05

TECHNICAL PAPER ON POWER PLANT ENERGY SAVINGS (BEE ISSUE # EE28)

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INTRODUCTION

Dependence on energy resources procured from outside the country has today created a precarious situation in terms of managing India's energy security. For a country such as ours, which needs huge capital for improving its social and economic conditions, be it alleviating poverty or providing education for all of its 1.132 billion population, importing of energy supplies at a very high price does not augur well. Demand for energy to power the basic needs of life-Light, Heat & Mobility will continue to expand. It becomes therefore imperative for Indian Industries and Power Plants to do their bit in reducing the overall energy consumption that is essential for producing goods and services. MRPL, which is an established entity in India's Hydrocarbon Refining Industry, has embarked upon energy conservation initiatives right from its inception. It is being ranked first in terms of least energy consumption per barrel per complexity factor among all Indian Public sector Petroleum Refineries, consecutively for the last four times and thereby continuously bagging the coveted Jawaharlal Nehru Centenary Award for least specific energy consumption.

MRPL has 2 Phases of Captive Power Plants with 3 Boilers + 2 Steam Turbines in Phase-1 and 4 Boilers + 3 Steam Turbines in Phase-2. These two phases came up along with corresponding first and second phases of the Refineries. This paper also delves upon some of the energy conservation initiatives carried out in MRPL Captive Power Plant, which caters to Power and Steam requirements of the Refinery and Petrochemicals complex.

A) FIVE MAJOR ENERGY SAVING AREAS HAVING MAXIMUM POTENTIAL

1. Energy capture from Process waste Heat streams.
2. Minimization of Boiler & Boiler Plant losses-Flue gas Temperature Reduction, Combustion improvement, Excess Air Control, minimizing Boiler surface heat losses, avoiding losses through Air Pre-heater leaks, selecting Boiler Water Treatment program, which minimizes blow-down and thereby its corresponding heat loss & minimizing losses due to Plant Start ups associated with Unit tripping by adopting Integrated Steam & Load shedding logics & Heat & Condensate recovery from Steam Traps.
3. Installing Variable frequency Units on major Power Intensive Equipment Drives.
4. Installing steam drives and switching over from motor drives.
5. Using waste heat for powering Refrigeration and Air Conditioning units using Vapor Absorption.

1. <u>Energy capture from Waste Heat streams.</u> If one looks around for associated processes, one could come across several waste heat streams either being let down to atmosphere or to cooling water. In many cases hot product streams are being sent to storage/ storage tanks. These energy rich product or material streams offer excellent scope for recovering energy by suitable means. As an example, recovering heat from Kerosene Product going to storage with Demineralised Water used as Dearator make-up can result in significant savings in stripping steam of Power Plant Dearators.

2. <u>Minimizing Boiler Heat losses.</u>

Critically evaluating various types of heat losses of a Boiler, presents scope for minimizing the same.

A) One of the criteria for determining flue gas exit temperature to be set in a Boiler is the sulfur content in Fuel Fired. Whenever there is scope for reducing this sulfur content and whenever the Boilers are operated at less than design loads, it is possible to bring down the flue gas exit temp. However, this temperature should not fall less than sulfur dew point temperature at cold end zones, which has the potential for cold-end corrosion. By carefully monitoring these cold end zone temperatures using on-line thermo-couples and replacing conventional Primary Air Preheater tubes with corrosion resistant tubes it is possible to effectively sustain reduction in Flue Gas temperatures.

B) Dry flue gas losses can also be minimized by an automatic combustion controller, which is useful for a continuously varying load scenario. However, on-line oxygen sensors and transmitters can sometimes malfunction. Regularly calibrating or crosschecking the same with relatively inexpensive hand-held or portable type flue gas analyzers can overcome this problem.

C) Another area for improvement in heat transfer efficiencies of Boiler heat transfer surfaces is adoption of Magnesium Oxide based fuel additives. This is particularly effective if the fuel contains higher amount of vanadium, which forms low melting ash, which is tenacious and scale like. MgO dosing makes these scales more friable after which they can be easily removed by soot-blowing.

D) It pays to monitor surface temperatures of Boiler insulation using a temperature gun. By replacing sections of worn out insulation, radiation losses can be minimized.

E) By monitoring flue gas oxygen before and after Air Pre-Heaters, it is possible to quantify the combustion air bypassing the Boiler Furnace. This loss in combustion air leads to increased fuel consumption on account of reduction in combustion air temperatures as well as losses in Fan Power as the Fan has to now supply more air for meeting the Boiler load. Regularly monitoring flue gas helps to take early corrective actions and savings.

