CHAPTER - 6

ADDITIONAL STUDIES (RISK ASSESSMENT & DISASTER MANAGEMENT PLAN)
In order to support the environment impact assessment and environment management plan, following additional studies have been included in the report.

- Risk assessment
- Disaster Management Plan
- On site and off site emergency action plan
- Occupational Health and Safety Management System

6.1 RISK ASSESSMENT

6.1.1 INTRODUCTION
Hazard analysis involves the identification and quantification of the various hazards (unsafe conditions). On the other hand, risk assessment deals with recognition and computation of risks, the equipment in the plant and personnel are prone to, due to accidents resulting from the hazards present in the plant.

Risk assessment follows an extensive hazard analysis. It involves the identification and assessment of risks the neighboring populations are exposed to as a result of hazards present. This requires a thorough knowledge of failure probability, credible accident scenario, vulnerability of population etc. Much of this information is difficult to get or generate. Consequently, the risk assessment is often confined to maximum credible accident studies. It provides basis for what should be type and capacity of its on-site and off-site emergency plan also what types of safety measures shall be required.

6.1.2 APPROACH TO THE STUDY
Risk involves the occurrence or potential occurrence of some accidents consisting of an event or sequence of events. The risk assessment study covers the following:

- Identification of potential hazard area;
- Identification of representative failure cases;
- Visualization of the resulting scenarios in terms of fire and explosion;
• Assess the overall damage potential of the identified hazardous events and the impact zones form the accidental scenarios;
• Furnish the recommendations on the minimization of the worst accident possibilities
• Preparation of Disaster Management Plan;
• Emergency Plan, which includes Occupational and Health Safety Plan;

6.1.3 METHODOLOGY
Quantitative risk assessment (QRA) is a means of making a systematic assessment of the risks from hazardous activities, and forming a rational evaluation of their significance, in order to provide input to a decision-making process. The term ‘quantitative risk assessment’ is widely used, but strictly this refers to the purely numerical assessment of risks without any evaluation of their significance. The study has been conducted based on the premises of a traditional Quantitative Risk Assessment. The key components of a QRA are explained below, and illustrated in Figure-6.1 and Figure-6.2.

FIGURE – 6.1
QRA METHODOLOGY
QRA is a mathematical approach of engineers to predict the risks of accidents and give guidance on appropriate means of minimizing them. Nevertheless, while it uses scientific methods and verifiable data, QRA is a rather immature and highly judgmental technique, and its results have a large degree of uncertainty. Despite this, many branches of engineering have found that QRA can give useful guidance. However, QRA should not be the only input to decision-making about safety, as other techniques based on experience and judgment may be appropriate as well. Risk assessment does not have to be quantitative, and adequate guidance on minor hazards can often be obtained using a qualitative approach.

The Key Components of QRA

It is a very flexible structure, and has been used to guide the application of risk assessment to many different hazardous activities. With minor changes to the wording, the structure can be used for qualitative risk assessment as well as for QRA.

The first stage is system definition, defining the installation or the activity whose risks are to be analyzed. The scope of work for the QRA should define the boundaries for the study, identifying which activities are included and which are excluded, and which phases of the installation's are to be addressed. Then hazard identification consists of a qualitative review of possible accidents that may occur, based on previous accident experience or judgment where necessary. There are several formal techniques for this, which are useful in their own right to give a qualitative appreciation of the range and magnitude of hazards and indicate appropriate mitigation measures. This qualitative evaluation is described in this guide as 'hazard assessment'. In a QRA, hazard identification uses similar techniques, but has a more precise purpose - selecting a list of possible failure cases that are suitable for quantitative modeling.

Once the hazards have been identified, frequency analysis estimates how likely it is for the accidents to occur. The frequencies are usually obtained from analysis of previous accident experience, or by some form of theoretical modeling.

In parallel with the frequency analysis, consequence modeling evaluates the resulting effects if the accidents occur, and their impact on personnel, equipment and structures, the environment or business. Estimation of the consequences of each possible event often requires some form of computer modeling, but may be based on accident experience or
judgments if appropriate. When the frequencies and consequences of each modeled event have been estimated, they can be combined to form measures of overall risk. Various forms of risk presentation may be used. Risk to life is often expressed in two complementary forms:

1. Individual risk - the risk experienced by an individual person.
2. Group (or societal) risk - the risk experienced by the whole group of people exposed to the hazard.

Up to this point, the process has been purely technical, and is known as risk analysis. The next stage is to introduce criteria, which are yardsticks to indicate whether the risks are acceptable, or to make some other judgment about their significance. This step begins to introduce non-technical issues of risk acceptability and decision-making, and the process is then known as risk assessment.

In order to make the risks acceptable, risk reduction measures may be necessary. The benefits from these measures can be evaluated by repeating the QRA with them in place, thus introducing an iterative loop into the process. The economic costs of the measures can be compared with their risk benefits using cost-benefit analysis.

The results of QRA are some form of input to the design or ongoing safety management of the installation, depending on the objectives of the study.

Qualitative Method

- Preliminary risk analysis
- Hazard and operability studies (HAZOP)
- Failure mode and effects analysis (FMEA/FMECA)
- Discussion and conclusion
FIGURE 6.2

FLOW CHART FOR QUANTITATIVE RISK ASSESSMENT

Start → Identify Risk Areas

Identify Risk Areas → Select a Risk Area

Select a Risk Area → Identify Failure Cases

Identify Failure Cases → Select a Failure Cases

Select a Failure Cases → Identify Consequence Outcomes

Identify Consequence Outcomes → Select Consequence Outcomes

Select Consequence Outcomes → Determine Frequency

Determine Frequency → Estimate Consequence

Estimate Consequence → Record Frequency and Consequence in a summary Table

Record Frequency and Consequence in a summary Table → Have all Consequence outcomes been studied?

