

## **6.0 ENVIRONMENTAL MANAGEMENT PLAN**

### **6.1 INTRODUCTION**

Environmental Management Plan (EMP) is the key to ensure a safe and clean environment. A project may have taken proper pollution control measures but without a management plan, the desired results may not be obtained. In view of ecological sensitivity of the project region, the stringent pollution limits prescribed by Assam State Pollution Control Board (ASPCB) and Ministry of Environment and Forests (MoEF), M/s Numaligarh Refinery Limited initiated pollution prevention / control measures from the very beginning stage. From the very onset, Numaligarh Refinery has been pursuing a focused program towards environmental management by formulating a comprehensive policy towards its commitment for the protection, preservation and development of the environment, in consistency with its overall corporate objectivity.

M/s NRL strictly adheres to the requirements of Environment Management Systems conforming to internationally recognized standard ISO:14001:2004, within its short period of operation. A sound and world class Environment Management System has been developed and implemented for which NRL has been recertified by DNV (Det Norske Veritas) under ISO 14001:2004 (recertified over 14001:1996) along with ISO 9001:2000 and OHSAS 18001: 1999 for Quality Management System and Occupational Health and Safety Management System respectively. NRL has also been awarded ISRS (International Safety Rating System) Level-8 by M/s DNV in the first attempt itself and Level-9 within a span of one year.

It has been evaluated that the study area has not been affected adversely with present industrialization (Tea Processing Units). The proposed project is likely to provide new economical fillip, not only for the study area but also for the region as a whole. Mitigation measures at the source level and an overall Management Plan for the study area elicited so as to improve the supportive capacity of the study area and also to preserve the assimilative capacity of the receiving bodies.

The affected environmental components in the study area include air quality, water quality, soil, land use, ecology, demography, etc. The management action plan aims at

controlling pollution at source level to the possible extent with the best available technology followed by treatment measures before they are discharged to the environment. Necessary energy saving measures would be taken during design stage to save and conserve energy. In addition to the specific control measures, the proposed project would explore reuse and recycling technologies to reduce generation of waste to the extent possible as well as controlling pollution at source. The Effluent Treatment Plant is there for treatment of waste water up to tertiary level and the treated wastewater is utilized for CT filter backwash, greenbelt, fire fighting system, etc.

## **6.2 ENVIRONMENTAL MANAGEMENT DURING CONSTRUCTION PHASE**

The facilities of the proposed project will be installed within the existing refinery premises and no additional land shall be acquired for the proposed project. M/s NRL shall take necessary steps to ensure strict implementation of occupational safety measures for the workers. Suitable safety clauses shall be included in individual construction contracts and the implementation of the same shall be monitored during job execution period. Environmental pollution expected during construction phase of proposed project is considerably insignificant as compared to construction of a grass root refinery. The impacts of the construction phase on the environment would be basically of transient nature and are expected to wear out gradually on completion of the construction phase. However, once the construction job related to the proposed units is completed and operation of units started, the operation stage impacts would overlap the impacts due to the construction activities. Following factors shall require due consideration during construction phase:

### **6.2.1 Site Preparation**

The proposed project site is already prepared to some extent and back filling is not required. Stock piling of earthen material would be required temporarily due to

foundation works for proposed facilities. Therefore, it is suggested that the disturbed slopes may be stabilized to prevent washout during rainy season. During dry weather conditions (other than rainy season), it is necessary to control the dust nuisance caused by earth work, leveling and transportation activities by water sprinkling.

### **6.2.2 Sanitation**

The site should be provided with adequate and suitable sanitary facilities to maintain proper standard of hygiene for construction workers. These facilities should include water supply, sanitary toilets, rest room, etc.

### **6.2.3 Construction Equipment & Waste**

Care shall be taken to prevent accidental spillage of any oil from construction equipment. Combustible waste, if any, shall be burnt in Incinerator. Other wastes shall be disposed-off by adopting environmentally compatible methodology.

### **6.2.4 Storage of Hazardous Materials**

The hazardous material such as lubricating oils, compressed gases (for welding), paints, varnishes, etc. are required to be stored at the site during construction phase. Since, these materials are hazardous in nature, they shall be stored as per the prescribed / accepted safety norms.

### **6.2.5 Solid / Hazardous Waste Disposal**

The hazardous materials used during the construction may include petrol, diesel, welding gas and paints. These materials would be stored and handled according to the guidelines specified under Solid Waste (Management, Handling & Trans-boundary Movement) Rules dated 24<sup>th</sup> September 2008 by MoEF. Some of the precautions of storage and handling of the hazardous materials and waste includes the following:

- Dyke enclosures would be provided where-ever necessary for storage of hazardous materials.
- Diesel and other fuels would be stored in separate dyke enclosures.
- On-site recycling of all waste solvents / thinners and oils and off-site recycling of paint thinner, solvent wastes and waste oil.
- Separate storage for waste paints and thinners, contaminated rags and brushes

to facilitate recycling and reuse. Rags could be laundered for reuse.

- Vehicle maintenance area to be selected properly, to prevent contamination of soil and ground water by accidental spillage of oil, and other wastes

### 6.2.6 Land Environment

The proposed site bears a barren look and is devoid of floral species. It is envisaged that minor leveling of land will be required for the proposed project.

## 6.3 ENVIRONMENTAL MANAGEMENT DURING OPERATION PHASE

The environmental management and safety management systems existing at NRL shall be extended to proposed facilities which shall cover prevention of pollution, minimization of waste generation, conservation of resources like energy, water, feed, etc. as well as accountability of all efforts towards environmental protection. However, NRL management accords top priority to health, safety and environment issues. The safety and environmental issues are regularly reviewed by the top management of NRL every month in functional co-ordination meeting.

In order to mitigate the environmental impacts during operation of proposed process units at existing Numaligarh Refinery, the following measures are recommended:

### 6.3.1 Air Environment

Numaligarh Refinery is located in an environmentally sensitive area delineated by Ministry of Environment & Forests (MoEF) vide gazette notification dated 5<sup>th</sup> July 1996. As per this notification of MoEF, Govt. of India proposed to create a “No Development Zone” within a radial distance of 15 km along the Numaligarh Refinery site except towards north-west, where the “No Development Zone” extends right up to the eastern/south-eastern boundary of Kaziranga National Park. The sensitivity is with special reference to Kaziranga National Park, which is a home for three fourth of total population of Rhinos in south-east Asia and contains largest single concentration of endangered species of wild animals like Swamp Deer, Wild Buffalo, Elephants, Tigers and Gangetic Dolphins. In view of this, some extraordinary mitigation measures for minimization of atmospheric emissions have already been implemented at Numaligarh Refinery as per the directives of the statutory authorities.