F) Minimizing heat loss through blowdown. Very High pressure Boilers requires Ultra-low TDS in their feed water make-up. Demineralised quality make-up water with Mixed Bed as polisher followed with Boiler Water Treatment that contributes minimum solids, will help in maximizing cycles of concentration without necessitating to give frequent blowdown, thereby saving on heat and water make-up.

G) Frequent trip outs/ Black-outs of Power Plants are associated with significant costs. Some of them are cost of start-ups, product reprocessing costs, costs on lost productivity and costs associated with deterioration of equipments and life of Process catalysts to name a few. It is therefore essential to design and implement a robust load cum steam shedding system to take care of such eventualities, which cuts off non-critical loads for saving Power Plant and Essential Units.

H) Whenever 2 Power Plants are located nearby, it is beneficial to interconnect associated facilities such as feed water, steam headers and associated utilities. By doing this, cost of internal steam can be brought down since the facility is now optimized. In such cases it is possible to stop one Boiler Feed Pump from operating by interconnecting feed water headers, thereby saving enormous pumping energy.

I) Heat and Condensate Recovery from Steam Traps. Condensate steam traps located within the Power Plants, inside Process Units as well as in interconnecting Pipe Racks provide opportunities for recovering sensible heat as well as Demineralised grade Boiler make-up water. Recovery schemes can be engineered in-house, while taking certain precautions such as segregation of condensate streams of different pressure levels and sizing the headers to allow for 2-phase flows. Pumping of flashed steam condensate can be achieved through commercially available steam pressured pumps, which offer energy benefits as compared with motor driven pumps.

3. Installing Variable frequency Units on major Power Intensive Equipment Drives

Areas where VFD's can be employed are Forced Draft Fans and Boiler Feed Pumps, which are major power consumers. Where 2 Fans are provided, one of the Fans can be an ordinary drive operating at full load, while the other can be on VFD, modulating the speed based on Boiler Load. Adopting VFD in Boiler Feed Pumps can minimize throttling of Boiler Feed Control valves. Another application is Cooling Tower Fans, where the set point for cooling water supply temperature can be maintained at Web-Bulb Temp minus Design Approach.

4. Installing Steam Drives and stopping motor drives where feasible

Applications for steam drives within Power Plant can be Boiler Feed Pumps, combustion air Fans, Condensate Extraction Pumps, Cooling Water Pumps, Fuel Oil pumps etc. Steam drives offer significantly higher direct energy savings, since power generation is a relatively inefficient process compared with steam generation and at the same time improving cogeneration efficiencies due to enhanced extractions. It is relatively easier to adopt steam drives during conceptual stages/configuration of a Power Plant.

5. Using Waste Heat for Refrigeration and A/C Requirements using Vapor Absorption Machine.(VAM)

Conventional A/C Units are motor operated compression chiller systems. With changing dynamics of global energy scenario and focus on energy conservation efforts, VAM stands to gain importance. These machines relate to solutions for ever-increasing power cost, unreliable power scenario and CFC emission issues. Common sources of energy for VAM are exhaust from Gen-sets, waste/vent steam, hot water, steam condensates or even fuels like Natural Gas, LDO and FO. With VAM, Power consumption can be drastically reduced as compared to operation of Compressors of Vapor Compression Systems and limiting the same to auxiliary pumps, which consume only a small fraction of the Power. In addition depreciation benefits can also be availed, making these projects attractive by having a faster payback.

B) SUCCESS STORIES IN MRPL-CAPTIVE POWER PLANT (DETAILS ATTACHED)

