CHAPTER – 11

SUMMARY AND CONCLUSION

11.1 INTRODUCTION
M/s. Numaligarh Refinery Limited along with M/s Chempolis Oy, Finland proposes to set up a Bamboo based Bioethanol project at Village Owguri Chaporai Gaon, Tehsil Golaghat, adjacent to Numaligarh Refinery, Mouza- Morongi, District Golaghat, Assam as a Joint Venture project. Main raw material of the project is Bamboo from which Fuel Grade Ethanol will be produce along with other by products.

11.2 PROJECT DESCRIPTION

11.2.1 PROJECT DETAILS

<table>
<thead>
<tr>
<th>Name of the company</th>
<th>M/s. Numaligarh Refinery Limited.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category of the project</td>
<td>A</td>
</tr>
<tr>
<td>S. No. In the schedule</td>
<td>5(g) (ii), Distilleries</td>
</tr>
<tr>
<td>Location of the project</td>
<td>Village Owguri Chapori Gaon, Tehsil Golaghat, Adjacent to Numaligarh Refinery, Mouza Morongi, District Golaghat, Assam</td>
</tr>
<tr>
<td>Capacity of the project</td>
<td>Proposed Bamboo based Bio-Refinery project to manufacture Ethanol (49,000 TPA), Acetic Acid (11,000 TPA), Furfural (19,000 TPA), Biocoal (1,60,000 TPA) and Stillages (Dry Basis, 30,000 TPA)</td>
</tr>
<tr>
<td>General condition &amp; Specific condition</td>
<td>Does not attract general condition &amp; Specific conditions.</td>
</tr>
<tr>
<td>Total project cost</td>
<td>Rs. 950.45 Crores</td>
</tr>
<tr>
<td>Cost for EPCM</td>
<td>Capital Cost: Rs. 11.7 Cr &amp; Recurring cost: Rs. 7.15 Cr.</td>
</tr>
<tr>
<td>Cost for CSR activity</td>
<td>Rs. 23.75 Cr. shall be utilized over a period of 5 years.</td>
</tr>
</tbody>
</table>

11.2.2 PROJECT REQUIREMENT

| Land requirement               | Total 1,05,090 sq. m. private land is already acquired. |
| Water requirement & its source | Total water requirement of the proposed project will be 2,764 KLD (2,224 KLD fresh + 540 KLD recycled) and shall be drawn from River Dhansiri using existing water intake facility within present permissible limit. |
| Electricity requirement & its source | The estimated power requirement for the proposed project is 8.6 MW. The company proposes to set up a captive power plant to meet its steam and electrical energy requirement. Additional power i.e. 11.4 MW produced by captive power plant will be diverted to grid. Existing power requirement of Numaligarh refinery complex is 38 MW. |
| Manpower requirements          | The proposed project will generate opportunity for around 150 direct employments and 10,000 indirect employments. |
| Fuel requirement & its source  | In proposed bamboo based distillery project, during biorefining process around 1,60,000 MT/year biocoal is also produced, which will be used as a fuel in power plant and hence no additional fossil fuel is required to run project. |
11.2.3 RAW MATERIAL REQUIREMENT

<table>
<thead>
<tr>
<th>No.</th>
<th>Raw Material</th>
<th>Quantity (In TPA)</th>
<th>Source</th>
<th>Means of Transport</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Bamboo</td>
<td>3,00,000</td>
<td>Assam, Arunachal Pradesh, Manipur Nagaland, Meghalaya</td>
<td>Through Water way, Road and rail</td>
</tr>
<tr>
<td>2.</td>
<td>Formic acid</td>
<td>6,000</td>
<td>Available from several domestic suppliers. Alternatively, may be imported and transported by road from the Port of Kolkata.</td>
<td>Through Road</td>
</tr>
<tr>
<td>3.</td>
<td>Cellulase enzyme</td>
<td>2,000 (quantity depends on the selected supplier and optimization of enzyme)</td>
<td>Imported</td>
<td>Through Road from Port of Kolkata</td>
</tr>
<tr>
<td>4.</td>
<td>Yeast</td>
<td>A relatively small volume depends on the extent of on-site inoculation.</td>
<td>Several domestic suppliers.</td>
<td>Through Road</td>
</tr>
<tr>
<td>5.</td>
<td>Urea and other nutrients</td>
<td>800</td>
<td>Several domestic suppliers.</td>
<td>Through Road</td>
</tr>
<tr>
<td>6.</td>
<td>Aqueous ammonia (tentatively 20%)</td>
<td>4,000</td>
<td>Several domestic suppliers.</td>
<td>Through Road</td>
</tr>
</tbody>
</table>

