

## Numaligarh Refinery Ltd, Assam

### (i) Unit Profile

Numaligarh Refinery Ltd., a subsidiary of M/s Bharat Petroleum Corporation Ltd is located in the North Eastern part of India at Numaligarh in Golaghat District of Assam. Numaligarh Refinery is designed to process 3.00 MMTPA Crude Oil from Assam fields adopting state of the art technology.

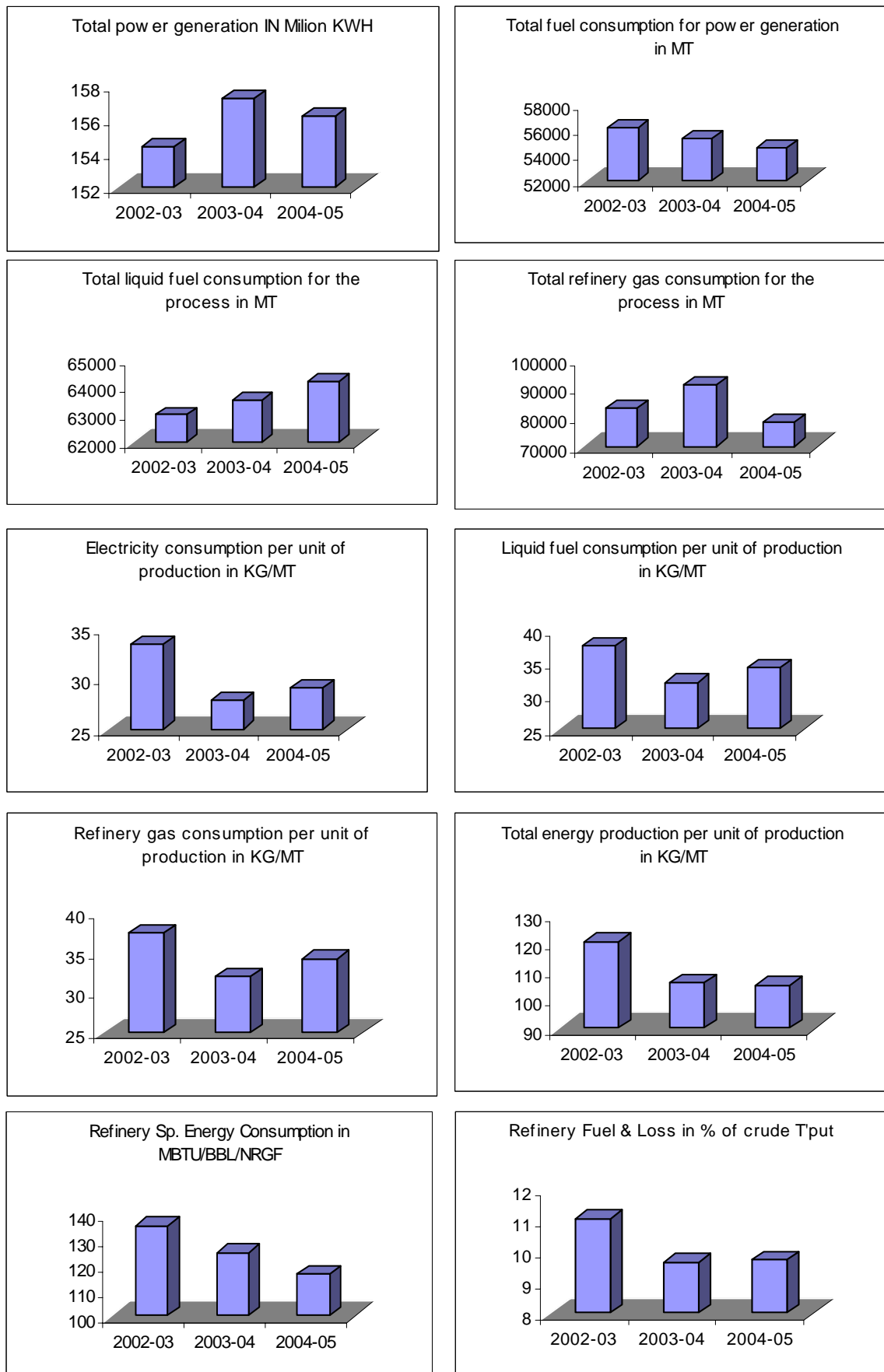
The refinery is one of the latest refineries of the country adopting state of the art technologies. Due to adoption of latest process technologies for secondary processing units as well as upgradation of residues / heavy ends, refinery ensures optimum value addition. The net distillate yield of the refinery is as high as 86% 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 cogeneration plant, installation of power recovery turbine, installation of condensate recovery system, installation of state of art instrumentation and digital control system etc.