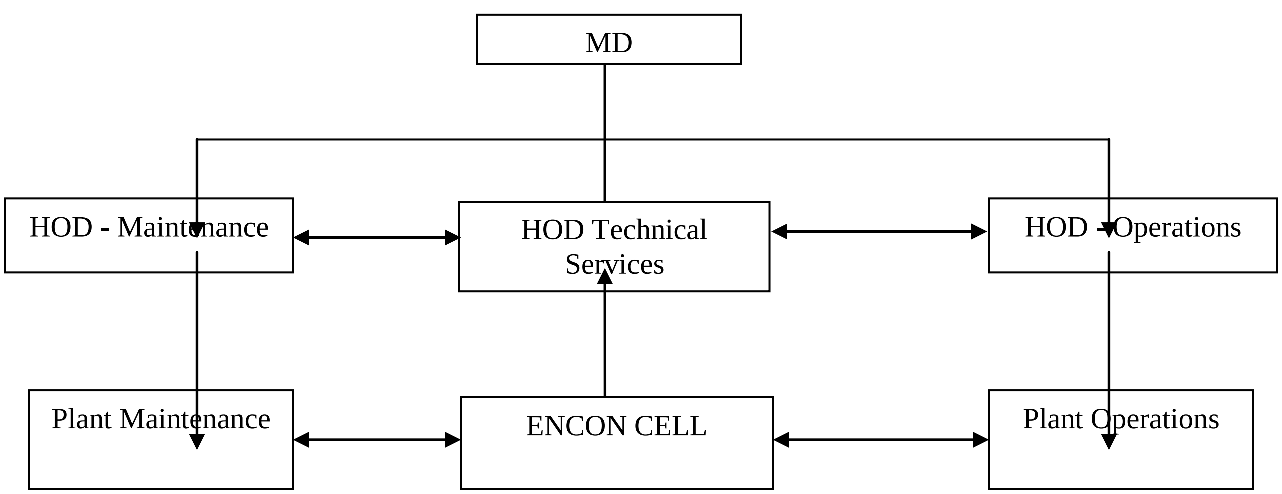
ENCON efforts in Power Plant have resulted in savings of several Giga-Kcals of energy on annual basis. Few of these measures implemented which together account to energy savings of 93.8×10^9 Kcals annually are listed below. This is equivalent to more than 9400 Metric Tonnes of fuel oil saved per annum.

1. Kero-DM water Heat Recovery Schemes-Phase-1 Power Plant
2. Kero-DM water Heat Recovery Schemes-Phase-2 Power Plant
3. Condensate & Heat Recovery Scheme.
4. Rain Water Harvesting.
5. Variable frequency drive for Cooling Tower Fans.
6. Replacement of Boiler Air Pre-Heater Tubes with Corten Tubes.
7. Variable frequency drive for Power Plant Centralized A/C Compressor.
8. Heat recovery from waste heat of Process Condensate for reducing steam consumption in Dearator.
9. Replacement of conventional Tube lights chokes with Electronic Ballasts.
10. Energy Efficient Lighting / Solar Energy for Plants & Facilities.

C) ENERGY MANAGEMENT CELL-ENCON CELL

- MRPL's commitment to Energy conservation is reflected in the management's setting-up of an ENCON cell for this purpose. It is established to monitor, control and minimize Energy consumption. Energy consumption report of Power Plant along with Individual Refinery Units are generated daily & being reviewed in daily & monthly meetings at the level of Group General Manager.
- Monitoring of the plant performances in daily/monthly/quarterly/half yearly/yearly wise is the main responsibility of the dedicated personnel at ENCON cell.
- The process data from DCS (Distributed Control System) & relevant production figures & lab results will be collected everyday by ENCON Cell personnel & a brief report will be prepared about entire refinery as well as individual units. This report along with major observations/ suggestions will be sent daily to the respective operations departments. ENCON cell will follow up for the implementation.
- In addition to the above, ENCON cell identifies opportunities for Energy optimization, both short & long-term projects, follows-up for implementation.
- ENCON Cell and concerned department personnel can suggest an opportunity. Respective unit process Engineer will prepare the scheme after studying the viabilities and will route it to design & Engineering after necessary clearances from operation department & Hazop study. Design & Engineering Department will prepare the entire drawing & will release for execution. Maintenance department will execute the project. Operations department will commission the project. Individual process personnel monitor savings.
- Energy Conservation cell in MRPL consists of qualified & experienced Chemical Engineers. A dedicated fund is budgeted every year for all Energy conservation modifications/schemes. Those modifications/schemes, which are identified as feasible, are implemented.

Flowchart of Energy Management system:



The core activities of Energy Management system can be summarized as follows:

- Monitoring of Fuel consumption, Furnace & Boiler Performance, Utility consumption, Flaring and other losses of individual units/ refinery.
- Setting target energy consumption figures (in terms of SRFT-Standard Refinery Fuel in Tons) for Refinery Units based on the Unit's best operating data/ benchmarks and monitoring the same on a daily and monthly basis. The best performing units with respect to Energy conservation are selected for Annual Awards.
- Suggesting measures to bring down the unit energy consumption to the set target levels. Discussing in detail during daily & monthly Performance review meetings attended by plant operating personnel.
- Optimizing the operation like RPM, stripping steam, reflux ratio etc.
- Implementation of various Energy conservation schemes and monitoring their performances.
- Identifying cost-effective opportunities for increasing Energy efficiency in new or existing plants.
- Creating and maintaining Energy consciousness throughout the Organization.

AWARDS FOR ENERGY CONSERVATION

Following are some of the awards won by MRPL for outstanding contribution towards ENCON.