The baseline ambient air quality monitoring carried out during study period around Numaligarh Refinery (within the study area), clearly reveals that the concentrations of SPM, RPM, SO<sub>2</sub>, NO<sub>x</sub>, CO and HC are well within the prescribed limits as per the National Ambient Air Quality Standards for residential as well as for sensitive areas. As per the details available in DFR, the additional fuel requirement is 0.24 MT/hr which is expected to release about 0.25 kg/hr of SO<sub>2</sub> from the stack which is very less and insignificant in comparison with the present emission level of around 110-120 kg/hr.

### 6.3.1.1 Existing Control Measures

- NRL is the first refinery in north-east region to install a Sulfur Recovery Unit (SRU) in spite of processing low sulfur Assam crude (having around 0.22% to 0.26% of Sulfur) along with Sour Water Stripping Unit and Sour Gas Sweetening Unit.
- Low NO<sub>x</sub> burners have been installed in all the furnaces to minimize the pollution due to oxides of nitrogen.
- Installation of a non-illuminating Ground Flare System, which is first of its kind in the Refinery Industry.
- All the furnace stacks are having facilities for continuous monitoring SO<sub>2</sub> and NO<sub>x</sub>.
- Regular monitoring of ambient air quality is carried out at five designated locations in and around refinery including one at Kaziranga National Park.
- The height of the stacks attached to all the furnaces have been kept at 60-metres or more to keep the ground level concentration of pollutants at minimum level.
- CAT degas process has been implemented in SRU to remove the entrapped H<sub>2</sub>S in liquid sulphur without exposing to atmosphere.
- A wind monitoring system has been installed for providing information on wind flow pattern, which is a critical parameter for air quality management and also for air pollution control.
- Regular monitoring of fugitive emissions from the storage tanks
- An Ultrasonic Mass Flow Meter to measure flare gas has been installed.

### 6.3.1.2 Proposed Control Measures

### **Design Stage**

The design stage endeavors to mitigate the problems related to health, safety and environment at the process technology/ source level itself. Besides international standards, emphasis would be given to comply with all design standards/ regulatory norms as specified by IBR, OISD, and CCE etc.

Following measures would be taken right from the design stage to ensure compliance with applicable regulatory standards:

- Use of low sulfur fuels in Furnace
- Low NO<sub>x</sub> burners would be used for Heaters/Furnaces to restrict the emission of NO<sub>x</sub>.
- Under normal circumstances, there will be no continuous release of volatile hydrocarbon streams. However, if during start-up/ shut down or an emergency situation any hydrocarbon stream is released, the same will be directed to an elevated flare for complete combustion. This will eliminate the possibility of forming an explosive mixture due to sudden release of un-burnt hydrocarbons to the atmosphere.

### **Construction Phase**

Generation of suspended particulate matter is a common phenomenon due to transportation of constructions materials. This would be mitigated by allowing the vehicles entering the NRL premises under cover. Emission of fugitive dust due to movement of heavy vehicles etc. shall be controlled by spraying water in the affected zone. Hosing down the wheels of the vehicles with water and providing washing troughs for them would further mitigate the amount of dust generated. In addition, emission of other pollutants from construction machinery using diesel driven prime movers, will be controlled by proper maintenance.

### **Operation Phase**

In-plant Control Measures: Some of the mitigation measures, which can reduce the impact on air environment, are as follows:

- Ensuring the operations of various process units as per specified operating guidelines/ operating manuals.

- Strict adherence to maintenance schedule including lubrication for various machinery/ equipment.
- Adoption of good house-keeping.

### **Fugitive Emissions**

To mitigate fugitive emissions of hydrocarbons, the following steps would be taken:

- ☞ Minimum number of flanges, joints and valves in pipelines
- ☞ Selection / use of state-of-the art leak proof valves
- ☞ Provision of mechanical seals in pumps
- ☞ Regular inspection of floating roof seals and proper preventive maintenance of roofs and seals for tanks
- ☞ Monitoring and preventive maintenance of valves, flanges, joints, etc.

## **6.3.2 Water and Waste Water Management**

### **6.3.2.1 Existing Wastewater Management**

For conservation of water resources, following measures are taken at NRL to reduce water consumption:

- Using stripped sour water from SRU as coke cutting water and used in CCU for direct quenching of hot coke.
- Use of crude & vacuum column over-head sour water as de-salter water.
- Use of hydrocracker column over-head water in high pressure water injection system.
- Recovery of steam condensate to reduce the DM water intake.
- 100% reuse of treated water (Zero Discharge) has been achieved since October 2006. Treated water is used as cooling water make-up, in fire water network and gardening of green belt.
- To recover oil from wastewater two numbers of high efficiency oil centrifuges are provided in ETP. All the treated effluent is being recycled by implanting suitable modification in ETP.

### **6.3.2.2 Measures to Control Water Pollution for Proposed Project**

Since the proposed project is expected to generate minimal additional effluent (8.1

m<sup>3</sup>/hr), it is proposed to route the same to the existing Effluent Treatment Plant.

### **Construction Phase**

The existing drinking and sanitation facilities available at the refinery shall be extended to the construction work force. This is necessary to reduce pollution of any receiving water body and also to prevent hazards due to water borne vectors.

### **Operation Phase**

The wastewater generation from proposed facilities would be about 8.1 m<sup>3</sup>/hr and would be treated in the existing ETP. The additional treated wastewater would also be utilized for various activities like horticulture, fire water make-up, etc. The following measures would be taken to minimize the water usage in the operational phase:

- Endeavor to reduce the actual process water consumption by way of improvement in operation of processing units.
- Water saving shower head flow controls, spray taps and faucet aerators and photo-sensitive taps.
- Exploring other options of reusing the treated effluent besides fire water make up or for horticulture development.
- Ensuring proper monitoring and maintenance schedule for the effluent treatment plant.

### **Existing Effluent Treatment Plant**

A modern Effluent Treatment Plant (ETP) with physical, chemical, biological and tertiary treatment facilities using latest technology having three-stage oil recovery system has been installed. To avoid hazardous solid waste generation, more environment friendly Hydrogen Peroxide (H<sub>2</sub>O<sub>2</sub>) treatment process has been introduced in place of conventional Ferric Chloride treatment process. To recover oil from wastewater two numbers of high efficiency centrifuges are also provided in ETP.

