

## NUMALIGARH REFINERY LIMITED

### Unit Profile:

Numaligarh Refinery has been set up in 1993 in the district of Golaghat, Assam in fulfillment of the commitment made by the Govt. of India in the historic Assam Accord for providing the thrust towards industrial and economic development of North-East. The company started commercial productions from October 2000 and has been performing creditably ever since. With its track record of profitability and steady growth, it has earned the status of a "Mini Ratna" PSU.

Numaligarh Refinery, a subsidiary of Bharat Petroleum Corporation Limited is designed to process 3.0 MMTPA of crude oil with the configuration of Crude Distillation Unit, Delayed Coker Unit, Hydrocracker Unit, Hydrogen Generation Unit, Sulphur Recover Unit, Coke Calcination Unit & Marketing Terminal (NRMT). In order to value addition for the currently available surplus Naphtha as well as to meet the market demand of MS in North- Eastern, Eastern and Northern regions, Motor Spirit Plant has been recently set up. The main products of Numaligarh Refinery are Euro-II/Euro-III.



High Speed Diesel , Euro –II/III Motor Spirit ,Liquified Petroleum Gas ,Aviation Turbine Fuel , Superior Kerosene Oil ,Naphtha , Fuel Oil ,Raw petroleum Coke/Calcined Coke etc.

Numaligarh Refinery is one of the latest refineries of the country adopting state of the art technologies. Due to adoption of latest process technologies for secondary processing units as well as upgradation of residues / heavy ends, refinery ensures optimum value addition. The net distillate yield of the refinery is as high as 85% of which 74% is middle distillates.

Various provisions were incorporated at the conceptual stage to make refinery energy efficient such as **use of pinch technology, installation of high efficiency furnaces, maximisation of air cooling, installation of co-generation plant, installation of power recovery turbine, installation of condensate recovery system, installation of state of art instrumentation and digital control system, Cast Iron & Glass Air Preheater in all the major Fired heaters in the refinery.**

A number of Encon schemes have been implemented during last three years as a part of continual efforts towards energy conservation and loss control. Some of the major schemes implemented are:

- Scheme for providing special type of Telescopic Insulation for all the 150 numbers of Catalysts Tubes at the reformer top to cover the bare hot tube length (550<sup>o</sup>C to 600<sup>o</sup>C) ,which is expected to save around 600 MT of fuel per year. The project was selected for 1<sup>st</sup> prize by PCRA for exemplary work in energy conservation under medium category project.
- For the first time in the country, NRL adopted Stepless control system in HCU make up Gas Compressor.
- Combination Coke Cutting tool in DCU has been implemented
- Implementation of Advanced Process Control (APC) in CDU/VDU to optimize Product recovery and improve product yield
- Improved and more reliable Steam Traps have been installed ,for which considerable amount of steam losses have been reduced
- Auto drain Traps for moisture separation in air compressor have been installed
- Mass flow meter in the Flare Header has been installed
- Reduction of GTG frequency to 49.5 Hz from 50 Hz resulted in saving of around 666 MT of fuel per year
- Energy master installed for even distribution of load in the air compressors that facilitates saving of energy by maintaining bypass valve opening to zero.