- Has won the first prize in Jawaharlal Nehru Centenary award for Energy performance among Refineries for four consecutive years, 2003-04, 2004-05, 2005-06, & 2006-07 under group-1, instituted by Ministry of Petroleum & Natural Gas.
- Won Second Prize thrice in Oil & Gas conservation fortnight award. In Jan 2008, Jan 2006 & in Jan 2004, in Furnace/boiler efficiency by Centre for High Technology (CHT).
- “National Energy Conservation award”, 2001-Commendation certificate.
- “Oil Conservation Award”, 2001-2002 - Medium projects category.
- “Energy Conservation Award” by Karnataka Renewable Energy development Limited.
- “Best-operated Boiler Award” instituted by Karnataka State Government for the year 2007.
- “Energy efficient Unit” award, by ‘Confederation of Indian Industry’ for the years 2006-07 & 2007-08.

D) **ENERGY MANAGER**

We have a certified Energy Manager cum Energy Auditor in place. He has been certified by Bureau of Energy Efficiency. He is the main co-coordinator for energy related activities such as measurement of energy performance and initiating corrective measures whenever deviations are observed. Energy Policy has been derived from Organisation’s Vision and Mission statement. Copy of the same is attached.

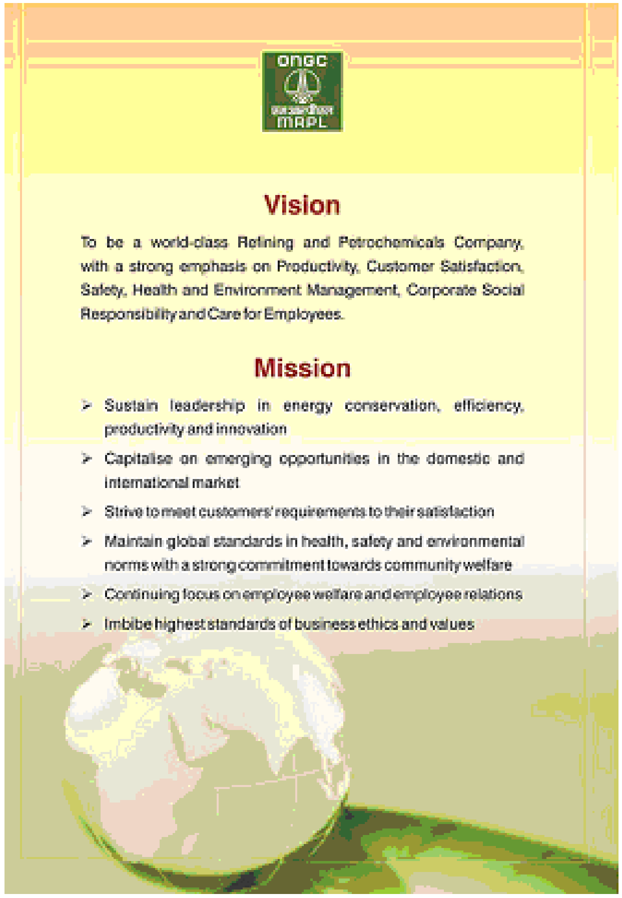
E) SUGGESTIONS FOR EFFECTIVE IMPLEMENTATION OF EC ACT IN POWER SECTOR.

1. Power sector being one of the largest energy consuming sectors in the country, initiatives taken by individual Organizations to adopt energy conservation measures and to sustain the same needs to be encouraged. Grant “Favored Organization Status” on entities adopting the EC Act. By this the customers, employees and other stake holders directly or indirectly related with the organization, will have a sense of esteem for working with such Organizations. This has an added advantage of retaining and attracting talent pool. To certain extent, this should induce the rest to follow suit.
2. Today, several organizations take pride in being certified as ISO 9000, ISO 14000 and OHSAS compliant (Quality, Environment and Occupational Health & Safety). Such certifications are generally voluntarily adopted. Take steps in this direction for encouraging Industries to adopt EC Act Compliant status voluntarily.
3. Apart from complying with financial performance it is important for firms to demonstrate energy performance. Announce sops/ tax benefits to firms demonstrating commitment, implementing recommendations on ENCON and actually complying with the EC Act.
4. Recognize & honor Power Plants that have made outstanding contributions to Energy conservation as required by the EC Act. Categorization of cycle / cogeneration adopted to be given due weightage.
5. Provide for a centralized fund, which can cater to capital requirements of firms/entities that are willing to invest in energy conservation programmes but having limited financial capacity for implementing the same. These firms should repay back to this centralized fund after accruing the benefits of ENCON measures adopted. Wherever these measures are not economically viable but capable of reducing CO_2 emissions, the same to be routed through CDM, for availing carbon credits.
6. Today’s children are tomorrow’s future. Incorporate chapters on importance of energy conservation in their school curriculum, so that they are sensitized to inculcate the same in their personal and professional lives.
7. Create a platform for holding interaction with Power Sector entities to exchange information on energy conservation measures adopted, problems faced in implementing various aspects associated with compliance of EC Act and how those issues were resolved. Individual Power Plants can take initiative in hosting such meets, a compendium prepared and circulated among user groups. Such meets can be planned semi annually or

annually on rotation among the participating Power Plants. BEE may chair these sessions and facilitate the proceedings.