The details of existing wastewater generation may be summarized as under:

**Table - 6.1**

#### **DETAILS OF EXISTING WASTEWATER GENERATION**

<b>Sl. No.</b>	<b>Source</b>	<b>m<sup>3</sup>/day</b>
01.	Oily Water System (OWS)	1215
02.	Contaminated Rain Water System (CRWS)	713
03.	DM Plant	422

04.	CT Blow Down	290
Total Waste Water Generation		<b>2640</b>

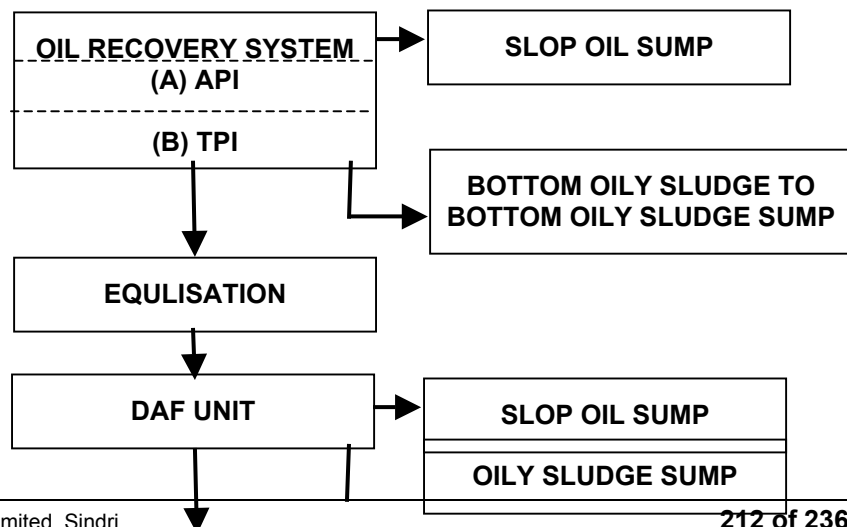
The estimated wastewater generation from proposed Solvent De-waxing/ De-oiling Unit is summarized as under:

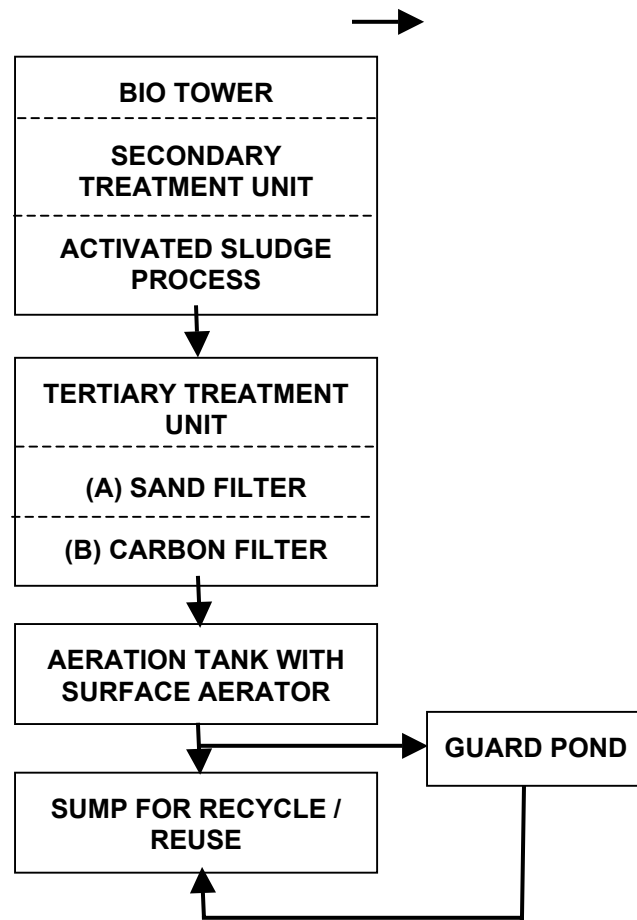
**Table - 6.2**  
**DETAILS OF PROPOSED WASTEWATER GENERATION**

Source	Quantity, m <sup>3</sup> /hr	Continuous/ Intermittent	Destination
Azeotrop Column	3.1 (Normal) 5.0 (Max.)	Continuous	OWS
Floor Washings	5.0	Intermittent	OWS
<b>Total</b>	<b>8.1</b>		

Thus, total waste water generation (from existing and proposed activities) will be 2834 m<sup>3</sup>/day (2640 m<sup>3</sup>/day from existing facilities + 194 m<sup>3</sup>/day from proposed wax project). The existing ETP shall be used for treatment of wastewater generated for the proposed project. Present generation of wastewater is about 110 m<sup>3</sup>/hr and additional wastewater to be generated from proposed project is about 8.1 m<sup>3</sup>/hr. Thus, a total of 118.1 m<sup>3</sup>/hr of wastewater shall be treated in ETP. The capacity of existing ETP is 220 m<sup>3</sup>/hr. Thus, the existing ETP is having surplus capacity to accommodate the wastewater generated from the proposed project. The process block diagram of ETP is given hereunder:

**PROCESS BLOCK DIAGRAM OF ETP**  
**(CAPACITY: 5280M<sup>3</sup> / DAY)**





Regular monitoring of effluent and combined final discharge of treated waste water including outlet of STP at township is recommended. Performance evaluation of ETP in Refinery as well as STP at township should be undertaken at regular intervals for all relevant parameters.

### 6.3.3 Noise Environment

#### 6.3.3.1 Existing Measures for abatement of noise pollution

The existing practices being followed for abatement of noise pollution in NRL refinery may be summarized as under:

- As green belt of is one of the prominent barrier for pollutants and noise, a meticulously planned 100-metres wide green belt around refinery and 25-metres

wide green belt around the marketing terminal has been developed covering a total area of around 70 hectares of land. The green has now grown into a rich foliage rendering a perfectly natural barrier to the industrial noise and minor air pollutants from reaching the immediate surroundings, both human population and rich flora and fauna.

- NRL is low noise generating equipment in process units. Regular noise monitoring is carried out inside the refinery premises.
- Adequate measures have already been incorporated in the existing plants for control of noise and vibration from the different equipment. The control of noise within the plants is through the provision of anti-vibration padding for moving machineries, silencers, hoods, and barrier walls to the noise generating equipment. The moving machineries are housed in the enclosed buildings. For attenuation of noise, a proper green belt development program already exists within refinery complex. However, some more areas would be brought under green belt development program.
- The control rooms have already been provided with acoustic glass walls to protect the workers from higher noise level. As the operational staff shall remain within the control rooms for most of the time, they are exposed to the higher noise levels for very short duration. During the visits to the areas of higher noise levels, the operational and maintenance personnel use earplugs and ear muffs as a safety measure. Moving parts of equipment are properly maintained and lubricated to minimize the generation of noise.