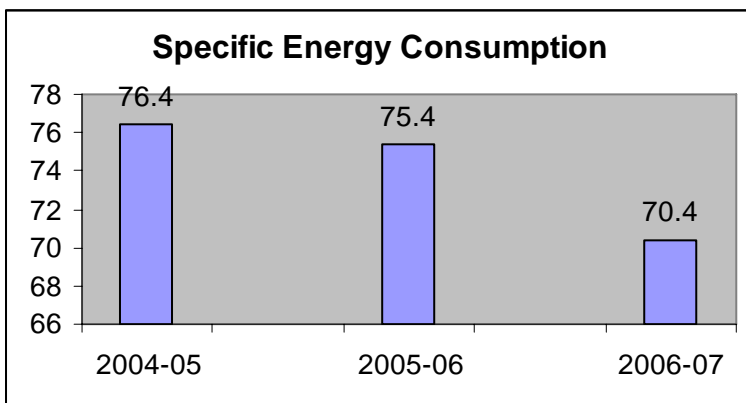
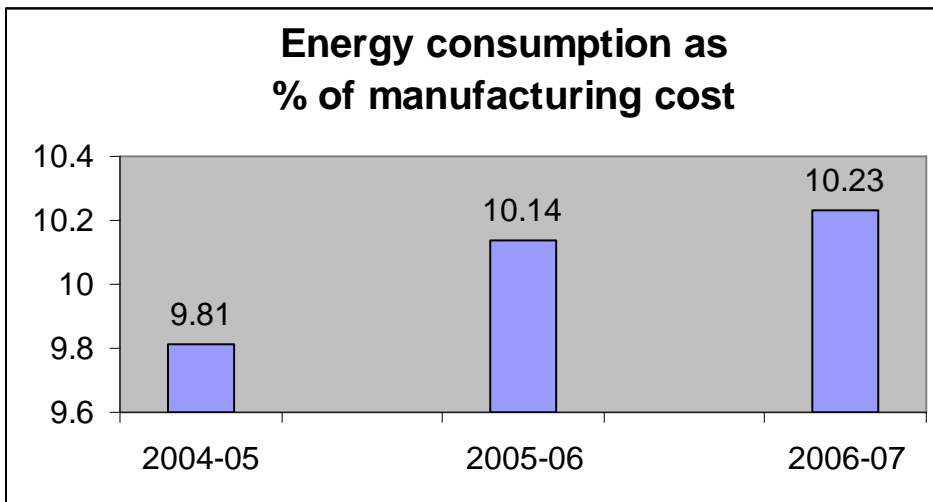
- Replacement of one Motor driven HRSG BFW feed pump by steam drive to cater BFW requirement of both HRSG & UB.
- Stopping of one Forced Draft Fan in CDU furnace and one Forced Draft Fan in HCU Furnace contrary to the normal operation philosophy. The action resulted in saving of around 600 MWH of power per year
- Optimisation of HSD pool blending components with unconverted oil of hydrocracker unit resulted in the saving of around 300 MT of fuel per year
- Stopping of steam heating in the crude tanks resulted in saving of around 666 MT of fuel per year
- Use of slop oil in place of gas oil for quenching purpose in DCU unit resulted in the saving of around 300 MT of fuel per year
- Routing filter back wash of hydrocracker unit to VR feed tank instead of slop resulted in saving of around 300 MT of fuel per year
- Regular monitoring for any passing valves and fugitive emission by Acoustic Leak Detector and Gas Measuring Instrument (GMI) is carried out as part of loss control measures and timely remedial actions are taken as required.

### ENERGY CONSUMPTION:

Numaligarh Refinery consumes various types of fuel viz. refinery fuel gas and low sulphur internal fuel oil in furnaces/boilers. Naphtha is consumed in Captive Plant for power generation and in Hydrogen unit for Hydrogen generation. Many numbers of energy conservation schemes has been implemented in Numaligarh Refinery contributing a lot for reducing consumption of fuel.

DESCRIPTION		UNIT	2004-2005	2005-2006	2006-2007
Annual Production		MT	1834149	1918876	2226735
Specific Energy Consumption		MBN	76.4	75.4	70.4
Energy Cost as % of Manufacturing Cost	Electricity	-	3.36%	3.19%	3.02%
	Liquid Fuel	-	2.97%	3.16%	2.95%
	Refinery Gas	-	3.48%	3.79%	4.26%
	<b>Total</b>		<b>9.81%</b>	<b>10.14%</b>	<b>10.23%</b>
F& L%			9.71	10.37	10.53