Have all Consequence outcomes been studied? → Have all failure cases been studied?

Have all failure cases been studied? → Have all risk areas been studied?

Have all risk areas been studied? → Draw Risk Contours

Draw Risk Contours → Yes → Finish

Next

Next
In this section, we will deal with the qualitative methods used in risk analysis namely preliminary hazard analysis (PHA), hazard and operability study (HAZOP), and failure mode and effects analysis (FMEA/FMECA).

**Preliminary Risk Analysis**

Preliminary Risk Analysis: Preliminary risk analysis or hazard analysis is a qualitative technique which involves a disciplined analysis of the event sequences which could transform a potential hazard into an accident. In this technique, the possible undesirable events are identified first and then analysed separately. For each undesirable events or hazards, possible improvements, or preventive measures are then formulated.

The result from this methodology provides a basis for determining which categories of hazard should be looked into more closely and which analysis methods are most suitable. Such an analysis also proved valuable in the working environment to which activities lacking safety measures can be readily identified. With the aid of a frequency/consequence diagram, the identified hazards can then be ranked according to risk, allowing measures to be prioritized to prevent accidents.

**Mitigation Measures**

The purpose of mitigation is to identify measures that safeguard the environment and the community affected by the proposal. Mitigation is both a creative and practical phase of the EIA process. It seeks to find the best ways and means of avoiding, minimizing and remedying impacts. Mitigation measures must be translated into action in the correct way and at the right time, if they are to be successful. This process is referred to as impact management and takes place during project implementation. A written plan should be prepared for this purpose, and includes a schedule of agreed actions. Opportunities for impact mitigation will occur throughout the project cycle.

**Noise Exposure**

High sound levels may be generated from the equipments used in the manufacturing and utilities (e.g.-compressed air, vacuum sources, unit operations system, etc). Irrespective of the enclosed design and anti vibration control measures in the work place modules, the workers are located close to the machines during manufacturing and exposed to noise. Mitigation measures
• Good engineering practices.
• The rotation of employees in shift should be followed so as to reduce their exposure to noise sources for longer period.
• Hearing protective devices in the form of ear muff and plug should be used to reduce employee’s exposure to high noise levels.
• Comprehensive hearing conservation programs should be carried out to identify noise sources for its prevention/control.
• Noise monitoring and medical surveillance should be carried out at regular intervals so as to assess the workers exposures to noise and corrective measures.

6.1.4 HAZARD IDENTIFICATION
Identification of hazards in the proposed project activity is of primary significance of the analysis, and quantification. Hazard states the characteristics of system/plant/process that presents potential for an accident. All the components of a system/plant/process need to be thoroughly examined to assess their potential for initiating or propagating an unplanned event/sequence of events, which can be termed as an accident.
A core challenge faced by emergency managers is how to prevent, prepare, mitigate, respond and recover from a myriad of hazards. Several questions arise when faced with this challenge:
• What hazards exist in my area?
• How frequently do they occur?
• How severe can their impact be on the community, infrastructure, property, and the environment?
• Which hazards pose the greatest threat to the community?
• A Hazard Identification and Risk Assessment (HIRA) assist emergency managers in answering these questions. It is a systematic risk assessment tool that can be used to assess the risks of various hazards.
• There are three reasons why a HIRA is useful to the emergency management profession:
• It helps emergency management professionals prepare for the worst and/or most likely risks.
6.1.4.1 IDENTIFICATION OF HAZARDOUS AREAS

The procedure for QRA starts with identification of major risk areas in the installation. Operation carried out in specialty chemical manufacturing unit usually come under certain board, general categories. At M/s. DIKL, major risk areas are as follows:

- Bulk storage area for Raw Materials at ambient temperature and atmospheric pressure.
- Process Plant involving pumping, transportation, reactors, distillation, heating, cooling, etc.
- Bulk loading and unloading from storage tanks to road takers and vice versa.

6.1.4.2 IDENTIFICATION OF FAILURE CASES FOR HAZARDOUS AREAS

- Release due to catastrophic failure of storage tanks or process vessels.
- Rupture of connected pipe with storage tank or process vessels.
- Continuous release at significant rates for long durations transfer pipelines caused by sudden, major break of the pipeline.
- Continuous release at low rate through small holes or cracks in piping and vessels, flange leaks, and leakage from pump glands and similar seals.

It is to be noted that for Quantitative Risk Assessment, worst case scenarios has been considered, though their frequency of occurrence is much lower than the cases of small leaks.
6.1.4.3 MAJOR HAZARDOUS AREAS

The hazardous chemical storage area is shown in Figure-6.3. The major Hazardous chemicals to be stored, transported, handled and utilized within the plot area are summarized in the Table-6.1. Other hazards and control measures are summarized in Table-6.2. Facilities / System for process safety, transportation, fire fighting system and emergency capabilities to be adopted are stated below.
FIGURE-6.3
HAZARDOUS CHEMICAL STORAGE AREA
### TABLE-6.1