### 6.3.3.2 Noise Mitigation Measures for Proposed Project

In order to minimize adverse impact on the noise environment, due attention shall be given for implementing noise control measures:

#### Design Stage

Comprehensive measures shall be taken at design stage for noise from proposed units. The measures are as under:

- The noise level at the plant boundary shall be restricted to 75 dB(A) during day time and 70 dB(A) during night time.

- Noise level shall be specified for various rotating equipment as per Occupational Safety and Health Association (OSHA) standards.
- Equipment lay-out shall be done considering segregation of high noise generating sources.
- Erection of suitable enclosure, if required, to minimize the impact of high noise generating sources.

#### **During Construction Phase**

Following measures shall be taken for abatement of noise during construction phase:

- Noise emissions from construction equipment will be kept to a minimum by regular maintenance.
- Heavy and noisy construction jobs shall be avoided during night hours.

Following measures shall be adopted for abatement of noise during operation phase:

- Acoustic laggings, enclosures and silencers shall be provided wherever necessary for high noise generating equipment.
- Sound proof glass paneling shall be provided for all operating stations / control rooms as well as for shift rooms at critical places.
- Strict implementation/ compliance of all statutory norms w.r.t. noise generation, occupational exposure shall be done.
- Use of personal protective devices such as ear-muffs and ear-plugs shall be strictly enforced.
- Acoustic barriers / shelter shall be developed in noisy workplaces.
- Noise generating sources in the plant areas shall be monitored regularly. Monitoring of ambient noise levels should also be carried out regularly both inside the Refinery premises as well as outside the greenbelt.

#### **6.3.4 Solid Waste Management**

As per Schedule-I, Section-4 of MoEF Notification 24<sup>th</sup> September, 2008 for Hazardous Waste (Storage, Handling & Trans-boundary Movement) Rules following wastes being generated from Petroleum Refining are kept under hazardous category:

- 1) Oily sludge emulsion

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- 2) Spent catalyst
- 3) Slop Oil
- 4) Organic residues from process
- 5) Chemical sludge from waste water treatment
- 6) Oil contaminated soil

The solid waste generated from existing production activities of NRL may be summarized as under:

Sl. No.	Waste Group	Description of waste item
1.	Metallic	a) Ferrous b) Non-ferrous
2.	Secured Land fill Burial Items	a) Oily Sludge with calorific value <2500 Kcal b) Spent Resins
3.	Hazardous waste to be disposed of to approved recycler	a) Spent Catalyst b) Spent Adsorbent c) Spent Activated Carbon d) Lead acid Batteries
4.	Incinerable Waste	a) Waste Papers b) Lunch Packets c) Oil Soaked Cotton, Hand Gloves d) Oily Sludge with Calorific value >2500 Kcal

Sl. No.	Waste Group	Description of waste item
5.	Elect. Waste	a) Fused bulbs & tubes b) Cable pieces c) Capacitors & other accessories d) Batteries
6.	Laboratory waste	a) Broken glassware b) Ceramics/porcelain ware c) PVC/Plastic wares
7.	Empty Drums	a) Metallic drums b) PVC/Plastic drums
8.	Plastic & Rubber scraps, Jute	a) Plastic hoses, scraps b) Rubber hoses, scraps c) Jute bags
9.	e- waste	a) Damaged Computers, printers b) DCS/PLC cards c) CD, Floppy, Cartridges
10.	Auto biodegradable Waste	a) Tree Branches b) Grasses & other vegetation
11.	Solid waste to be buried	a) Sediment of Raw Water Plant b) Sand from filters

		c) Refractory/Insulation materials
12.	Excess earth	a) Excavated earth b) Site grading soils
13.	Screwding & burial items	a) Asbestos materials b) Waste insulation c) Glass wool d) Waste Gaskets e) Tar contaminated waste f) Packing boxes

#### 6.3.4.1 Existing Management of Hazardous Waste

During the operation of a refinery, some amount of solid waste material of various natures is generated, which requires an environment friendly and proper solid waste management system. The major categories of hazardous waste generated from NRL refinery are mainly in the form of:

- a) Slope Oil (Waste Oil) from all process units and marketing terminal
- b) Oily Sludge generated from Effluent Treatment Plant
- c) Spent Catalyst

Following management practices are adopted for management of above wastes:

##### 6.3.4.1.1 Recycling of Slop Oil

The slop oil, which is generated from different process units, during blow-down of any vessel, equipment, etc., is drained to CBD (Closed Blowdown) System. From CBD the slop oil is directly transferred to the Wet Slop Tanks in the Off-site area. The water accumulated after necessary settlement is drained to the ETP for treatment. After that the slop oil is transferred to the Dry Slop Tank for reprocessing.

##### 6.3.4.1.2 Recycling of Waste Oil from OWS System

All the process wastes, tank bottom drains, de-salter effluents, effluents from Marketing Terminal, are routed to ETP through Oily Water Sewer (OWS) System which comprises three stage oil recovery.

- The oil is skimmed out from waste stream by passing the effluent through the API Oil Separator and sent to the slop oil tanks for reprocessing.
- The oil is then separated from the waste stream by using the Tilted Plate

Interceptor (TPI) and sent to the slop oil tanks for further reprocessing.

- Traces of oil escaped with the wastewater from TPI is recovered from the equalization tanks by using floating oil skimmers and sent to the slop oil tanks through slop oil recovery system for further reprocessing.
- The slop is taken either to Delayed Coker Unit (DCU) for reprocessing or transferred to crude tanks for further reprocessing.

#### **6.3.4.1.3 Recycling of Waste Oil from CRW System**

Free oil from Contaminated Rain Water System (CRWS) is recovered using two oil recovery system. Initially the oil is recovered at the two big surge tanks by using floating skimmers and then by using TPI.

#### **6.3.4.1.4 Recovery of Oil from Sludge**

Oily sludge generated in different locations of ETP is collected in a sludge thickener through Sludge Collection System and from the thickener, floating oil with water is recycled back to the Inlet Receiving Sump (IRS) for further processing and oil recovery. The thickened sludge from the bottom of the thickener is taken to the centrifuge feed sump for feeding to the oily centrifuge through the feed pumps, recovering the absorbed oil from it. By using the specially designed centrifuge for this purpose almost total oil is recovered from the sludge and is recycled back to slop oil system for reprocessing. The oil free cake from the centrifuge is to be disposed off in the Secure Landfill.

#### **6.3.4.1.5 Disposal of Spent Catalyst**

Spent catalysts belong to hazardous waste category. These are sold to MoEF authorized recyclers. The containers consisting spent catalysts after proper sealing are kept under covered area. The floors of the area where the spent catalysts are kept are impervious. The area identified for storage of spent catalysts is exclusive for storing hazardous waste.

#### **6.3.4.2 Solid Waste Management for Proposed Project**

The following measures shall be adopted for protection of the environment:

- Spent Catalysts shall be sold to MoEF authorized recyclers.