11.2.4 WASTE WATER GENERATION AND DISPOSAL

Around 1,296 m³/h spent wash or stillage will be generated from the proposed distillery. Spent wash/Stillage is the distillation residue from ethanol separation. Stillage is a suspension containing yeast, enzymes, and residual components of cellulose. Stillage will be concentrated for combustion in boiler to produce power and steam.

After spent wash treatment around 96 KLD (considering maximum quantity) waste water as distillery bleed will be generated. This distillery bleed will be diverted to existing effluent treatment plant of NRL and after treatment and confirming norms reused in Colling tower makeup, green belt development and dust suppression after treatment. Hence no waste water will be discharge to outside industry to follow zero discharge concept.

11.2.5 AIR EMISSION & AIR POLLUTION CONTROL MEASURES

<table>
<thead>
<tr>
<th>No. of Stack</th>
<th>Stack attached to</th>
<th>Name &amp; quantity of fuel</th>
<th>Pollution Control Equipment</th>
<th>Height &amp; Diameter (mtr)</th>
<th>Pollutant As per SPCB limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 135 TPH Boiler</td>
<td>Biocoal and stillages 1,60,000 MT/year</td>
<td>Electro Precipitator (ESP) with Modern combustion technology</td>
<td>Ht. 60 m &amp; dia. 2.4 m</td>
<td>PM – 50 mg/Nm³ SO₂ – 100 ppm NO₂ – 50 ppm</td>
<td></td>
</tr>
</tbody>
</table>

11.2.6 SOLID WASTE GENERATION & DISPOSAL

<table>
<thead>
<tr>
<th>No.</th>
<th>Particular</th>
<th>Source</th>
<th>Quantity</th>
<th>Method of Disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Fly Ash</td>
<td>Boiler</td>
<td>21.6 MT/day</td>
<td>Utilized as fertilizer or in cement production.</td>
</tr>
</tbody>
</table>
11.3 DESCRIPTION OF THE ENVIRONMENT

11.3.1 INTRODUCTION
The baseline environmental quality of air, water, soil, noise, socioeconomic and ecology has been assessed during 1st October, 2016 to 31st December, 2016 in a study area of 10 km radial distance from the project site.

11.3.2 ENVIRONMENTAL SETTING OF THE AREA

<table>
<thead>
<tr>
<th>Project location</th>
<th>Village Owguri Chaporoi Gaon, Tehsil Golaghat, Adjacent to Numaligarh Refinery, Mouza Morongi, District Golaghat, Assam.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nearest Village</td>
<td>Rajaban at around 0.2 km in NW direction</td>
</tr>
<tr>
<td>Nearest Town /City/ Dist Headquarter</td>
<td>Golaghat at around 18 km in SE direction</td>
</tr>
<tr>
<td>Nearest National Highway</td>
<td>NH - 39 at around 5 km in W direction</td>
</tr>
<tr>
<td>Nearest Railway Station</td>
<td>Kuntai railway station at around 6.5 km in NE direction</td>
</tr>
<tr>
<td>Nearest Airport</td>
<td>Jorhat airport at around 40 km in NNE direction</td>
</tr>
<tr>
<td>Nearest River</td>
<td>Dhansiri river at around 0.95 km in E direction</td>
</tr>
<tr>
<td>National Park / Reserve Forest, Biosphere Reserve</td>
<td>1. Kaziranga National park at around 22.5 km in north-west direction 2. Garampani Wildlife sanctuary at around 20 km in south-east direction</td>
</tr>
<tr>
<td>Seismicity</td>
<td>Seismic Zone-V</td>
</tr>
</tbody>
</table>

11.3.3 BASE LINE DATA
Base line data has been collected during the study period i.e. 1st October, 2016 to 31st December, 2016.