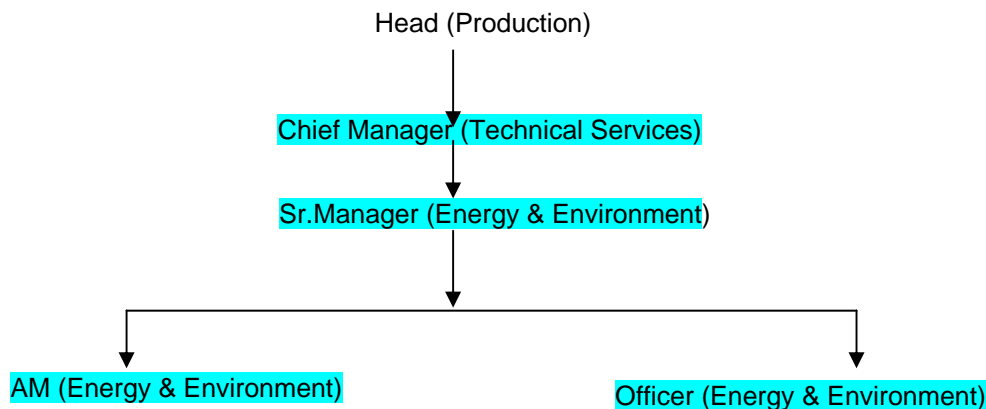
The energy consumption in refinery is reported in terms of % Fuel & Loss on crude and MBTU/BBL/NRGF (MBN), where the term MBTU refers to total heat value of fuel and loss in thousand BTU, BBL refers to barrel of crude processed and NRGF is a derived factor that depends upon actual intake in both primary and secondary processing units as per industry standard. The % fuel & loss, MBN and energy cost as % manufacturing cost for last three years is as given below: The specific energy consumption is gradually improving over the last three years, graphical representation of which is given below.



#### **ENERGY CONSERVATION COMMITMENT, POLICY AND SET-UP:**

Numaligarh Refinery has the highest concern and commitment for conservation of Energy and preservation of Environment. Numaligarh Refinery is having commitment for compliance of all the statutory regulations and acts pertaining to energy conservation and to attain sustained excellence in the field of energy management and energy efficiency. The Energy Management Policy of the refinery has been approved by the board of directors of the refinery which consists of adopting and nurturing Energy Efficient and environment technologies and undertaking social responsibility to educate, share and promote energy and environment aspects with others in the vicinity. Based on these guidelines, the Energy Policy has been framed –up which is attached herewith as annexure.

A fully functional, dedicated and separate Energy & Environment Cell manned by qualified engineers, headed by a Chief Manager and reporting to Head (Production) is continuously working for continuous improvement, monitoring of energy and environment related activities.



## **Energy Conservation Achievements:**

The major energy conservation projects implemented at Numaligarh Refinery are as given below:

### **1)Implementation of Stepless Control System in HCU make up Gas Compressor:**

This is the first of its kind in the country implemented in Numaligarh Refinery in HCU at Make up Gas Compressor saving energy by eliminating excess flow of gas to the compressor .



Without the Stepless Control System, hydrogen is supplied by the compressor in steps of 50% -75%-100% .At variable plant load, gas compressed more than the plant requirement was spilled back which is mere wastage of energy. This energy lost at partial load is recovered by installation of Stepless Control System which operates in a range between 0-100% and hence spillback flow becomes zero.

Hydraulically actuated unloader keep the suction valves open during part of the compression cycle. Thus part of the gas taken into the cylinder during suction cycle is pushed back into the suction plenum. In this way, the gas volume per working stroke can be controlled. This system saves compression power at part load, since the energy consumption of a compressor is proportional to the quantity of gas compressed per compression cycle.

**Around 39 lakh kWh of energy is saved per annum by implementing this scheme.**

### **2) Combination Coke Cutting Tool in DCU**

As a measure towards continual improvement in operating systems as well as conservation of energy. Combination Cutting tool has been introduced in coke cutting operation .Major benefits of the combination nozzles are: reduced cutting time, increased safety, operator convenience, ability to readily revert to the initial cutting mode in the event of cave-ins and convenience of maintenance.



