat content in it. Both tumbler dryers work for 19 hours a day

- 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/cm²g and the user requirement is up to only 5.5-6.0 kg/cm²g

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/cm²g
- 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

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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°C)

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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.

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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 CO₂.
- ❖ Reducing the HVAC load.
- ❖ Reducing the Fuel consumption and further reduction in the CO₂ 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

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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

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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 70°C 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)
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- 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°C)

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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

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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 or 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