**STORAGE AND HANDLING DETAILS OF HAZARDOUS CHEMICALS**

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Tank-1</th>
<th>Tank-2</th>
<th>Tank-3</th>
<th>Tank-4</th>
<th>Tank-5</th>
<th>Tank-6</th>
<th>Tank-7</th>
<th>Tank-8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Stored</td>
<td>EO</td>
<td>EO</td>
<td>PO</td>
<td>XYLENE</td>
<td>XYLENE</td>
<td>XYLENE</td>
<td>XYLENE</td>
<td>TOLUENE</td>
</tr>
<tr>
<td>Location</td>
<td>Above ground</td>
<td>Above ground</td>
<td>Above ground</td>
<td>Underground</td>
<td>Undergrou nd</td>
<td>Undergrou nd</td>
<td>Undergrou nd</td>
<td>Undergrou nd</td>
</tr>
<tr>
<td>Diameter</td>
<td>2 m</td>
<td>2 m</td>
<td>2 m</td>
<td>3 m</td>
<td>3 m</td>
<td>3 m</td>
<td>3 m</td>
<td>1.94 m</td>
</tr>
<tr>
<td>Length</td>
<td>10 m</td>
<td>10 m</td>
<td>10.9 m</td>
<td>10.5 m</td>
<td>10.5 m</td>
<td>10.5 m</td>
<td>10.5 m</td>
<td>5.24 m</td>
</tr>
<tr>
<td>Thickness</td>
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<td>12 mm</td>
<td>12 mm</td>
<td>8 mm</td>
<td>8 mm</td>
<td>8 mm</td>
<td>8 mm</td>
<td>8 mm</td>
</tr>
<tr>
<td>Type</td>
<td>Horizontal Bullet</td>
<td>Horizontal Bullet</td>
<td>Horizontal Bullet</td>
<td>Horizontal with flat ends</td>
<td>Horizontal with flat ends</td>
<td>Horizontal with flat ends</td>
<td>Horizontal with flat ends</td>
<td>Horizontal with flat ends</td>
</tr>
<tr>
<td>Capacity (water filled)</td>
<td>31 KL</td>
<td>31KL</td>
<td>34 KL</td>
<td>15 KL</td>
<td>15 KL</td>
<td>15 KL</td>
<td>15 KL</td>
<td>14.4 KL</td>
</tr>
<tr>
<td>Capacity (Liq Stored)</td>
<td>14 KL</td>
<td>14 KL</td>
<td>27 KL</td>
<td>10KL</td>
<td>10 KL</td>
<td>10 KL</td>
<td>10 KL</td>
<td>10 KL</td>
</tr>
<tr>
<td>Operating Pressure kg/cm²</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>Atmospheri-c pressure</td>
<td>Atmospheri-c pressure</td>
<td>Atmospheri-c pressure</td>
<td>Atmospheri-c pressur e</td>
<td>Atmospheri-c pressure</td>
</tr>
<tr>
<td>Dyke Details (m x m x m)</td>
<td>5 x 14 x 0.45</td>
<td>5 x 14 x 0.45</td>
<td>6 x 15 x 0.45</td>
<td>Not Applicable</td>
<td>Not Applicabl e</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Dyke Capacity (m³)</td>
<td>31.5</td>
<td>31.5</td>
<td>40.5</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Cooling area provided</td>
<td>Yes (limpet coil)</td>
<td>Yes (limpet coil)</td>
<td>Yes (limpet coil)</td>
<td>Not Applicable</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Relief valve release rate</td>
<td>8.46 x 2</td>
<td>8.46 x 2</td>
<td>46 x 2</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
</tr>
</tbody>
</table>