- Waste having calorific value above 2500 Kcal/kg should be burnt in incinerator or may be considered for bio-remediation.
- Other hazardous wastes shall be considered for secured land fill.
- The bio-sludge generated during treatment of wastewater shall be used as compost and applied in the garden.
- Record with respect to quantity, quality & treatment/management of solid/hazardous waste shall be kept as usual at environmental monitoring cell for different process units (as per the MoEF guidelines).

#### 6.3.4.2.1 Recovery & Re-use of Solvent

##### De-waxed Oil Solvent Recovery Section

The de-waxed oil (DWO) solvent recovery section consists of three staged flashing followed by steam stripping. The different stages are to be operated at the following conditions:

Stages	Operating Pressure (Kg/cm <sup>2</sup> a)
Atm. Flash	1.34
MP Flash	2.8
HP Flash	4.2
Steam Stripping	1.2

The primary filtrate from feed mix chilling section is sent to DWO solvent recovery section to recover solvent from the de-oiled wax. Here the primary filtrate is first preheated by solvent vapours obtained from atmospheric and pressure flash columns in exchanger and followed by final heating in the LP steam heater before feeding to the atmospheric flash column, MP flash column and HP flash column, join after exchanging heat in exchangers and are sent to the Atmospheric Solvent Cooler where liquid solvent is cooled to 40°C. The cooled solvent and water from solvent cooler is routed to solvent water separator drum where solvent and water are separated. The solvent flows to dry solvent receiver whereas the water containing equilibrium quantity of solvent is sent to Azeotrope Column after being heated by Azeotrope Colum Feed Bottom Exchanger. Solvent contained in Azeotrope Column is stripped off by steam and the solvent vapours along with steam and condensed in solvent condenser and routed to solvent water separator.

Fresh make-up solvent is pumped to dry solvent receiver drum by make-up solvent pump. Dry solvent is sent to chilling and filtration section by solvent dilution and reflux pump.

The de-waxed oil obtained from the bottom of atmospheric flash column is pumped by the DWO atmospheric flash bottom pump to DWO MP flash column after pre-heating in DWO mix/ HP flash vapour exchanger followed by DWO Mix/ Fouts oil exchanger. The separated vapours from column top are also sent to atmospheric solvent cooler after exchanging heat with primary filtrate in exchanger. The bottom liquid from column is routed to DWO HP flash column through pump after preheating in DWEO mix heater. The HP flash column operates at 4.2 Kg/cm<sup>2</sup> a pressure. The liquid from HP flash bottom is fed to DWO stripper under its own pressure for final solvent stripping. The solvent vapours from HP flash column are sent to atmospheric solvent cooler after exchanging heat with MP flash column feed. Vapours from DWO stripper are routed to solvent condenser. In DWO stripper the last traces of the solvent are recovered by steam stripping. The de-waxed oil from the stripper bottom called Fouts Oil is sent to storage tank through DWO stripper bottom pump after heat recovery and cooling in the DWO Mix/ Fouts Oil exchanger and finally to Fouts Oil Cooler respectively.

### **Slack Wax Solvent Recovery Section**

The slack wax solvent recovery section consists of single stage flashing followed by steam stripping. Different stages are to be operated at the following conditions:

	<b><u>Operating Pressure (Kg/cm<sup>2</sup> a)</u></b>
Flash Column	1.3
Steam Stripping	1.2

The wax mix after preheating in wax mix LP Steam is routed to wax mix surge vessel which is equipped with heating coil. The wax mix is pumped by wax flash column feed pump to slack wax flash column after pre-heating in a series of exchangers. The wax mix is first pre-heated by SW mix flash vapour exchanger and finally by MP steam in exchanger. The flashed solvent recovered from column top after heat recovery is routed to atmospheric solvent cooler. The wax mix obtained from column bottom is fed

by gravity to wax stripper. The last traces of solvent are recovered in the stripper by steam stripping. The wet solvent vapours from stripper top are routed to solvent cooler and then to solvent separator for further processing. The wax product obtained from stripper bottom is sent to storage through wax stripper bottom pump after being cooled in tempered water cooler.

In solvent water separator the wet solvent from various sources is collected and water & solvent phases are allowed to separate. The water rich phase is pumped to waste water stripper column through column feed pump. The stripped solvent vapours obtained from column top by steam stripping are condensed in solvent condenser and routed to solvent water separator drum. The waste water obtained from waste water stripper column bottom is routed to oily water sewer (OWS).

### 6.3.5 Preventive Measures for Methyl Iso-Butyl Ketone (MIBK)

#### Fire Hazards

MIBK is highly flammable and adequate ventilation should be provided during its handling and storage. MIBK vapours may form an explosive mixture with air. Vapours can travel to a source of ignition and flash back. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion. The containers may explode in the heat of fire. Vapors of MIBK are heavier than air. They can spread along the ground and collect in low or confined areas. MIBK may polymerize explosively when involved in a fire.

#### Fire Fighting Measures

In case of fire, a self-contained breathing apparatus should be used. For small fires, dry chemical, carbon dioxide, water spray or alcohol-resistant foam should be used. Pouring water on the site of fire may be ineffective. For large fires, water spray fog or alcohol-resistant foam should be used. Straight streams of water should not be used. The containers with flooding quantities of water should be cooled until well after fire is out.

#### Accidental Release Measures

Following measures are recommended during accidental release of MIBK:

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- Avoid runoff into storm sewers and ditches which lead to waterways.
- Wear a self contained breathing apparatus and appropriate personal protection.
- Scoop up with a non-sparking tool then place into a suitable container for disposal.
- Remove all sources of ignition.
- Absorb spill using an absorbent, non-combustible material such as earth, sand, or vermiculite.
- Provide ventilation.

**Handling and Storage**

Following measures are recommended for handling and storage of MIBK:

Handling	Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use with adequate ventilation. Ground and bond containers when transferring material. Use spark-proof tools and explosion proof equipment. Avoid contact with skin and eyes. Empty containers retain product residue, (liquid and/or vapor), and can be dangerous. Avoid ingestion and inhalation. Do not Pressurize, cut, weld, braze, solder, drill, grind or expose empty containers to heat, sparks open flames.
Storage	Keep away from sources of ignition. Store in a cool, dry, well-ventilated area away from incompatible substances.

**First Aid Measures**

The first aid measures may be summarized as under:

Eyes	Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. Do NOT allow victim to rub or keep eyes closed.
Skin	Immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid if irritation develops or persists. Wash clothing before reuse.
Ingestion	If victim is conscious and alert, give 2-4 cup of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately.
Inhalation	Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid if other symptoms appear.
Advice to Physician	Treat symptomatically and supportively.