### (ii) ENERGY CONSUMPTION

	Unit	2002-03	2003-04	2004-05
Total power generation	Million KWH	154.35	157.211	156.23
Total fuel consumption for power generation	MT	56128.00	55359.48	54592.081
Total liquid fuel consumption for the process	MT	62988	63540.93	64187.037
Total refinery gas consumption for the process	MT	83061	91069.01	78376.374
Electricity consumption per unit of production	KG/MT	33.45	27.936	29.142
Liquid fuel consumption per unit of production	KG/MT	37.54	32.064	34.263
Refinery gas consumption per unit of production	KG/MT	49.5	45.955	41.838
Total energy consumption per unit of production	KG/MT	120.5	105.955	105.2426
Refinery Fuel & Loss	% of crude oil throughput	11.06	9.64	9.71
Refinery Sp. Energy Consumption	MBTU/BBL /NRGF	136.0	125.0	116.6

## Graphical Representation Of Specific Energy Consumption

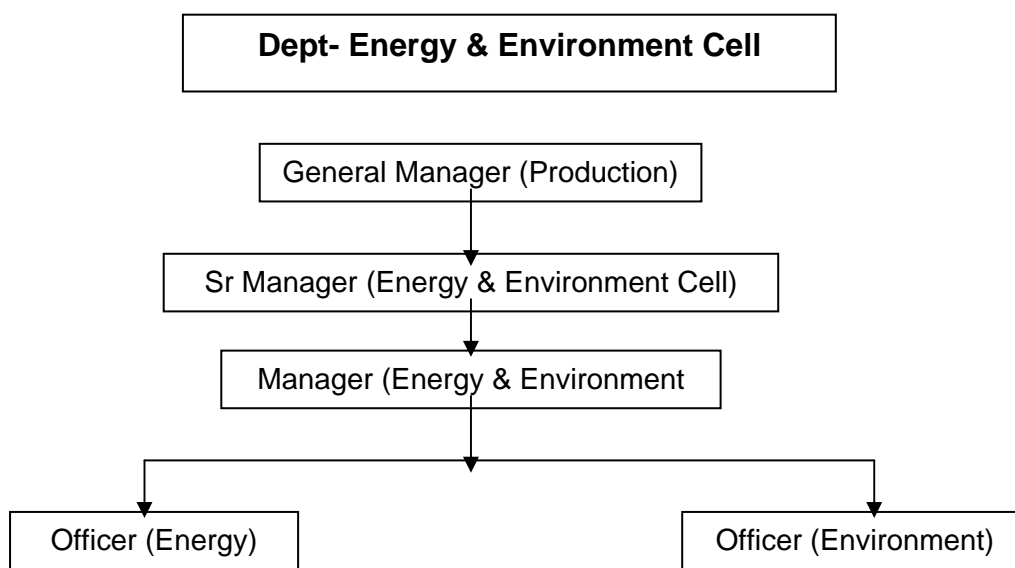


### (iii) Energy Conservation Commitments, Policy and Organizational Set Up

NRL is having the highest concern and commitment for conservation of Energy and preservation of Environment. We are complying with all regulations/acts and may even go beyond these to attain the sustained excellence in energy conservation. We consider energy conservation is the integral part of our business planning and operation process.

In view of above, NRL has formulated a draft Energy Management Policy which is presently under approval stage.

#### ENERGY CONSERVATION CELL STRUCTURE



### (iv) Energy conservation Achievements

The major Energy Conservation Projects Implemented During The Year 04-05 :

#### 1. Installation of telescopic insulation for the catalyst tubes at the reformer top to cover the bare hot tube length.

NRL is operating a 38000 TPA hydrogen plant licensed by Haldor Topsoe A/S. 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°C due to thermal expansion of the tubes. The problem was studied and a suitable scheme for insulating the expanded portion of catalyst tubes was developed. M/s INSULCON B.V Holland has provided 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 has provided 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.