6-11
**LIST OF TANKS FOR STORAGE OF HAZARDOUS PRODUCTS:-**

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Tank-1</th>
<th>Tank - 2</th>
<th>Tank-3</th>
<th>Tank-4</th>
<th>Tank – 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Stored</td>
<td>PPD</td>
<td>PPD</td>
<td>PPD</td>
<td>PPD</td>
<td>PPD</td>
</tr>
<tr>
<td>Location</td>
<td>Above ground</td>
<td>Above ground</td>
<td>Above ground</td>
<td>Above ground</td>
<td>Above ground</td>
</tr>
<tr>
<td>Diameter</td>
<td>3.0 m</td>
<td>3.0 m</td>
<td>2.65 m</td>
<td>1.52 m</td>
<td>1.52 m</td>
</tr>
<tr>
<td>Length</td>
<td>3.5 m</td>
<td>3.5 m</td>
<td>3.5 m</td>
<td>2.32 m</td>
<td>2.32 m</td>
</tr>
<tr>
<td>Thickness</td>
<td>8 mm</td>
<td>8 mm</td>
<td>8 mm</td>
<td>8 mm</td>
<td>8 mm</td>
</tr>
<tr>
<td>Type</td>
<td>Vertical</td>
<td>Vertical</td>
<td>Vertical</td>
<td>Vertical</td>
<td>Vertical</td>
</tr>
<tr>
<td>Capacity (water filled)</td>
<td>30 KL</td>
<td>30 KL</td>
<td>25 KL</td>
<td>10 KL</td>
<td>10 KL</td>
</tr>
<tr>
<td>Capacity (Liq Stored)</td>
<td>25KL</td>
<td>25 KL</td>
<td>10KL</td>
<td>2 x 9 KL</td>
<td>9 KL</td>
</tr>
<tr>
<td>Operating Temperature °C</td>
<td>60°C – 80°C</td>
<td>60°C – 80°C</td>
<td>60°C – 80°C</td>
<td>Room Temperature</td>
<td>Room Temperature</td>
</tr>
<tr>
<td>Operating Pressure kg/cm²</td>
<td>Atmospheric Pressure</td>
<td>Atmospheric Pressure</td>
<td>Atmospheric Pressure</td>
<td>Atmospheric Pressure</td>
<td>Atmospheric Pressure</td>
</tr>
<tr>
<td>Material of construction</td>
<td>SS304</td>
<td>SS304</td>
<td>SS304</td>
<td>MS with SS304 lining</td>
<td>MS with SS304 lining</td>
</tr>
<tr>
<td>Dyke Details (m x m x m)</td>
<td>9 x 6 x 1 (common dyke)</td>
<td>4.65 x 4.65 x 1</td>
<td>8.5 x 3.5 x 1 (common dyke)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dyke Capacity (m³)</td>
<td>54</td>
<td>21.62</td>
<td>29.75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Particulars</td>
<td>Tank-1</td>
<td>Tank-2</td>
<td>Tank-3</td>
<td>Tank-4</td>
<td>Tank-5</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>-------------------------</td>
<td>-------------------------</td>
<td>-------------------------</td>
<td>-------------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>Chemical Stored</td>
<td>Non-ionic Surfactant</td>
<td>Anionic Surfactant</td>
<td>Anionic Surfactant</td>
<td>Construction Chemical</td>
<td>Oleic Acid</td>
</tr>
<tr>
<td>Location</td>
<td>Above ground</td>
<td>Above ground</td>
<td>Above ground</td>
<td>Above ground</td>
<td>Above Ground</td>
</tr>
<tr>
<td>Diameter</td>
<td>2.65 m</td>
<td>2.15 m</td>
<td>2.0 m</td>
<td>2.55 m</td>
<td>2.66 m</td>
</tr>
<tr>
<td>Length</td>
<td>3.5 m</td>
<td>6.25 m</td>
<td>2.65 m</td>
<td>3.4 m</td>
<td>4.0</td>
</tr>
<tr>
<td>Thickness</td>
<td>8 mm</td>
<td>8 mm</td>
<td>8 mm</td>
<td>8 mm</td>
<td>6mm</td>
</tr>
<tr>
<td>Type</td>
<td>Vertical</td>
<td>Vertical</td>
<td>Vertical</td>
<td>Vertical</td>
<td>vertical</td>
</tr>
<tr>
<td>Capacity (water filled)</td>
<td>25 KL</td>
<td>26.4 KL</td>
<td>2 x 9.6 KL</td>
<td>19 KL</td>
<td>22KL</td>
</tr>
<tr>
<td>Capacity (Liq Stored)</td>
<td>20KL</td>
<td>22KL</td>
<td>2 x 8 KL</td>
<td>16 KL</td>
<td>20KL</td>
</tr>
<tr>
<td>Operating Temperature °C</td>
<td>60°C – 80°C</td>
<td>Room Temperature</td>
<td>60°C – 80°C</td>
<td>60°C – 80°C</td>
<td>50°C – 60°C</td>
</tr>
<tr>
<td>Operating Pressure kg/cm²</td>
<td>Atmospheric Pressure</td>
<td>Atmospheric Pressure</td>
<td>Atmospheric Pressure</td>
<td>Atmospheric Pressure</td>
<td>Atmospheric Pressure</td>
</tr>
<tr>
<td>Material of construction</td>
<td>SS304</td>
<td>SS304</td>
<td>SS304</td>
<td>SS304</td>
<td>SS316</td>
</tr>
</tbody>
</table>

Note: Depending upon production capacities in the future, more storage tanks for products as well as raw materials would be installed; details of which will be furnished accordingly.
### TABLE 6.2

**OTHER HAZARDS AND CONTROL**

<table>
<thead>
<tr>
<th>SR. NO.</th>
<th>NAME OF THE POSSIBLE HAZARD OR EMERGENCY</th>
<th>ITS SOURCES &amp; REASONS</th>
<th>ITS EFFECTS ON PERSONS, PROPERTY &amp; ENVIRONMENT</th>
<th>PLACE OF ITS EFFECT</th>
<th>CONTROL MEASURES PROVIDED</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>ELECTRICITY</td>
<td>Loose Contacts, Weak earthing Short Circuit Improper Insulation</td>
<td>Burning, Shock, Death</td>
<td>Surrounding the accident area</td>
<td>Proper Earthing, Periodical Checking of joints, proper insulations of Equipments, etc. Flame proof fitting in solvent storage area, bounding and jumpers to all solvent barrier lines provided.</td>
</tr>
<tr>
<td>3</td>
<td>HOUSE KEEPING</td>
<td>Bad House keeping</td>
<td>Physical / Chemical Thermal Burn Injury (Major / Minor)</td>
<td>In all surrounding areas i.e. Storage, Plants</td>
<td>Proper Handling, regular cleaning. Proper placement of material (RIGHT THING AT THE RIGHT PLACE)</td>
</tr>
<tr>
<td>4</td>
<td>PIPE LINE LEAKAGES Spillages etc.</td>
<td>Leaking of pipe line due to corrosion, Loose contact etc.</td>
<td>Physical / Chemical Thermal Burn Injury (Major / Minor)</td>
<td>Plant area</td>
<td>Proper maintenance, Proper Selection of Material for pipe lines, Immediate attention, Earthing provided, flame proof fitting, NO SMOKING Boards displayed.</td>
</tr>
<tr>
<td>5</td>
<td>Structural Failure</td>
<td>Inside the factory (Corrosion)</td>
<td>Injury/Death to persons, damage to property</td>
<td>Within the factory</td>
<td>Automatic operation Periodic Testing of safety valves Regular Inspection and Maintenance</td>
</tr>
<tr>
<td>6</td>
<td>Toxic Release</td>
<td>Outside the factory</td>
<td>Injury/Death</td>
<td>Within &amp; outside the unit</td>
<td>Alarm, Evacuation rescue &amp; shelter/ Welfare</td>
</tr>
<tr>
<td>7</td>
<td>Natural Calamity</td>
<td>Nature</td>
<td>Injury / Death to persons, damage to property</td>
<td>Within &amp; outside the unit</td>
<td>Alarm, Evacuation rescue &amp; shelter/ Welfare</td>
</tr>
</tbody>
</table>