11.3.4 SITE SPECIFIC MICRO-METEOROLOGY
The maximum and minimum temperatures observed in the study period are 28-30.5 ºC with average relative humidity 81%. The predominant wind direction is North-East followed by East-North-East and East.

11.3.4.1 AMBIENT AIR QUALITY
**Particulate Matter (PM$_{10}$):**
During the monitoring period, it has been observed that the average values of PM$_{10}$ for all the monitoring stations ranging from 41.2 – 56.4 µg/m$^3$. The lowest value 32.5 µg/m$^3$ was observed Sankala Gaon and highest value 64.2 µg/m$^3$ was observed at Telgram and Pura Bangla. All the results were found to be below the NAAQS limits i.e. 100 µg/m$^3$.

**Particulate Matter (PM$_{2.5}$):**
During the monitoring period, it has been observed that the average values of PM$_{2.5}$ for all the monitoring stations ranging from 19.7-26.1 µg/m$^3$. The lowest and highest values are 14.2 to 31.1 µg/m$^3$ were observed at Sankala Gaon and Telgram respectively. All the results were found to be below the NAAQS limits i.e. 60 µg/m$^3$.

**Sulphur Dioxide (SO$_2$):**
During the monitoring period, it has been observed that the average values of SO$_2$ for all the monitoring stations ranging from 4.4 - 6.0 µg/m$^3$. The lowest values 4.0 was observed at Lattakonjan and Sankala Gaon, and highest values 6.8 µg/m$^3$ was observed at Telgram and Numaligarh Dabha. All the results were found to be below the NAAQS limits i.e. 80 µg/m$^3$.

**Nitrogen Dioxide (NO$_2$):**
During the monitoring period, it has been observed that the average values of NO$_2$ for all the monitoring stations ranging from 10.4-16.1 µg/m$^3$. The lowest and highest values are 9 to 17.3 µg/m$^3$ were observed at Sankala Gaon and Telgram respectively. All the results were found to be below the NAAQS limits i.e. 80 µg/m$^3$. 
Carbon Monoxide (CO):
During the monitoring period, it has been observed that the average values of CO for all the monitoring stations ranging from 120.3-671.9 µg/m³. The lowest and highest values are 100 to 786 µg/m³ were observed at Sankala Gaon and Telegram respectively. All the results were found to be below the NAAQS limits i.e. 2000 µg/m³.

Ammonia (NH₃) and Hydrocarbon (Methane and Non-Methane):
The arithmetic mean and 98th percentile values of NH₃ and Hydrocarbon (Methane and Non-Methane) are found below detectable limit (BDL).

11.3.4.2 SURFACE WATER QUALITY MONITORING
The Physico-chemical characteristics of surface water during the study period are summarized in table-3.7. The pH varied is from 6.76-7.24, the turbidity varied from 1-1.2 NTU, the total dissolved solids varied from 102-183 mg/l, Conductivity varied from 42-132 µS/cm, The total alkalinity varied from 24-60 mg/l the total hardness varied from 28-80 mg/l, calcium varied from 1.6-8 mg/l, chloride varied from 2.5-15 mg/l and the sulphate varied from 21.4-45.5 mg/l.

The results indicate that the nutrient values in the form of nitrate were found to be varied from 0.3-1.9 mg/l. The values for demands parameters like DO and BOD varied from 7.3-10 mg/l and 4-10 mg/l respectively. The levels of heavy metals viz. Chromium, Cadmium, Copper, Lead, Iron, Manganese and Zinc were found to be within permissible limits.