**Measures recommended during poisoning****Symptoms of poisoning**

Symptoms and signs include irritation of the eyes, skin, and respiratory tract, and depression of the central nervous system, manifested by headaches, nausea, and

narcosis. Gastrointestinal pain and hepatic toxicity may occur with exposure to high concentrations.

#### **Medical advice**

In case of MIBK exposure, contact the nearest Health Centre for detailed advice on treatment. Information on first aid is provided in the Summary of Chemical Safety Information. If breathing ceases or becomes weak and irregular, artificial respiration should be applied and oxygen administered. If there has been ingestion, vomiting should not be induced, because of the risk of aspiration into the lungs and the production of chemical pneumonitis.

### **6.3.5 Biological Environment**

Development of greenbelt with carefully selected plant species is one of prime importance due to their capacity to reduce noise and air pollution impacts by attenuation / assimilation and for providing food and habitat for local micro fauna. The existing 100 m wide green belt around refinery as well as 25 m wide green belt around marketing terminal is sufficient to mitigate impacts from proposed project. The selected species which will be useful, locally grown and found to be most suitable for strengthening the existing greenbelt, are recommended as follows:

- *Cedrela toona* (Poma)
- *Bischoffia javanica* (Urian)
- *Mussaea ferrea* (Nahar)
- *Terminalia citrine* (Hilikha)
- *Dillenia indica* (Owtanga)
- *Salix tetrasperma* (Bhe)
- *dendrocalamus hamiltonii* (Kakobamboo)
- *Areca catechu* (Tamul)
- *Terminalia bellerica* (Bhomara)
- *Cassia fistula* (Sonaru)
- *Hibiscus microphylla* (Chamia)
- *Mangifera indica* (Aam)
- *Mallotus albus* (Morolia)
- *Melia azadirachta* (Gora neem)

- *Michelia champaca* (Titasopa)
- *Polyalthia simiarum* (Borkoliori)
- *Saraca indica* (Ashok), etc.

### 6.3.6 Socio-economic Environment

Formulation of an effective EMP is important to mitigate the impacts likely to arise out of the proposed project and to maintain goodwill with local people. The support from local residents in the nearby villages is always helpful in long term sustainability of the project. In view of this, the following measures are suggested:

- ☞ NRL shall continue organizing regular environmental awareness programme to bring forth the environmental management measures being undertaken and the beneficial aspects of the proposed project towards the improving the quality of life and environment.
- ☞ Social welfare activities should be improved with local bodies and the future plans of social welfare programme may be chalked out in consultation with local bodies and same shall be widely circulated to public.
- ☞ In order to improve socio-economic status in nearby tribal area, the NRL authority shall consider extending welfare measures under the community development programme.
- ☞ Some basic amenities like education, safe drinking water supply, etc. to the nearby villages shall be taken up as a gesture of goodwill.
- ☞ Regular medical checkup camps for the villagers shall be organized on routine basis in the villages around the refinery with proper data record and also by providing mobile hospital services.

## 6.4 ENVIRONMENTAL MANAGEMENT & MONITORING

### 6.4.1 Environmental Management Cell

NRL is already having a full fledged Environmental Management Cell under the Technical Services Department, consisting of well qualified and experienced technical personnel from relevant fields. It will continue to carry out various functions under the

control of a Senior Executive who reports directly to the head of the organization. The Cell will continue to ensure that all pollution control measures are effectively operating and are being maintained on regular basis. The main functions of the Cell are as follows:

- Co-ordination with the Production Department for proper operation of pollution control systems;
- Co-ordination with Central and State Pollution Control Boards;
- Routine monitoring of the efficiencies of pollution control systems;
- Routine monitoring of the quality of effluents, stack emissions, ambient air quality, noise level, etc.;
- Maintaining records and sending relevant portions of the results to State and Central Pollution Control Boards, as and when required;
- Implementation of pollution control measures.
- Implementation of safety rules and safe working procedures.
- Preparedness for tackling emergency situations arising from accidents, fire, explosion, toxic gas release, etc.

#### **6.4.2 Environmental Monitoring**

Environmental monitoring plays an important part in environmental management. In some instances it is beneficial to perform continuous monitoring. This can lead to rapid detection and recognition of irregular conditions and give the operating staff the possibility to correct and restore the optimum standard operating condition as quickly as possible. In general, the frequency of regular monitoring depends on process technology, type of process equipment, stability of the process, and reliability of the analytical method.

Monitoring schedule shall be followed in line with stipulations/conditions laid down by SPCB/ CPCB & MoEF. Monitoring reports shall be forwarded regularly to the State and Central Pollution Control Boards as per the schedule:

- Ambient air quality: Ambient air quality monitoring shall be continued at five locations as is being presently practiced. The parameters being monitored at present are SPM, RPM, SO<sub>2</sub>, NO<sub>x</sub> & CO. The measurements will be performed

regularly with the frequency of twice per week to evaluate 24 & 8 hourly concentrations.

- Stack Emissions: For evaluation of flow rate, temperature, pressure, PM, SO<sub>2</sub>, NO<sub>x</sub> & CO in the stack flue gases, appropriate sampling ports with approach ladders and working platforms shall be made in all the stacks during the construction phase.
- Waste water Streams: Monitoring of waste water streams shall cover all the relevant parameters as per statutory requirement.
- Regular analysis of influent and effluent water shall be continued. Sampling and analysis of wastewater from individual treatment units shall be carried out periodically.
- Methods prescribed in “Standard Methods for Examination of Water and Wastewater” prepared and published jointly by American Public Health Association (APHA: 21<sup>st</sup> edition, 2005) and American Water Works Association (AWWA) and Water Pollution Control Federation (WPCF) are recommended. Existing Laboratory at NRL is well equipped to analyze all the relevant parameters of treated effluent.
- Ground water quality: Ground water samples from 04 locations (near-by secured land fill area) representing the site, are collected and characterized for all parameters specified under IS: 10500 once in a month.
- Noise level: Noise generated by different sources and noise level within work zone & near boundary walls shall be measured once in two months, as is being presently practiced.

### 6.4.3 Environmental Initiatives taken by NRL to Control Pollution

In its endeavor towards protecting and caring for the environment in every step of its sojourn, NRL has adopted a very advanced and comprehensive step towards controlling pollution, essentially the stepping towards environment protection. These features were incorporated at the very nascent stage of project conceptualization and have been important corner stones, on which, the refinery stands today, modern efficient and yet eco-friendly in true sense.

#### Environment Friendly Process & Equipment

Selection of process technologies and equipment was done with special care for environmental protection. Hydro-cracker technology had been incorporated to produce the low sulfur products. Equipment like low NO<sub>x</sub> burners and low noise rotary equipment were considered during the time of equipment selection.