**TABLE 6.3**

HAZARDOUS PROPERTIES OF THE CHEMICALS, COMPATIBILITIES, SPECIAL HAZARD AND ANTIDOTES (*Raw Material*)

<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Name of the Chemical</th>
<th>State</th>
<th>Hazards</th>
<th>TLV Ppm</th>
<th>F. P. °C</th>
<th>B. P. °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Acetone</td>
<td>L</td>
<td>F</td>
<td>750</td>
<td>-9</td>
<td>56</td>
</tr>
<tr>
<td>2</td>
<td>Acetic Acid</td>
<td>L</td>
<td>C</td>
<td>15</td>
<td>43</td>
<td>118</td>
</tr>
<tr>
<td>3</td>
<td>Acrylonitrile</td>
<td>L</td>
<td>F,T</td>
<td>2</td>
<td>0</td>
<td>77.3</td>
</tr>
<tr>
<td>4</td>
<td>Allyl Alcohol</td>
<td>L</td>
<td>F,T</td>
<td>-</td>
<td>21</td>
<td>96.9</td>
</tr>
<tr>
<td>5</td>
<td>Allyl Chloride</td>
<td>L</td>
<td>F</td>
<td>2</td>
<td>-29</td>
<td>45</td>
</tr>
<tr>
<td>6</td>
<td>Benzoyl Peroxide</td>
<td>S</td>
<td>Organic</td>
<td>-</td>
<td>NA</td>
<td>103</td>
</tr>
<tr>
<td>7</td>
<td>Benzyl Chloride</td>
<td>L</td>
<td>C,T</td>
<td>.....</td>
<td>74</td>
<td>179</td>
</tr>
<tr>
<td>8</td>
<td>Bisphenol A</td>
<td>L</td>
<td>Organic</td>
<td></td>
<td></td>
<td>254</td>
</tr>
<tr>
<td>9</td>
<td>Butanol</td>
<td>L</td>
<td>F</td>
<td></td>
<td>36</td>
<td>118</td>
</tr>
<tr>
<td>10</td>
<td>C-9 Aromatic Hydrocarbon Fraction</td>
<td>L</td>
<td>F</td>
<td>......</td>
<td>56</td>
<td>191</td>
</tr>
<tr>
<td>11</td>
<td>Cyclohexanone</td>
<td>L</td>
<td>F</td>
<td>.....</td>
<td>46</td>
<td>155.6</td>
</tr>
<tr>
<td>12</td>
<td>Diethylene Glycol</td>
<td>L</td>
<td>HS</td>
<td>.....</td>
<td>143</td>
<td>146</td>
</tr>
<tr>
<td>13</td>
<td>Diethylene Triamine (DETA)</td>
<td>L</td>
<td>C</td>
<td>1</td>
<td>101.7</td>
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<tr>
<td>14</td>
<td>Dimethyl Amine (40%)</td>
<td>L</td>
<td>F,C</td>
<td>10</td>
<td>.....</td>
<td>100</td>
</tr>
<tr>
<td>15</td>
<td>Epichlorohydrine</td>
<td>L</td>
<td>T</td>
<td>.....</td>
<td>28</td>
<td>115</td>
</tr>
<tr>
<td>16</td>
<td>Ethylene Oxide</td>
<td>G</td>
<td>F</td>
<td>1</td>
<td>-20</td>
<td>10.7</td>
</tr>
<tr>
<td>17</td>
<td>2 Ethyl Hexanol / OA</td>
<td>L</td>
<td>C</td>
<td>.....</td>
<td>81</td>
<td>184</td>
</tr>
<tr>
<td>18</td>
<td>Formaldehyde</td>
<td>L</td>
<td>F,T</td>
<td>0.3</td>
<td>60</td>
<td>96</td>
</tr>
<tr>
<td>19</td>
<td>Formic Acid</td>
<td>L</td>
<td>C,HS</td>
<td>10</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>20</td>
<td>Hydrogen Peroxide</td>
<td>L</td>
<td>OS</td>
<td>1</td>
<td>.....</td>
<td>110</td>
</tr>
<tr>
<td>21</td>
<td>Hydroquinone</td>
<td>S</td>
<td>Organic</td>
<td>.....</td>
<td>.....</td>
<td>.....</td>
</tr>
<tr>
<td>22</td>
<td>Iso Propyl Alcohol</td>
<td>L</td>
<td>FL</td>
<td>.....</td>
<td>12</td>
<td>82</td>
</tr>
<tr>
<td>23</td>
<td>Maleic Anhydride</td>
<td>S</td>
<td>C</td>
<td>0.25</td>
<td>103</td>
<td>202</td>
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<tr>
<td>24</td>
<td>Methyl Alcohol</td>
<td>L</td>
<td>F</td>
<td>.....</td>
<td>.....</td>
<td>...</td>
</tr>
<tr>
<td>25</td>
<td>Methyl Chloride</td>
<td>G</td>
<td>TG</td>
<td>50</td>
<td>.....</td>
<td>-24</td>
</tr>
<tr>
<td>26</td>
<td>Methyl Methacrylate</td>
<td>L</td>
<td>F</td>
<td>125</td>
<td>19</td>
<td>100</td>
</tr>
<tr>
<td>27</td>
<td>Nitrogen</td>
<td>G</td>
<td>HS</td>
<td>.....</td>
<td>.....</td>
<td>-196</td>
</tr>
<tr>
<td>28</td>
<td>Oleum</td>
<td>L</td>
<td>C</td>
<td>.....</td>
<td>.....</td>
<td>140</td>
</tr>
<tr>
<td>29</td>
<td>O-Xylene</td>
<td>L</td>
<td>F</td>
<td>100</td>
<td>21-27</td>
<td>135</td>
</tr>
<tr>
<td>30</td>
<td>Phenol</td>
<td>S</td>
<td>C</td>
<td>5</td>
<td>85</td>
<td>182</td>
</tr>
<tr>
<td>31</td>
<td>Phosphoric Acid</td>
<td>L</td>
<td>C</td>
<td>3</td>
<td>.....</td>
<td>158</td>
</tr>
<tr>
<td>32</td>
<td>Phosphorous Pentaoxide</td>
<td>S</td>
<td>C</td>
<td>.....</td>
<td>.....</td>
<td>.....</td>
</tr>
<tr>
<td>33</td>
<td>Potassium Hydroxide</td>
<td>S</td>
<td>HS</td>
<td>2</td>
<td>.....</td>
<td>1384</td>
</tr>
<tr>
<td>34</td>
<td>Propylene Oxide</td>
<td>L</td>
<td>F</td>
<td>20</td>
<td>-37</td>
<td>34</td>
</tr>
<tr>
<td>35</td>
<td>Sodium Hydroxide</td>
<td>S</td>
<td>T,C,HS</td>
<td>100</td>
<td>36.7</td>
<td>145</td>
</tr>
<tr>
<td>36</td>
<td>Styrene</td>
<td>L</td>
<td>F</td>
<td>1</td>
<td>.....</td>
<td>270</td>
</tr>
<tr>
<td>37</td>
<td>Sulphuric Acid</td>
<td>L</td>
<td>C</td>
<td>50</td>
<td>16</td>
<td>110</td>
</tr>
<tr>
<td>38</td>
<td>Toulene</td>
<td>L</td>
<td>F</td>
<td>0.02</td>
<td>135</td>
<td>251</td>
</tr>
</tbody>
</table>