8. Strengthen and empower administration machinery to include district level authorities to monitor compliance of entities/factories coming under its jurisdiction for submitting necessary data stipulated in the act.
9. Liaison and Empower Boiler Inspectorate to verify compliance, during annual renewal of licenses.
10. Insert riders such that new Power Plants comply with the EC Act, before clearing these Projects.

MRPL's VISION AND MISSION STATEMENT



Successful Implementation – Energy Conservation Measure (Case-Study-1)

Measure: Reduction of Stripping steam Consumption in Dearator of Power Plant-1.
Equipment: Dearator
Industry / Sector: Chemical / Hydrocarbon Refinery
Year of Implementation: 2000
Cost Benefit Analysis
❑ Type of Measure: Long Term
❑ Annual energy Savings: 29,680 MKcals (8000hrs)
❑ Actual cost savings: Rs 160.6 Lakhs (Per Annum)
❑ Actual investment: Rs 36 Lakhs

❑ Payback: 0.2 years
Implementation Highlights
Commissioned on 6th November 2000 and working well as on date.

Summary

Kerosene product from Phase-1 Hydrocracker Unit is routed to storage after cooling the product in fin fan coolers and water coolers. Product draw temp is around 210-213degC, while run down temperature to storage is 35-40degC. In order to recover heat lost to atmosphere from Hot Kerosene product, a scheme was proposed to heat the Phase-1 Power Plant DM water to Deaerator using the Hot Kerosene product, resulting in reduction of stripping steam consumption in Dearator. This modification scheme has been successful and Management has decide to implement the same in second phase of Power Plant

Background

Mangalore Refinery and Petrochemicals Limited (MRPL), a subsidiary of Oil and Natural Gas Corporation Limited, is a Grass root Crude oil Refinery located at Mangalore, a coastal city of Karnataka. The refinery is certified with ISO-9001: 2000 & ISO-14001 certifications for its Quality management and Environment management systems. MRPL contributes approximately 8% of India's total Refining capacity. MRPL's refinery complex consists of state-of-the-art facilities for crude distillation and secondary processing units. The refinery, with its predominant middle-distillates product focus, is a trendsetter among Indian Refineries with two Hydrocracker, two Catalytic Reforming, Mixed Xylene and & Light Naphtha Isomerization units.

Principle

Heat recovery from waste heat stream through a Shell and Tube Heat Exchanger. Process involves routing of cold DM water at ambient Temp through the tube side of a shell and Tube Hot Product Heat Exchanger.

Implementation issues

None. Both the basic package, including Shell and Tube Heat exchanger Design and Extended Process Package have been carried out with in-house expertise

Successful Implementation – Energy Conservation Measure (Case-Study-2)

Measure: Reduction of Stripping steam Consumption in Dearator of Power Plant-2.
Equipment: Dearator
Industry / Sector: Chemical / Hydrocarbon Refinery
Year of Implementation: 2001
Cost Benefit Analysis
❑ Type of Measure: Long Term
❑ Annual energy Savings: 26,800 MKcals (8000hrs)
❑ Actual cost savings: Rs 138.5 Lakhs (Per Annum)
❑ Actual investment: Rs 145 Lakhs
❑ Payback: 1.04 years
Implementation Highlights
Commissioned on 30th November 2001 and working well as on date

Summary

Kerosene product from Phase-2 Hydrocracker Unit was routed to storage after cooling the product in fin fan coolers and water coolers. Product draw temp is around 220degC. In order to recover heat lost to atmosphere from Hot Kerosene product, a scheme was proposed to heat the Phase-2 Power Plant DM water to Deaerator using the Hot Kerosene product, resulting in reduction of stripping steam consumption in Dearator. This is the second modification after implementation in phase-1.

Background

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Principle

Heat recovery from waste heat stream through a Shell and Tube Heat Exchanger. Process involves routing of cold DM water at ambient Temp through the tube side of a shell and Tube Hot Product Heat Exchanger.