### Energy saving

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 : 21lakhs



### **02. Installation of seven number of pneumatic No-Loss Drain Trap in air compressor and air reservoir**

Instrument air and plant air requirement of the whole refinery is met by two number of low pressure (LP) compressors. The low pressure (LP) compressors fed air to one of the LP receiver (4.2 m<sup>3</sup> capacity) at 8.5 kg/cm<sup>2</sup>. LP compressor is a three stage centrifugal compressor having the capacity of 5890 Nm<sup>3</sup>/hr capacity each. The discharge pressure is increases up to 8.5 kg/cm<sup>2</sup> in three stages. At every stage of compressor the air is cooled and fed to the next stage. In case of condensation of the air the total seven number of traps were provided, three numbers each in interstage cooler and one at LP receiver. The traps were of thermostatic type.

It was found that traps were not working properly. So always trap bypass used to keep open leading to sufficient amount of heat losses. The problem was discussed with compressor vendor i.e. Ingersoll-Rand. The vendor has provided the new pneumatic types of trap i.e. Pneumatic No-Loss drain traps. Pneumatic No-Loss Drain trap is a heavy-duty industrial drain valve that will not waste compressed air. The PNLD is not required the use of electricity, any pre-setting or manual intervention and has a 7/16th

### **Technical & Financial Analysis**

Power consumption of the air compressor before installing the new pneumatic types of traps = 500 kw

Power consumption of the air compressor after installation of new types of traps = 490.5 kw

Net saving of power = 120 KWHR per Day

Annual saving of power = 0.39 lakhs KWHR

Total cost of project = 4.2 lakhs



### **03. Utilisation of surplus air by stopping the air compressor in LPG bottling plant**

#### **▪ Description of present system :**

The Present system consist of 6.0 Nos. of Deluge Valves with Quartzoid Bulb detector network and Air Header Ring . Air in the ring is fed from the Air Compressor through Air Vessel of Capacity 3.0 NM<sup>3</sup>. During Night or of working hours the Vessel supplies the Air to the network. However, it has been noticed that pressure drops to the operating level of DV over a period of 17-18 Hrs.

#### **▪ Modification Implemented**

Already one 3" instrumentation header was existing near the black oil gantry from refinery air compressor system. From there one 2" line was extended up to LPG bottling plant air compressor discharge system.

#### **▪ Advantage due to above modification**

1. This line enabled the deluge valves (DV) to keep in auto mode as per the requirement of OISD.
2. This line enabled to stop the air compressor in LPG bottling plant resulted in saving of power as well as cooling water.
3. Resulted in reduction of surplus air.

A. **Power Saving :**

1. Air Compressor :  
22 kW X 6.5 Hrs X 300 = 42900 kWh
2. Cooling Water Motor :  
2.7 kW X 6.5 Hrs X 300 = 7215 kWh
3. Cooling Water Motor :  
2.7 kW X 6.5 Hrs X 300 = 7215 kWh

Total Power savings : 57300 kWh per annum



B. **Water Saving :**

- i. Cooling Water Requirement (Drinking Water)  
: **340 KL**



**(v) Energy Conservation Plans and Targets**

S.N.	Energy Conservation Measures (Planned)	Anticipated savings in		Approx. investment (Rs. Lakhs)	Project Commencement & Completion year
		Energy Value (Specify units)	Rs. Lakhs		
01	Installation of 12 MW Steam Turbo Generator (STG) for utilising surplus steam and recovering power from PRDS, for which detailed engineering completed during the year. The project is expected to recover around 14000 MWH of energy from PRDS as well as utilize the total surplus steam of the refinery.	11988.00	1198.80	3000.00	April' 05 & March' 07
02	Step less control system in HCU make up Gas Compressors, which is in the advanced stage of implementation. The implementation of this scheme will result in a saving of around 600 MT of fuel per year.	1100.00	110.00	100.00	2004-05 & 2005-06
03	Replacement of one motor driven HRSG feed pump by Steam Drive to cater the BFW requirement of both HRSG & Utility Boiler.	600.00	60.00	55.00	2004-05 & 2005-06
04	Implementation of Combination	733.00	73.30	158.00	2004-05 &

	Coke Cutting tools in Delayed coker unit.				2005-06
05	Utilisation of very low low pressure hot well gases from VDU to CDU furnace is under implementation.	1000.00	100.00	10.00	2004-05 & 2006-07
06	Replacement of existing mass flow meter in the flare header with accurate ultrasonic mass flow meter	333.00	33.30	35.00	2005-06
	<b>Total</b>	<b>15754.00</b>	<b>1575.40</b>	<b>3358.00</b>	

## Major Energy Conservation Projects Implemented During The Year 04-05:

### 2. Installation of telescopic insulation for the catalyst tubes at the reformer top to cover the bare hot tube length.