6-15
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>FIRE</td>
</tr>
<tr>
<td>T</td>
<td>TOXIC</td>
</tr>
<tr>
<td>E</td>
<td>Explosive</td>
</tr>
<tr>
<td>R</td>
<td>REACTIVE</td>
</tr>
<tr>
<td>BP</td>
<td>BOILING POINT</td>
</tr>
<tr>
<td>LEL</td>
<td>LOWER EXPLOSIVE LIMIT</td>
</tr>
<tr>
<td>UEL</td>
<td>UPPER EXPLOSIVE LIMIT</td>
</tr>
<tr>
<td>SP.GR</td>
<td>SPECIFIC GRAVITY</td>
</tr>
<tr>
<td>ER</td>
<td>EVAPORATION RATE</td>
</tr>
<tr>
<td>H</td>
<td>HEALTH HAZARD CLASS</td>
</tr>
<tr>
<td>F</td>
<td>FIRE HAZARD CLASS</td>
</tr>
<tr>
<td>R</td>
<td>REACTIVE HAZARD</td>
</tr>
<tr>
<td>BR</td>
<td>BURNING RATE</td>
</tr>
<tr>
<td>TLV</td>
<td>THRESHOLD LIMIT VALUE</td>
</tr>
<tr>
<td>PPM</td>
<td>PARTS PER MILLION</td>
</tr>
<tr>
<td>STEL</td>
<td>SHORT TERM EXPOSURE LIMIT</td>
</tr>
<tr>
<td>NFPA</td>
<td>NATIONAL FIRE PROTECTION ASSOCIATION-USA</td>
</tr>
<tr>
<td>U.G. Tank</td>
<td>UNDERGROUND STORAGE TANK</td>
</tr>
<tr>
<td>C</td>
<td>CORROSIVE SUBSTANCE</td>
</tr>
<tr>
<td>CL</td>
<td>COMBUSTIBLE LIQUID</td>
</tr>
<tr>
<td>H</td>
<td>HUMAN CARCINOGEN</td>
</tr>
<tr>
<td>TG</td>
<td>TOXIC GAS</td>
</tr>
<tr>
<td>OS</td>
<td>OXIDISING SUBSTANCE</td>
</tr>
<tr>
<td>HS</td>
<td>HARMFUL SUBSTANCE</td>
</tr>
</tbody>
</table>
6.1.4.3.1 PRECAUTIONS DURING STORAGE AND TRANSPORTATION OF HAZARDOUS CHEMICALS LIQUIDS