Hydraulically, combination nozzles are superior to any nozzle used in decoking service. The combination coke cutting tool is integration of features of boring and cutting tools of conventional coke cutting operation. An especially designed jet nozzles is its unique feature that enhances more effective coke cutting by creating a sharper jet of water. A tighter stream of water is maintained at the wall of coke drums (larger diameter) by the jet nozzles.

Using same head the pilot bit mode of the coke cutting tool can be switched to cutting mode that eliminates maintenance activity related to tool change. In comparison to earlier two tool coke cutting method, the combination coke cutting method saves 1 to 1 & 1/2 time, thus running time of the jet pump driven by an electric motor of 1.7 MW rating gets reduced.

**Around 3.57 Lakh kWh energy per annum is being saved by implementing the project**

### **3) Installation of telescopic insulation for the catalyst tubes at the reformer top to cover the bare hot tube length**

Numaligarh refinery is operating a 38000 TPA hydrogen plant licensed by Haldor Topsoe A/S. Unit was commissioned in Feb'2000 and plant is operating normal. Steam reformer is the side fired furnace having 150 nos. of catalyst filled tubes.

Significant heat loss was taking place from the bare portion of the reformer tubes extending outside the reformer at the top having surface temperature in the range of 550<sup>0</sup>C. During normal operating condition tube skin are maintained in the range of 950<sup>0</sup>C inside the reformer. High temperature operating condition causes significant vertical movement due to the thermal expansion of reformer tubes.

Thermal expansion causes variation in the exposed length of the tube thus making it difficult to provide the conventional insulation over the exposed length as it exist only during operation in hot condition. Till date no refinery in country could carry out the insulation on bare portion of reformer tube extending outside the reformer due to the vertical movement which takes place from cold condition to hot condition caused by thermal expansion because of its variable nature of length.

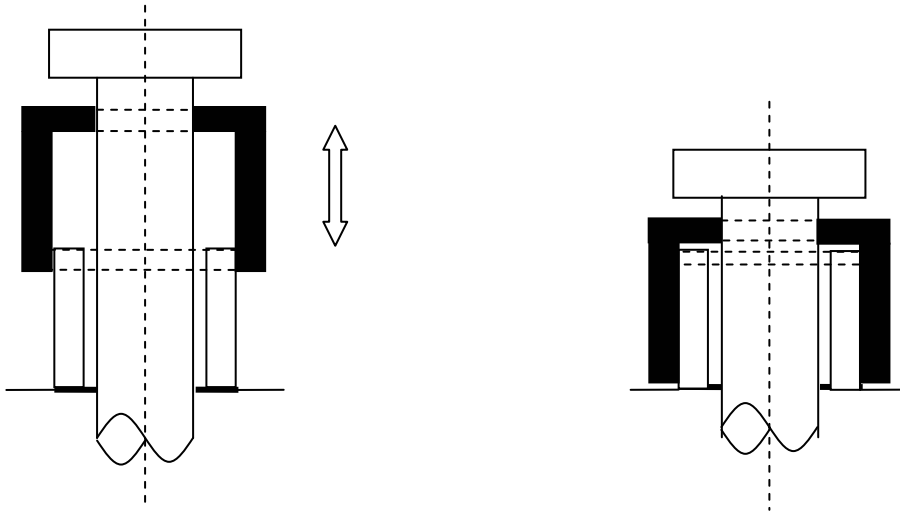
#### Technical Analysis

#### Telescopic Insulation- A Unique solution first implemented by Numaligarh Refinery in Country.

The problem was studied and a suitable scheme for insulating the expanded portion of catalyst tubes was developed. Various expert parties and supplier were searched through out the world for providing the suitably designed insulation, for controlling the heat loss from the catalyst tubes. Nine numbers of vendors responded to the problem however only one party i.e. M/s INSULCON B.V Holland could provide the suitable design for insulating the bare portion of reformer tube. The scheme was also concurred by M/s. Haldor Topsoe A/S, licensor of the unit.