Implementation issues

None. Both the basic package, including Shell and Tube Heat exchanger Design and Extended Process Package have been carried out with in-house expertise

Successful Implementation – Energy Conservation Measure (Case study-3)

Measure: Heat and Condensate Recovery Scheme from Steam Traps Located in Power Plant
Equipment: Flash Vessel/ Steam Traps
Industry / Sector: Chemical / Hydrocarbon Refinery
Year of Implementation: 2007
Cost Benefit Analysis
❑ Type of Measure: Long Term
❑ Annual energy Savings: 3045.8 MKcals (8000hrs)
❑ Actual cost savings: Rs 61 Lakhs (Per Annum)
❑ Actual investment: Rs 20 Lakhs
❑ Payback: 0.3 years
Implementation Highlights
Commissioned on 31st December 2007.

Summary

SCAPH (Steam coil Air Pre-Heater) condensate along with High, Medium and Low Pr steam traps, discharging to atmosphere, were considered for heat and condensate recovery. Instead of procuring new flash vessel, one of the redundant tanks was converted to flash vessel. SCAPH condensate, which was earlier routed to condenser flash vessel, operating under near vacuum, was rerouted to this modified atmospheric flash vessel. Heat energy that was earlier lost to cooling water is now recovered by flashing at atm pr & realized as hot water make-up in a Process Dearator. The 2nd part is recovery of flashed condensate from steam traps, which is also sent to Process Dearator. Additionally, a small quantity of DM grade water is also recovered.

Background

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Principle

Condensate recovery from flashing high pr (40bar, 15bar &15bar) steam condensate.

Implementation issues

None. Entire conceptualization, engineering and implementation were carried out with in-house expertise.

Successful Implementation – Energy Conservation Measure (Case-Study-4)

Measure: Rain Water Harvesting Scheme for minimizing Pumping Costs
Equipment: Pumps
Industry / Sector: Chemical / Hydrocarbon Refinery
Year of Implementation: 2005
Cost Benefit Analysis
❑ Type of Measure: Long Term
❑ Annual energy Savings: 340 MKcals
❑ Actual cost savings: Rs 17.35 Lakhs (Per Annum)
❑ Actual investment: Rs 15 Lakhs
❑ Payback: 0.9 years
Implementation Highlights
Commissioned in September 2005 and operating well as on date.

Summary

Kalavar pumping station was installed for utilizing rainwater run-off available at southeast corner of Refinery complex. A pumping facility was constructed besides this stream for tapping this water and 2 spare pumps having capacities of 685m3/hr and 150m3/hr were identified and installed for recovering this water for Refinery Operations. These pumps are operated depending on the season and quantity of water available. Since the regular source of water supply is sourced from River Water, situated around 40 Kms from the Refinery, this modification has resulted in reducing pumping power by about 85% along with resource minimization.

Background

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Principle

Reduction in pumping head by sourcing part of water requirements from nearby flowing Rain Water stream.

Implementation issues

None. Entire conceptualization, engineering and implementation were carried out in-house.

Successful Implementation – Energy Conservation Measure (Case-Study 5)

Measure: Variable Frequency Drive for Process Cooling Tower Fans
Equipment: Cooling Tower Fan Motors.
Industry / Sector: Chemical / Hydrocarbon Refinery
Year of Implementation: 2005
Cost Benefit Analysis
Type of Measure: Long Term
❑ Annual energy Savings: 661.7 MKcals (8000hrs)
❑ Actual cost savings: Rs 35 Lakhs
❑ Actual investment: Rs 25 Lakhs
❑ Payback: 0.7 years
Implementation Highlights
Commissioned in 2005.

Summary

Cooling tower fans are installed for enabling proper air to liquid contact that is required for meeting the Plant cooling water supply temperatures. However, when there is variation in CT load or drop in wet bulb temperatures during seasonal variations, it is not required to operate these Fans at full speed for meeting the designed approach. VFD was installed in all 5 Process CT fans, which has resulted in operating at lower speeds due to above factors and thereby resulted in power savings.

Background

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Principle

Speed reduction of CT Fans for meeting design approach temperature with resultant reduction in power consumption.

Implementation issues

None.

Successful Implementation – Energy Conservation Measure (Case Study –6)

Measure: Replacement of Boiler Air Pre-Heater Tubes with Corrosion Resistant Corten Tubes
Equipment: APH Tubes
Industry / Sector: Chemical / Hydrocarbon Refinery
Year of Implementation: 1999-2000
Cost Benefit Analysis
❑ Type of Measure: Long Term
❑ Annual energy Savings: 10633 MKcals (8000hrs)
❑ Actual cost savings: Rs 130 Lakhs per annum
❑ Actual investment: Rs 45 Lakhs (differential cost)
❑ Payback: 0.3 years
Implementation Highlights
Implemented first in one Boiler and later replicated in all 7 Boilers.