#### **Minimum Generation of Waste**

In-built measures had been adopted to minimize and control pollution and generation of waste in all the units with proper collection and disposal system.

#### **Adequate Segregation and Centralized treatment facilities**

Adequate segregation, collection and treatment facilities for waste water for centralized treatment has been provided to meet the stringent standards laid down in MINAS.

#### **Use of River Ways**

River ways was used for the movement of over weight consignments (OWS) and over dimensioned consignments (ODC) of project equipment.

#### **Diversion of National Highway No-39**

To reduce congestion and ensure safety for traffic on NH-39, a portion of highway parallel to the refinery has been diverted by constructing a bypass road.

#### **Unique Ground Flare System**

To avoid any adverse impact of the flare on animals in Kaziranga National Park, non-illuminating ground flare has been incorporated, which is first of its kind in the country.

#### **Sulfur Recovery Plant**

In spite of processing low sulfur Assam crude (having only 0.26% sulfur) a Sulfur Recovery Plant has been incorporated and installed, which is the first amongst the refineries using sweet Assam crude.

#### **Installation of Display Board**

Magnetically operated electronic display board has been installed at the main gate for displaying on-line stack emission parameters from all the major stacks of the refinery / treated effluent quality.

The display board is being upgraded for displaying information on Hazardous Wastes in line with Hazardous Waste (Management, Handling & Trans-boundary Movement) Rules-2008.

#### **Fugitive Emission Monitoring**

To prevent loss of hydrocarbon, regular monitoring of passing valves and fugitive emissions are carried out throughout the year.

## 6.5 ENERGY CONSERVATION MEASURES

There has been continuous thrust on the reduction of energy usages by means of adopting various energy conservation (ENCON) measures. ENCON is an on-going process. Since commissioning of refinery, plans have been formulated to achieve further saving in the coming years.

### 6.5.1 Energy Conservation Measures Taken

As a part of NRL's continual efforts towards energy conservation, the following new ENCON schemes have been implemented / under implementation:

The salient features of ENCON's schemes are as follows:

- NG utilization project for replacement of naphtha as fuel in GTG and replacement of naphtha both as feed and fuel in H<sub>2</sub>U and replacement of fuel in refinery furnaces.
- 12 MW STG (Steam Turbine Generator) for utilizing surplus waste steam and recovering power from PRDS (Pressure Reducing and De-superheater) has been installed and commissioned. This project is expected to recover around 14000 MWH of energy through PRDS as well as utilization of total surplus steam of the refinery.
- Substantial energy saving by cleaning finned tubes of Fin Fan Coolers in Hydro-cracker Unit by application of Foam Cleaning Technique has been achieved. Cleaning of Fin Coolers of other units also done by similar cleaning method in RTA 2008.
- Continual use of Energy Master in air compressors of CPP for better energy management.
- Continual benefit from the unique Step-less Control System implemented in the make-up gas compressor of the Hydro-cracker Unit during the year 2006-07. This has saved around 600 MT of fuel per year. This has also improved the energy efficiency of the machine as well as the operational convenience. NRL has bagged the prestigious TERI award for best Energy Management with the

above mentioned Step less Control System as case study.

- Regular monitoring of all the valves connected with flare system for any passing by Acoustic Leak Detector was carried out throughout the year and timely detection and rectification of such passing valves had resulted in the saving of substantial amount of process/fuel gas from flaring.
- Fugitive emission survey for detecting and rectifying any minor leak from valve glands, flanges etc. was carried out on regular basis throughout the year by using Gas Measuring Instrument (GMI).

### 6.5.2 Energy Conservation Measures Planned

In continuation of its energy conservation efforts, NRL has identified various schemes for future implementation. Some of the schemes are as under:

- Phase-wise implementation of Advance Process Control (APC) in the remaining process plants are in progress (already implemented in CDU/ VDU). Activities for APC implementation in DCU and HCU have been taken-up.
- Implementation of innovative technology for use of oxygen rich waste air stream available from Nitrogen Plant as enrich air in Sulphur Recover Unit by replacing conventional use of process air.
- Replacement of conventional lighting fixture by more energy efficient fittings.
- Installation of improved insulation over the High Pressure (HP) steam line to reduce the heat loss.
- Installation of Flare Gas Recovery System for recovery and reuse of refinery waste gas going to flare.
- Steams trap survey and rectification covering all the units including utilities and off-sites.
- Utilization of surplus HP saturated steam from MS Unit.

## 6.6 FIRE & SAFETY MANAGEMENT

Full fledged fire fighting facilities are available in the refinery to tackle any fire contingency. Regular safety audits by internal and external auditors are carried out for

improving safety performance. On-site and Off-site Disaster Management Plans have been developed and mock drills are conducted at regular intervals to keep the disaster management team in a state of full preparedness. Furthermore, refresher training programmes are conducted at regular intervals for NRL's own employees / contractor labourers as well as for tank lorry crews engaged in transportation of products to enhance their safety awareness and preparedness. The existing fire and safety management shall be extended to the proposed wax project.

### **Fire Preventive Measures**

- Alarm/ detection system have been installed in strategic locations of the refinery.
- Fire proofing of supports of LPG sphere and other structure is provided to prevent its collapse in case of fire.
- Predictive maintenance like thickness measurement of coke drum and pre-reformer tubes are done.
- Gas and hydrocarbon detector provided in plant area to detect leakage.
- Work permit system is being strictly adhered to in all operational areas.

### **Fire Fighting Measures**

The following fire protection facilities are available to combat the emergencies and depending upon the type of emergencies, any one or combination of the facilities is applied:

- a. Fire Water System
- b. Carbon Dioxide System
- c. Foam System
- d. First Aid Fire Fighting Equipment
- e. Mobile Fire Fighting Equipment
- f. Fire / Gas Detection and Alarm System

#### **a) Fire Water System**

Following facilities are available in NRL:

- Two Fire Water Reservoirs of combined capacity 14,000 m<sup>3</sup> are provided to meet the water demand of two major fires at a time. These reservoirs are further connected to Raw Water Reservoirs of capacity 24,000 m<sup>3</sup>.
- Four electric motor driven pumps, four diesel engine driven pumps and

three jockey pumps are provide in Fire Water Pump House.

- Around 25-Kms fire water network with residual pressure of 7 Kg/cm<sup>2</sup> at the remotest point laid with 554 hydrant points and 104 monitors inside the refinery.
- Deluge sprinkler system and remote operated valves are provided in LPG storage facility.
- Three nos. of foam cum water tenders and one DCP tender with crew is always ready at Fire Station.
- All hydrocarbon storage tanks have been provided with water spray cooling system and foam pourer system.
- High hazard area and hot oil pumps in the refinery have been provided with water spray system.
- Portable fire extinguishers as per OISD norms are placed at each unit and off-site areas.