M/s INSULCON B.V Holland was entrusted to provide the telescopic seals built up of two overlapping stainless steel shells capable of compensating 310 mm of vertical movement in hot and cold condition. Shells are filled with 19 mm layer of ceramic fiber blanket of high insulation properties.

The arrangement is shown below (Not to the scale):



Hot Position (with telescopic seal)

Cold Position (with telescopic seal)

### **Impact of implementation**

After installation of telescopic seal considerable amount saving in heat loss was achieved.

Bare tube surface temperature : 500 °C  
(Before putting insulation)

Surface temperature after insulation  
(Outer insulation) : 260 deg C  
(Inner insulation) : 320 deg C

Heat loss reduced : 0.38 MMKcal /hr  
Saving of Fuel Naphtha : 288 TPA

Total Investment Incurred : 21 lakhs



### **Energy Conservation Plans and Targets:**

- Installation of 12 MW Steam Turbo Generator (STG) for Captive Power Generation by recovery and utilisation of the waste (thermal & pressure ) of HP steam .The project will be implemented by January,2008.
- Use of natural Gas in GTG and Hydrogen Unit by replacing Naphtha.
- Utilisation of very low low pressure hot well gases from VDU to CDU furnace is under implementation.
- Replacement of conventional lighting fixtures by more energy efficient fittings.
- Improvement of insulation effectiveness of steam lines and heaters.
- Implementation of LDAR (Leak Detection and Repair Program).

### **Environment & Safety:**

Numaligarh Refinery is situated near ecologically sensitive zone. The requirement of safety and environment is incorporated during design and construction stage itself, for new facilities. All relevant national and international standards like ISI, ASME, OISD, API, NFPA etc. are taken into consideration at the design stage. Requirements of various statutory rules and regulations like Factories Act, Petroleum Act and Rules, Boiler Rules, Environment and pollution Regulations etc. are complied with. NRL Management accords top most priority to Health, Safety and Environment Issues. The Environment & Safety performance is reviewed by the apex committee once in two months which is chaired by Director Technical of the refinery. Besides unit level and area level safety committees meet every month to review the safety performance of respective unit/area, the environment and safety issues are also reviewed in functional co-ordination meeting chaired by the Managing Director every month.

Numaligarh Refinery is having a modern & well equipped Fire station located near the Main Gate of Refinery and is away from the operating units. Fire station Control room equipped with sophisticated communication system. A full-fledged Energy & Environment Cell having qualified engineers exists to deal with all environmental issues well equipped lab has been established to monitor environmental performance on day-to-day basis. The lab is accredited by the National Accreditation Board for Testing and Calibration Laboratories (NABL). In addition, a full –fledged Occupational Health Centre (OHC) is functional at the refinery for monitoring of work related hazards namely toxic gas hazards, noise hazards etc and health monitoring of employees

Environment Management in Numaligarh Refinery is based on recommendations forwarded by National Environmental Engineering Research Institute (NEERI), stipulations laid down by Ministry of Environment & Forests & Pollution Control Board, Assam.

Following are the some of the Initiatives taken by NRL for environment protection since its inception:

- Selection of process technology/equipments made on basis of special care for environment protection. Hydrocracker technology has been incorporated to produce low sulphur products
- Sulphur Recovery unit has been incorporated in spite of low sulphur processing crude.
- Sweet refinery gas/low sulphur naphtha is used as primary fuel resulting in low SO<sub>2</sub> emission to the atmosphere.
- Low Nox burners installed in all the refinery furnaces to minimize pollution because of nitrogen dioxide.
- Stack heights have been kept at 60/77 mtrs to minimize pollution concentration at ground level.
- Hazardous solid waste generated in the refinery is disposed off by Secured Landfill technology.
- Schemes for 100% recycle of effluent discharge will be implemented very soon.