#### (i) Back ground of the project

NRL 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.

#### (ii) Observation made

##### Source of Heat Loss

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°C. During normal operating condition tube skin are maintained in the range of 950 deg Celsius inside the reformer. High temperature operating condition causes significant vertical movement due to the thermal expansion of reformer tubes.

##### Unique Nature of Problem

Thermal expansion causes the 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.

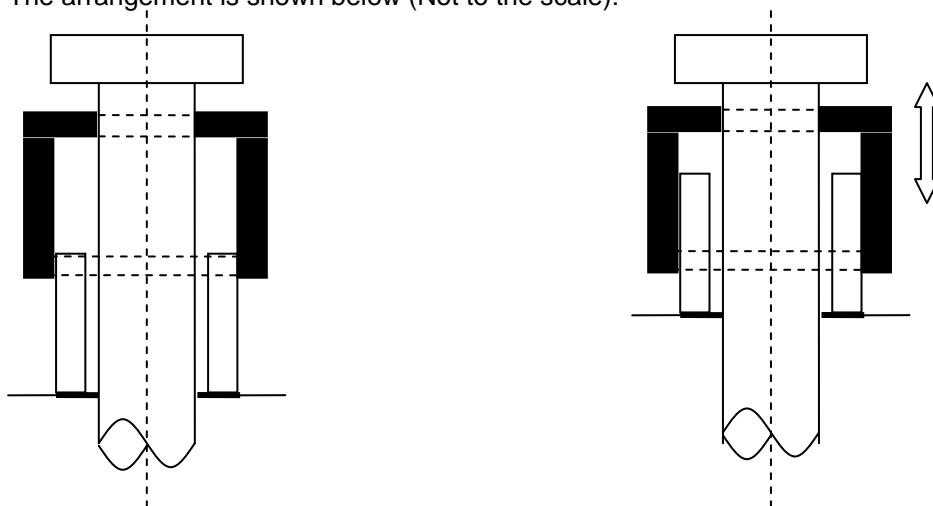
#### (iii) Technical analysis

##### Telescopic Insulation – A Unique solution first implemented by NRL 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)

**(iv) 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 : 21lakhs



**02.**

**ss Drain Trap in air compressor**

**(i)**

Instrument air and plant air requirement of the whole refinery is met by two number of low pressure (LP) compressors. The low pressure (LP) compressors fed air to one of the LP receiver (4.2 m3 capacity) at 8.5 kg/cm2. LP compressor is a three stage centrifugal compressor having the capacity of 5890 Nm3/hr capacity each. The discharge pressure is increases up to 8.5 kg/cm2 in three stages. At every stage of compressor the air is cooled and fed to the next stage. In case of condensation of the air the total seven number of traps were provided, three numbers each in interstage cooler and one at LP receiver. The traps were of thermostatic type.

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It was found that traps were not working properly. So always trap bypass used to keep open leading to sufficient amount of heat losses. The problem was discussed with compressor vendor i.e. Ingersoll-Rand. The vendor has provided the new pneumatic types of trap i.e. Pneumatic No-Loss drain traps. Pneumatic No-Loss Drain trap is a heavy-duty industrial drain valve that will not waste compressed air. The PNLD is not required the use of electricity, any pre-setting or manual intervention and has a 7/16th discharge orifice to prevent clogging.