Summary

CPP Boilers were originally designed to operate at 180degC (for given sulfur content in Fuel Oil). By monitoring sulfur content in Fuel Oil and operating at around 80% load, based on demand, it is possible to reduce its Flue Gas Temperatures. However, this temperature should not fall less than sulfur dew point temperature at cold end zones, which has the potential for cold-end corrosion By carefully monitoring these cold end zone temp using on-line thermo-couples and replacing conventional Primary Air Preheater tubes with corrosion resistant tubes (Corten Tubes), it is possible to sustain and effectively maintain such reduction in Flue Gas temperatures. In MRPL, we have successfully brought down our Flue Gas temperatures from 180degC to 170degC, in all our 7 Boilers, resulting in significant energy savings over the years.

Background

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Principle

Dry flue gas heat losses by reducing Boiler Stack exit Temperature

Implementation issues

None. Corten Tubes are commercially available in the market.

Successful Implementation – Energy Conservation Measure (Case Study –7)

Measure: Provision of VFD on A/C Compressor for Power Plant Control Room
Equipment: Refrigeration Compressor
Industry / Sector: Chemical / Hydrocarbon Refinery
Year of Implementation: 2005
Cost Benefit Analysis
❑ Type of Measure: Long Term
❑ Annual energy Savings: 137.6 MKcals (8000hrs)
❑ Actual cost savings: Rs 7.2 Lakhs per annum
❑ Actual investment: Rs 1.5 Lakhs
❑ Payback: 0.2 years
Implementation Highlights
Implemented in year 2005

Summary

Centralized Air Conditioning system of Power Plant Control Room is operated by vapor compression based refrigeration system. Since the compressor is having margins on higher side, the motor drive has been provided with VFD system as a means of energy conservation initiative. By this, the motor speed has dropped from 1440RPM to 1010 RPM, resulting in considerable savings in Power requirement. This is possible, since the Power varies cube of speed as per affinity laws.

Background

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Principle

Reduction in speed has contributed to reduction in Power, since the Power consumption varies cube of speed as per affinity laws.

Implementation issues

None. At very low RPMs, the lube oil pump can trip on low pressure/high lube oil Temp and thereby tripping the compressor. Speed set point can be slightly raised and minimum speed may be locked to avoid such tripping of compressor.

Successful Implementation – Energy Conservation Measure (Case Study –8)

Measure: Heat Recovery Scheme from ISOM Process Condensate using a Heat Exchanger
Equipment: Shell & Tube Heat Exchanger
Industry / Sector: Chemical / Hydrocarbon Refinery
Year of Implementation: 2007
Cost Benefit Analysis
❑ Type of Measure: Long Term
❑ Annual energy Savings: 21388 MKcals (8000hrs)
❑ Actual cost savings: Rs 130 Lakhs per annum
❑ Actual investment: Rs 32.7 Lakhs
❑ Payback: 0.12 years
Implementation Highlights
Implemented during commissioning of Condensate Polishing Unit for Refinery Process Condensate.

Summary

Process condensate coming from ISOM (Isomerisation) Unit is recycled back after treating in a Condensate Polishing Unit. Since this condensate is available at 115degC, it is routed through a double shell and tube heat exchanger instead of directly cooling in a cooler. Turbine return condensate is passed through this double heat exchanger in the tube side, which was earlier directly routed to Power Plant Dearator. By this, the stripping steam quantity is reduced considerably due to heat recovery from a waste stream.

Background

Mangalore Refinery and Petrochemicals Limited (MRPL), a subsidiary of Oil and Natural Gas Corporation Limited, is a Grass root Crude oil Refinery located at Mangalore, a coastal city of Karnataka. The refinery is certified with ISO-9001: 2000 & ISO-14001 certifications for its Quality management and Environment management systems. MRPL contributes approximately 8% of India's total Refining capacity. MRPL's refinery complex consists of state-of-the-art facilities for crude distillation and secondary processing units. The refinery, with its predominant middle-distillates product focus, is a trendsetter among Indian Refineries with two Hydrocracker, two Catalytic Reforming, Mixed Xylene and & Light Naphtha Isomerization units.

Principle

Heat recovery from waste heat stream through a Shell and Tube Heat Exchanger. Process involves routing of Turbine condensate at around 45degC through the tube side of a twin Shell and Tube Heat Exchanger.

Implementation issues

None.