- Always use the road tankers having authorization/registration for transporting the said liquids.
- Vendor will be asked to provide MSDS to Tanker Driver.
- Tankers will have clearly marked identification of material being contained with mentioning Safety Card.
- Driver to have concerned Safety Officer’s contact details to contact him in case of emergency.
- Provide Flame Arrester on exhaust while entering tanker within premises.
- Ensure Earthing Boss connection before starting any transferring.
- SOP to cover routine checking of Tank farm area to be carried out for checking any spillage / leakage.
- Tanks will be inspected physically daily for having any visual abnormality.
- Readings of Temperature & Pressure will be noted, recorded & reported immediately for abnormality.
- Safety instruments like rupture disc, safety valves will be checked at defined duration for intakeness.
- Scheduled testing of tanks to be done for thickness testing.
- Tanks to be painted on regular interval defined as per laws to protect them from atmospheric corrosion.
- Barrels to be checked for proper fixing of bungs before sending it outside the premises.
- Barrels to be monitored physically daily for developing any pressure or vacuum within it on long storage.
- Concerned persons will be trained properly to use spill kit in case of observing any spillage inside warehouse.
SOLIDS

- Vendor will be asked to provide MSDS to Truck Driver.
- Driver to have concerned Safety Officer’s contact details to contact him in case of emergency.
- Provide muffler on exhaust while entering truck within premises.
- SOP to cover routine checking of Bags & Containers for checking any damage.
- Containers to be tested for safe racking & transportation.
- Proper PPE to be used while handling the material & concerned persons to be trained for usage of the same.
- Concerned persons will be trained properly to use spill kit in case of observing any spillage inside warehouse.

THE MAJOR HAZARDS IN THE M/S. DAI ICHI KARKARIA LTD ARE DESCRIBED BELOW.

- Toxic hazard due to leakage of hazardous chemicals from storage tank.
- Corrosive hazard due to leakage of chemicals from storage tank or Carboys.
- Electrical hazards due to the electrical major equipment/ machinery, operations, welding, motors, and heavy lift devices, cabling, human intervention (short circuit possibility), maintenance work (due to machinery breakdown etc.), plant lighting related electrical hazards.
- Possibility of human injury due to working with mechanical machines, manual handling etc.
- Possibility of injury during chemicals handled, during operations and due to intoxication.
- Major dropped objects hazard due to large number of physical handling steps / operations involved with crane/ overhead lifting/ hoisting equipment.
- Fires in any part of the plant working areas – there is a possibility of rapid escalation if it is not brought under control quickly.
- Possibilities of fire hazards at transformers, switchgear and other electrical equipment etc.
### 6.1.4.4 TRANSPORTATION, UNLOADING AND HANDLING PROCEDURE FOR HAZARDOUS CHEMICALS

Transportation, Unloading and Handling Procedure for Solvents

<table>
<thead>
<tr>
<th>SR. NO.</th>
<th>ACTIVITY</th>
<th>TYPE OF POSSIBLE HAZARD</th>
<th>MITIGATION MEASURES</th>
</tr>
</thead>
</table>
| 1       | Transportation of Solvents by road tanker | Leakage & Spillage | • Check the source of leakage point.  
• Do not touch damaged containers or spilled material unless wearing appropriate protective clothing.  
• Stop leak if you can do it without risk. |
|         |          | Fire, & explosion        | • Use water spray to reduce vapors; do not put water directly on leak, spill area or inside container.  
• Keep combustibles (wood, paper, oil, etc.) away from spilled material. |
|         |          | Toxic release            | • Isolate the area  
• Isolate the container  
• Training will be provided to driver and cleaner regarding the safe driving, hazard of Flammable chemicals, emergency handling.  
• TREM card will kept with TL.  
• Fire extinguishers will be kept with TL.  
• Flame arrestor will be provided to TL exhaust.  
• Instructions will be given not to stop road tanker in populated area.  
• Clear Hazard Identification symbol and emergency telephone number will be displayed as per HAZCHEM CODE.  
• Appropriate PPEs will be kept with TL. |
| 2       | Road tanker unloading at project site. | Leakage & Spillage | • Check the source of leakage point.  
• Do not touch damaged containers or spilled material unless wearing appropriate protective clothing.  
• Stop leak if you can do it without risk. |
|         |          | Fire, & explosion        | • Use water spray to reduce vapors; do not put water directly on leak, spill area or inside container.  
• Keep combustibles (wood, paper, oil, etc.) away from spilled material. |
|         |          | Toxic release            | • Isolate the area  
• Isolate the container  
• Check the source of leakage point.  
• Isolate the area  
• Isolate the container  
• Spray the water on leakage  
• Priority will be given to Tanker to immediately enter the storage premises at site and will not be kept waiting near the gate or the main road.  
• Security person will check License, TREM CARD, Fire extinguisher condition; Antidote Kit, required PPEs as per SOP laid down.  
• Store officer will take sample as per sampling SOP from sampling point.  
• After approval of QC department unloading procedure will be allowed be started. |
### Following precautions will be adopted during unloading
- Wheel stopper will be provided to TL at unloading platform.
- Static earthing will be provided to road tanker.
- Tanker unloading procedure will be followed according to check list and implemented.
- Flexible SS hose connection will be done at TL outlet line.
- The quantity remaining in the hose pipeline will be drained to a small underground storage tank, which will be subsequently transferred by nitrogen pressure to the main storage tank thus ensuring complete closed conditions for transfer from road tanker.
- All TL valves will be closed in TL.
- Finally earthing connection and wheel stopper will be removed.
- Only day time unloading will be permitted.