**b) Carbon Dioxide System (In CPP)**

The fire extinguishing system for protection of Turbo set is housed in an enclosure by total CO<sub>2</sub> flooding system separately for turbine and generator of turbo set. The fire detection system is separately provided in CPP control room and other areas to actuate the system of fire protection/ fire fighting in turbo set. The system has two types of fire detectors:

- Ionization Smoke Detectors BJ-31
- Photo Electric Smoke Detectors BH-31

There is also manual call point for initiating manual fire alarm detection located in each protected area. In the event of fire out-break in any particular area, the detectors located on the ceiling of the particular area will sense the fire and annunciate the same in the annunciation panel. In case of human detection when a particular call point is actuated under fire, also annunciate the main fire alarm panel of BS-100.

**c) Foam System**

Two types of systems are in use:

- **Semi Fixed Foam System:** In this system foam solution is supplied

through mobile foam tender to fixed piping system connected to foam makers of tanks (vapour seal box in case of cone roof tanks).

- **Mobile System:** Mobile system includes foam producing unit mounted on wheels to supply foam through monitors to the burning surface.

**d) First Aid Fire Fighting Equipment (Fire Extinguisher)**

First aid fire fighting equipment (extinguishers) provided in process units, Off-sites, Utilities and building etc., are of following types:

CO<sub>2</sub> Type : 6.5 Kg and 9.0 Kg capacities.

DCP Type : 75 Kg and 10 Kg capacities.

Halon Type : 5 Kg capacity.

**e) Mobile Fire Fighting Equipment (Fire Tenders)**

- Foam cum water tenders (3 Nos.): Each foam tender has one water tank and one foam tank of 2600 KL and 3000 KL capacities. The tenders are equipped with public address system, siren and other accessories.
- DCP Tender – 1 No.
- Mobile Oil Spill Recovery Unit – 1 No.

**f) Alarms**

- The process control and tripping logic including alarm and warning are provided in the control system (remote & local) through sophisticated PLC for all the plants.
- The Co-Generation Plant has a dedicated Fire Detection and Suppression System for automatic control of fire. The refinery Fire Detection and Alarm System covers the refinery and marketing terminal, having data gathering fire alarm panel (DGFAP) in different sections. The rest of the refinery is networked with manual call points.
- Automatic/ Manual Sire System covers refinery, NRMT and township for communication in case of major emergencies.

**Communication Facilities available during Emergency**

The following facilities are available in NRL refinery:

- a) P&T Telephones: Individual telephone connections, both in office as well as

residence, to all key persons of the refinery.

- b) Intercom System for refinery with 800 lines, covering all offices, control rooms, process units and off-site areas etc., and other strategic locations like main gate, material gate, watch towers etc.
- c) Intercom system with another 500 lines connecting the quarters, offices, security main gate of township.
- d) Multi-channel mobile VHF station, seven nos. of base stations and VHF hand sets.
- e) Public address system to Central Control Room with all units and fire station
- f) E-mail facility
- g) V Sat facility

### **Details of First Aid and Hospital Services**

Following facilities at NRL:

- A Medical Centre with one Doctor and paramedical staff runs in the plant round the clock to provide preliminary medical aid to accident victims. The doctor is a specialist in occupational diseases, having the Associated Fellowship in Industrial Medicine from Central Labour Institute, Mumbai.
- One ambulance is available at the medical centre round the clock.
- Fully equipped 30 bedded Vivekananda Kendra Hospital at township with specialists of various disciplines and other medical staff is available round the clock. It is also a burn ward.
- The Onsite and Off-site Mock drills are regularly conducted at NRL as per the following schedules:

Minor fire mock drill	:	Monthly Once
Major fire mock drill	:	Quarterly
On-site Mock drill	:	Half-yearly
Off-site Disaster Mock drill	:	Yearly

### **Quality Assurance**

NRL is having a quality assurance plan which includes all reference methods for monitoring, relevant analytical technique, calibration of equipment, standard of reagents, collection and presentation of results, frequencies of monitoring, etc. This

quality assurance plan will continue after establishment of proposed wax project.

### **Post Project Monitoring**

NRL has an Energy & Environmental Management Cell headed by Senior Manager (TS) and Senior Manager (Environment & QC). The post project monitoring system currently in practice at Numaligarh Refinery shall be extended to the proposed project, especially monitoring of atmospheric emissions, noise sources, waste water and solid waste generation along with occupational health and safety aspects for the workers.

NRL has won many awards in the area of excellence for energy conservation performance, environment and safety management, Corporate Environment Award during the period 2003 to 2009. Thus, the environmental management has been the part of company's policy. The ambient air quality monitoring around existing Numaligarh Refinery is being outsourced with a reputed party. Stack monitoring is being done by online continuous analysis. Effluent quality is being monitored by in-house laboratory using sophisticated equipment. Regular environmental audit studies are also conducted with the objective of conservation of natural resources.

## **6.7 VARIOUS SOCIAL WELFARE SCHEMES UNDERTAKEN BY NRL**

With a strong commitment towards socio-economic up-liftment of the region, NRL has always definitive measures for improving the quality of life of the people residing in neighboring areas through innovative and people friendly programme. Presently, NRL's special attention is focused on major thrust areas such as Agri-allied/ Income generation activities, Education, Infrastructure Development, Community Health, Promotion of art, Sports, Literature and Culture.

Training and awareness programs on environment protection for the local residents are organized regularly. Every year, World Environment Day is celebrated over a week by involving people from nearby villages, students and teachers of nearby schools, college etc. Saplings are distributed to local population to develop plantation in nearby locality. Essay competition, debate, extempore speeches are organized in neighboring schools, colleges to create environmental awareness amongst the mass.

In keeping with the commitment of a good corporate citizen, NRL has also initiated

community development programs, extending medical assistance to the people of nearby villages through Vivekananda Kendra Hospital, instituting scholarships to the needy and deserving student, extending financial assistance to different educational institutions contributing positively for the development of sports and culture in the area. In association with Vivekananda NRL Hospital, several free medical and health checkup programs are organized at regular intervals. The mobile hospital van of NRL Hospital is providing regular medical treatment and distributing essential medicines to rural areas of the locality through weekly medical camps conducted within 10-Kms radius. A Cervical and Breast Cancer Detection Camp is organized by NRL at regular intervals in which people from nearby villages are screened.

Awareness campaign on Eye Donation in collaboration with District Blindness Control Society is also organized at regular intervals by NRL.