**(iii) Technical Analysis & Impact of implementation  
(iv)**

Power consumption of the air compressor before installing the new pneumatic types of traps = 500 kw

Power consumption of the air compressor after installation of new types of traps = 490.5 kw

Net saving of power = 120 KWHR per Day

Annual saving of power = 0.39 lakhs KWHR

Total cost of project = 4.2 lakhs



#### 04. Utilisation of surplus air by stopping the air compressor in LPG bottling plant

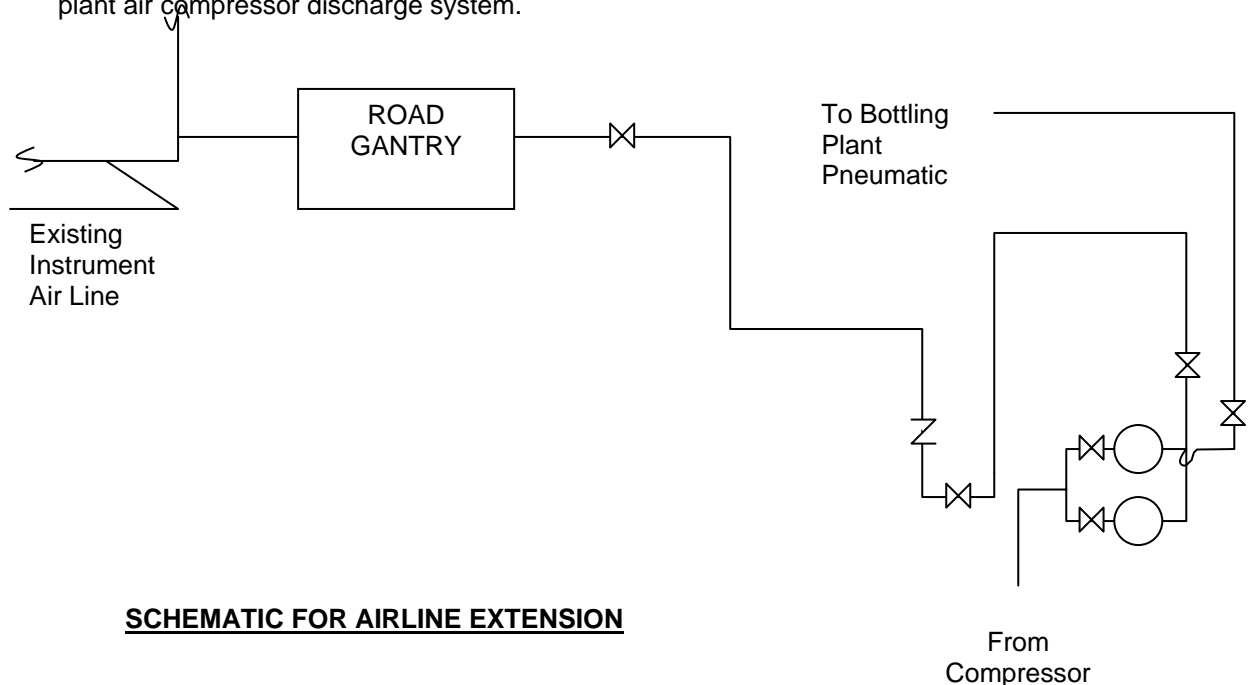
(i) **Background of the project & observation made:**  
(ii)

Extension of Instrument Air Line from Black oil Gantry to the Ring Header of Deluge Valve system in LPG Bottling Plant for continuous Deluge Valve Operation. This enabled to keep the (Deluge Valve) DV in auto mode as per the requirement of OISD – 144 (“MV sprinkler system having remote/ local operated deluge valve and at critical places like carousal, evacuation, valve change shed, automatic detection of heat for automatic operation of sprinkler system shall be provided.” (Para 10.4.8 a.)(Also OISD 169).

The Present system consist of 6.0 Nos. of Deluge Valves with Quartzoid Bulb detector network and Air Header Ring . Air in the ring is fed from the Air Compressor through Air Vessel of Capacity 3.0 NM<sup>3</sup>. During Night or of working hours the Vessel supplies the Air to the network. However, it has been noticed that pressure drops to the operating level of DV over a period of 17-18 Hrs.

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**(iv) Impact of implementation**

**C. Power Saving :**

4. Air Compressor :  
 $22 \text{ kW} \times 6.5 \text{ Hrs} \times 300 = 42900 \text{ kWh}$
5. Cooling Water Motor :  
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6. Cooling Water Motor :  
 $2.8 \text{ kW} \times 6.5 \text{ Hrs} \times 300 = 7215 \text{ kWh}$

Total Power savings : 57300 kWh per annum

**D. Water Saving :**

- i. Cooling Water Requirement (Drinking Water) :  
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