11.3.4.3 GROUND WATER QUALITY MONITORING
Groundwater samples from different villages in the project area were collected and analyzed during the study period. The physico-chemical characteristics of the groundwater are presented in the table-3.6. The pH varied in the range of 6.69-7.46, turbidity <1.0 NTU, total hardness 18-50 mg/l, total alkalinity 10-40 mg/l, total dissolved solids 22-92 mg/l, Conductivity 36-168 µS/cm, Chloride 5-20 mg/l, Sulphate 3.8-36.2 mg/l, and nitrate was found in the range 0.6-2.5 mg/l.

11.3.4.4 BACKGROUND NOISE LEVEL
At the Project site the noise level was found 51.4 dBA in daytime and 40.6 dBA in night time. The noise levels varied in the residential area of the study area during day time [night time] in the range of 52.6-54.2[41.3-44.7] dBA. The noise sources identified are vehicular traffic, industrial and commercial activities. The observed noise levels were below the stipulated standards of CPCB.

11.3.4.5 SOIL QUALITY
The eight soil samples collected from surrounding areas including project site were assessed for physical and chemical quality parameters. The porosity ranged from 22-38% and WHC from 12.6-22.8%. The EC ranged from 136-210 dS/m. The soil pH varied from 6.86-7.32. The OC varied from 1-1.34 and available nitrogen from 210-325 kg/ha. The available phosphorus and potassium ranged from 70-94 kg P₂O₅/ha and 142-210 kgK₂O/ha, respectively. Among basic cations there is predominance of sodium (2.3-3.8 Meq/100gr) followed by calcium (1.24-3.12 Meq/100gr) and magnesium (1.02-1.72 Meq/100gr).

11.3.5 LAND USE PATTERN
Major land use of the study area considering 10 km radius of the project site is single crop land i.e. around 36.3% of the total study area, followed by Land with scrub 16.2% and Tea Plantation 14.8 %. Other land use identified are Settlements 7.1%, Industrial area 3.10%, Tank / River etc. 8.6%, Double crop 11.6% and Land without scrub 2.3%.

11.3.6 BIOLOGICAL ENVIRONMENT
Tea gardens and agriculture land occupies the most of the study area. The most commonly spotted bird species of this area were; Cattle Egret, Intermediate Egret, Black-winged Stilt, Rock Pigeon etc. The study area doesn’t form any part of National park, wild life sanctuary, and natural biosphere reserve. Few subtropical deciduous forests observed in the study area. especially near Thong teron, Betbaari teron.
11.3.7 SOCIO-ECONOMIC STUDY
Around 85 villages are falls in 10 km radius of the proposed project with the total population of 88,517. As per socioeconomic study all the respondents across all socio-economic groups, age, gender and locations felt that the concerned industry will be beneficial for them and it will improve their quality of life by increasing their employment opportunities and also by bringing about a positive change. People’s willingness and ability to be employed in the production activities need to be given importance. The actions that the residents have suggested for the overall improvements in some areas like proper drinking water facility, adequate electricity, good road conditions, generation more direct or indirect employment opportunities etc. need to be taken up for overall growth and development of the areas.

11.4 ANTICIPATED ENVIRONMENTAL IMPACTS & MITIGATION MEASURES

11.4.1 IMPACT ASSESSMENT
An effort has been made to identify various environmental, social and ecological impacts due to proposed project during construction and operation phases considering present environmental scenario as baseline. The corresponding mitigation measures to take care of the adverse impacts are also discussed in following sections.

11.4.2 IMPACTS DURING CONSTRUCTION PHASE & ITS MITIGATION MEASURES
During Construction Phase, the fugitive dust emission due to civil work and vehicular movement is not expected to spread too far as water spraying will be carried out to suppress the dust emission at the site and as well as on road. The increase in noise levels due to the movement of vehicles will be taken care of by regulating the movement of vehicles and the impact on the human beings will be taken care of by providing the working people with ear plugs / ear muffs. During construction, drainage pattern and water supply system of overland water flow will not be changed during the site preparation activities. Suspended solids can be controlled by sprinkling water and by employing enclosures to construction area to allow the particles to settle down, prior to discharge. During construction period, the project is likely to generate substantial employment and income.