Successful Implementation – Energy Conservation Measure (Case Study –9)

Measure: Replacement of Tube lights chokes with Electronic Ballasts.

Equipment: Illumination Lighting
Industry / Sector: Chemical / Hydrocarbon Refinery
Year of Implementation: 2008
Cost Benefit Analysis
❑ Type of Measure: Long Term
❑ Annual energy Savings: 77 MKcals (8000hrs)
❑ Actual cost savings: Rs 8.96 Lakhs per annum
❑ Actual investment: Rs 15.96 Lakhs
❑ Payback: 1.8 years
Implementation Highlights
Being implemented throughout the Refinery complex.

Summary

Electronic ballasts, used in illumination / lighting are known to make use of modern power semi-conductor devices in their operation. Efficiency of fluorescent lamps is expected to be higher at higher frequency, which is provided by these electronic ballasts. Since the frequencies maintained are higher, the excitation of lamp phosphors are also increased thereby resulting in better illumination. A total of 2800 fluorescent lamps are taken up for converting to electronic ballasts and is under implementation.

Background

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Principle

Low internal core losses in electronic ballasts as compared with conventional magnetic ballasts.

Implementation issues

None.

Successful Implementation – Energy Conservation Measure (Case Study –10)

Measure: Energy Efficient Lighting / Solar Energy for Plants & Facilities
Equipment: Illumination Lighting
Industry / Sector: Chemical / Hydrocarbon Refinery
Year of Implementation: 2007-08
Cost Benefit Analysis
❑ Type of Measure: Long Term

❑ Annual energy Savings: 1052 MKcals (8000hrs)
❑ Actual cost savings: Rs 48 Lakhs per annum
❑ Actual investment: Rs 19 Lakhs
❑ Payback: 0.4 years
Implementation Highlights
Being implemented throughout the Refinery complex.

Summary

A total of 3507 nos. of ordinary lamps / GLS were replaced with CFL/ Tri-Phosphor Fluorescent lamps. Solar lamps were installed for street lighting and garden lighting and solar heating partly employed at Canteen and Township. In addition, lighting transformers were also installed for reducing overall power consumption. All these are implemented as part of ENCON measures.

Background

Mangalore Refinery and Petrochemicals Limited (MRPL), a subsidiary of Oil and Natural Gas Corporation Limited, is a Grass root Crude oil Refinery located at Mangalore, a coastal city of Karnataka. The refinery is certified with ISO-9001: 2000 & ISO-14001 certifications for its Quality management and Environment management systems. MRPL contributes approximately 8% of India's total Refining capacity. MRPL's refinery complex consists of state-of-the-art facilities for crude distillation and secondary processing units. The refinery, with its predominant middle-distillates product focus, is a trendsetter among Indian Refineries with two Hydrocracker, two Catalytic Reforming, Mixed Xylene and & Light Naphtha Isomerization units.

Principle

Higher luminous efficacy of CFL Lamps. Renewable energy as source for Solar lighting / heating.

Implementation issues

None.

	1. Power Plant Name 2. Location 3. State/UT 4. Power Plant Capacity	MRPL-Captive Power Plant Mangalore Karnataka 118.5MW
A.	Photograph	
B.	Personal Details: 1. Name : 2. Regd. No. (EM/EA)/ Year of passing: 3. Designation: 4. Qualifications: 5. Email Address: 6. Complete postal address 7. Fax No:	 Venugopal V.J Energy Auditor EA-6334 / Year: 2007 Manager-Process Engineering B.E Mechanical, BOE (Karnataka State) gopal@mrplindia.com Technical Services Department, Mangalore Refineries and Petrochemicals Ltd, Kuthethoor Via Katipalla, Mangalore 575030 Karnataka-India +91-824-2270013
C.	Total experience in years Energy Management related experience details	10 Years 1. Condensate and Heat recovery scheme from Steam Traps. 2. Rain water Harvesting scheme 3. Integrated Load cum Steam Shedding for Refinery Complex. 4. Fuel Oil Additive Trials.
D.	Area of Specialization	1) Process Engineering of Power and Utilities, Optimization, Modifications and Safety. 2) Recycling of Treated Effluent as part of Cooling Tower make-up.
E.	Major Achievements	1) In House design, development and fabrication of Acoustic Silencers for Dearator venting steam. 2) Troubleshooting of low throughput in Demineralization Plant 3) In-house design and Implementation of multi-pressure Condensate Recovery System 4) Rain water Harvesting.
F.	Details of Energy Management Projects undertaken, if any	Joint auditor for steam loss survey audit carried out in IOCL-Koyali Refinery in the year 2007 under the auspices of Center for High Technology, (CHT).