11.4.3 IMPACT DURING OPERATION PHASE & MITIGATION MEASURES

11.4.3.1 AIR ENVIRONMENT
Major air emissions are anticipated by the gaseous emissions from a single stack is a local phenomenon. The ISCST3 scientific model has been used to predict the proposed air quality on the environment. The maximum 24 hourly average GLC’s for Particulate Matter, SO\textsubscript{2} and NO\textsubscript{x} is observed to be 0.5μg/m\textsuperscript{3}, 1.4 μg/m\textsuperscript{3} and 1.0 μg/m\textsuperscript{3} respectively at a distance of 1.4 km in south west direction. Fugitive emission will be generated from storage and processing, vessels, loading and unloading section.

**Mitigation measures:**
- Electro static precipitator as pollution control equipment will be installed to CHP plant.
- Adequate height will be provided to the stack
- Regular stack and fugitive emission mentoring will be carried out to ensure proper functioning of APC equipment’s
- Online monitoring system will be installed to main stacks.

11.4.3.2 NOISE ENVIRONMENT
The noise pollution management will be taken up in the following manner:
- By selecting low noise generating equipment, which would have below 75 dBA noise level at 1m distance. This is taken care at the equipment design stage.
- By isolating the noise unit from the working personnel's continuous exposure by providing acoustic aids for plant personnel.
- By administrative & safety measures, providing noise level monitoring, remedial measures, providing noise safety appliances to the working personnel.

By these measures, it is anticipated that noise levels in the plant will be maintained below 75 dBA.
11.4.3.3 WATER ENVIRONMENT
During operation phase, daily water requirement of M/s. Numaligarh Refinery Limited shall be 2,224 KL/Day. Presently, raw water is sourced from Dhansiri River for existing refinery operation purposes. The additional raw water requirement of Bio-refinery will be tapped from existing refinery system which is within permissible withdrawl limit.
The company will follow zero discharge effluent concept wherein waste water from process, boiler Blow down, cooling tower blow down, etc. shall be treated in existing effluent treatment plant of Numaligarh refinery and reused for cooling tower make up, greenbelt development and dust suppression after confirming norms prescribed by Pollution Control Board. Hence, no significant impact on water environment due to the proposed activities is envisaged.

11.4.3.4 LAND ENVIRONMENT
Main solid waste generation during construction phase will be construction debris like rubble, brick bats, debris, steel scrap, wooden scrap, sand, gravel etc. However, these materials are inert in nature and will not result into leaching of any substance or constituent.
These materials will be properly sorted and will be used within premises for filling of low lying areas.
Wooden scrap, steel scrap will be given to scrap dealers.
On completion of civil work, all debris etc. will be completely removed from site to avoid any incompatibility with future use.
During operation phase Main source of solid waste is boiler bed ash & fly-ash, approximately 21.6 Ton/day. Fly ash shall be trapped and will be utilized as fertilizer or in cement production.

11.4.3.5 SOCIO-ECONOMIC ASPECT ENVIRONMENT
Positive Impacts
- During the construction phase, the major socio-economic impact will be in the sphere of generation of temporary employment of very substantial number of personnel. Persons from nearby locality have been given preference to engaged in various types of jobs. It is understood that sufficient construction labourers (floating, if not locals) are already available in the impact area who can be utilise during the construction phase of the proposed plant.
- Due to operation phase of the proposed project, employment opportunities will be generated which will improve the local economy.
- Local community infrastructure will be improved through the proposed CSR activities.

Negative Impacts
- Due to the proposed project, impact can be assumed on human health due to marginal increase in pollution load due to industrial as well other activities.
- Increase in population/population density of the area.

Mitigation measures
- Use of adequate pollution control measures to control environmental pollution
- Regular Monitoring of environment
- people friendly CSR activities and ensure extending reach of the activities to the surrounding villages will be planned
- Possible extend local people will be employed

11.4.3.6 INFRASTRUCTURE AND SERVICES
As a result of development of industry, the neighbouring areas shall be developed for commercial use. The infrastructure services e.g. roads, state transport, post and telegraph, communication, education and medical facilities, housing, etc. shall be improved in the surrounding areas.

11.4.3.7 GREEN BELT DEVELOPMENT
About 34,700 sq. m. area shall be developed as green belt at plant boundary, road side, around offices & buildings and Stretch of open land.
11.5 ENVIRONMENTAL MONITORING PROGRAMME

11.5.1 ENVIRONMENTAL MONITORING
A regular monitoring of environmental parameters like air, water, noise and soil as well as performance of pollution control facilities and safety measures in the plant are important for proper environmental management of any project. The following routine monitoring programme as detailed in as under will be implemented at site.

- Stack monitoring for the parameters like PM, SO$_2$, and NO$_x$, online continuous
- Ambient air quality monitoring as per NAAQS, 2009, 2 samples per week
- Work environment monitoring for the parameters like SO$_2$, CO, H$_2$S, and Cl$_2$ twice in a month.
- Liquid effluent monitoring once in a month.
- Ground water, surface water and soil quality monitoring once in six month.
- Noise monitoring bi-monthly.

11.6 ADDITIONAL STUDIES

11.6.1 PUBLIC HEARING
Public hearing is applicable for the proposed project as per Para 7(i) III (b) of EIA Notification, 14$^{th}$ September, 2006. Details of the Public hearing will be incorporated after completion of public hearing.

11.6.2 RISK ASSESSMENT
The management is very much aware of their obligation to protect all persons at work and others in the neighbourhood who may be affected by an unfortunate and unforeseen incidence occurring at the works. Any hazard either to employees or others arising from activities at the plant site shall, as far as possible, be handled by the personnel of the company and prevented from spreading any further. However, in the case of eventuality the Disaster Management plan adopted by the proponents is sufficient and may be able to control the situation.

11.7 PROJECT BENEFITS

11.7.1 PHYSICAL INFRASTRUCTURE
As a project M/s. Numaligarh Refinery Limited will adopt CSR activities which will surely develop the existing scenario of the area. As in the existing scenario, condition of the physical infrastructure is not good.

11.7.2 EMPLOYMENT POTENTIAL
Due to proposed project, around 150 direct employment and 10,000 indirect employments will be generated for manufacturing activities. Preference shall be given to local people. This will improve the socio-economical status of area.

11.7.3 CORPORATE SOCIAL RESPONSIBILITY (CSR)
Funds to the extent of Rs. 23.75 Cr will be utilize for the CSR activities for the five years after words fund as per the requirement and government rules CSR activities shall be utilized per annum as recurring expenditure. The company will utilize the fund as per regulations for CSR activities like Safe drinking water facility, Health care, Education and Training, Infrastructural development, Awareness programme on environment, Rain water harvesting plan, Plantation, Sports, etc.

11.8 ENVIRONMENTAL MANAGEMENT PLAN

11.8.1 ENVIRONMENTAL MANAGEMENT PLAN (ADMINISTRATIVE ASPECTS)
Environmental monitoring of different parameters will be done regularly and the activity will be coordinated by A fully functional, dedicated environment management cell manned by qualified engineers/officers and headed by a Deputy General Manager (Technical) reporting to General Manager (Technical) has been continuously working for constant improvement, monitoring, safe guarding and reporting of environmental activities of the refinery. Also, a multidisciplinary Apex-level Committee on Environment which includes senior level officers from various departments as members under the chairmanship of Director (Technical) constantly guides the Environment Cell regarding all the environmental issues in the refinery. The Apex Committee that convenes quarterly discusses the unresolved
issues if any, regarding the environment and monitors the regular environmental activities. The company will undertake various training programme for improving the performance of the working personnel. Special training will be arranged in regular intervals to combat emergency scenarios that may occur during the plant operation.

11.8.2 ENVIRONMENT BUDGET ALLOCATION
Total capital cost allocated for environmental pollution control measures is 11.7 Cr. and recurring cost/annum 7.15 Cr.

11.9 CONCLUSION
Company has committed to implement all the pollution control measures to protect the surrounding environment. The project can definitely improve the regional, state and national economy. Industrial growth is an indication of socio economic development. The implementation of this project will definitely improve the physical and social infrastructure of the surrounding area.