<table>
<thead>
<tr>
<th>3</th>
<th>Storage tank safety</th>
<th>Leakage &amp; Spillage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Check the source of leakage point.</td>
<td>Do not touch damaged containers or spilled material unless wearing appropriate protective clothing.</td>
</tr>
<tr>
<td></td>
<td>Stop leak if you can do it without risk.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Use water spray to reduce vapors; do not put water directly on leak, spill area or inside container.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Keep combustibles (wood, paper, oil, etc.) away from spilled material.</td>
<td></td>
</tr>
</tbody>
</table>

### Storage tank safety
- Isolate the area
- Isolate the container
- Check the source of leakage point.
- Spray the water on leakage
- SS storage tank will be provided as per IS code.
- Dyke wall will be provided to storage tank.
- Level transmitter will be provided with low level high level auto cut-off provision.
- Vent will be connected to water trap and vent of water trap will be provided with flame arrestor.
- Water sprinkler system will be provided to storage tank.
- Fire hydrant monitor with foam attachment facility will be provided.
- Dumping / Drain vessel/alternate vessel will be provided to collect dyke wall spillage material.
- FLP type pump will be provided.
- Nitrogen blanketing will be provided to storage tank.
- Double static earthing will be provided to storage tank.
- Double Jumper clip will be provided to all Solvent handling pipeline flanges.

### Leakage & Spillage due to Line rupture, Flange Gasket failure, Fire, Explosion, Toxic release.
- Double mechanical seal type FLP type pump will be provided.
- Double on / off switch will provided at tank farm and process area near day tank. Pump auto cut off with day tank high level will be provided.
- Flame arrestor will be provided on day tank vent.
- Over flow will be provided for additional safety and it will be connected to main storage tank.

<table>
<thead>
<tr>
<th>4</th>
<th>Solvents transfer from storage tank to Day tank</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Double mechanical seal type FLP type pump will be provided.</td>
</tr>
<tr>
<td></td>
<td>Double on / off switch will provided at tank farm and process area near day tank. Pump auto cut off with day tank high level will be provided.</td>
</tr>
<tr>
<td></td>
<td>Flame arrestor will be provided on day tank vent.</td>
</tr>
<tr>
<td></td>
<td>Over flow will be provided for additional safety and it will be connected to main storage tank.</td>
</tr>
</tbody>
</table>
6.1.5 CONSEQUENCE ANALYSIS

In a plant handling hazardous chemicals, the main hazard arises due to storage, handling & use of these chemicals. If these chemicals are released into the atmosphere, they may cause damage due to resulting fires or vapour clouds. Blast Overpressures depend upon the reactivity class of material between two explosive limits.

Operating Parameters

Potential vapour release for the same material depends significantly on the operating conditions. Especially for any liquefied gas, the operating conditions are very critical to assess the damage potential. If we take up an example of ammonia, if it is stored at ambient temperature, say 30°C, and then the vapour release potential of the inventory is much higher as compared to the case if it is stored at 0°C.

Inventory

Inventory Analysis is commonly used in understanding the relative hazards and short listing of release scenarios. Inventory plays an important role in regard to the potential hazard. Larger the inventory of a vessel or a system, larger the quantity of potential release. The potential vapour release (source strength) depends upon the quantity of liquid release, the properties of the materials and the operating conditions (pressure, temperature). If all these influencing parameters are combined into a matrix and vapour source strength estimated for each release case, a ranking should become a credible exercise.

Loss of Containment

Plant inventory can get discharged to Environment due to Loss of Containment. Certain features of materials to be handled at the plant need to the clearly understood to firstly list out all significant release cases and then to short list release scenarios for a detailed examination. Liquid release can be either instantaneous or continuous. Failure of a vessel
leading to an instantaneous outflow assumes the sudden appearance of such a major crack that practically all of the contents above the crack shall be released in a very short time. The more likely event is the case of liquid release from a hole in a pipe connected to the vessel. The flow rate is depending on the size of the hole as well as on the pressure, which was present, in front of the hole, prior to the accident. Such pressure is basically dependent on the pressure in the vessel. The vaporisation of released liquid depends on the vapour pressure and weather conditions. Such consideration and others have been kept in mind both during the initial listing as well as during the short listing procedure. In the study, Maximum Credible Loss accident methodology is to be used, therefore, the largest potential hazard inventories have been considered for consequence estimation.

### 6.1.5.1 DAMAGE CRITERIA

In consequence analysis, use is made of a number of calculation models to estimate the physical effects of an accident (spill of hazardous material) and to predict the damage (lethality, injury, material destruction) of the effects. The calculations can roughly be divided in three major groups:

a) Determination of the source strength parameters;

b) Determination of the consequential effects;

c) Determination of the damage or damage distances.

The basic physical effect models consist of the following.

### SOURCE STRENGTH PARAMETERS

* Calculation of the outflow of liquid, vapour or gas out of a vessel or a pipe, in case of rupture. Also two-phase outflow can be calculated.

* Calculation, in case of liquid outflow, of the instantaneous flash evaporation and of the dimensions of the remaining liquid pool.

* Calculation of the evaporation rate, as a function of volatility of the material, pool dimensions and wind velocity.

* Source strength equals pump capacities, etc. in some cases.
CONSEQUENTIAL EFFECTS

* Dispersion of gaseous material in the atmosphere as a function of source strength, relative density of the gas, weather conditions and topographical situation of the surrounding area.

* Intensity of heat radiation [in kW/ m²] due to a fire or a BLEVE, as a function of the distance to the source.

* Energy of vapour cloud explosions [in N/m²], as a function of the distance to the distance of the exploding cloud.

* Concentration of gaseous material in the atmosphere, due to the dispersion of evaporated chemical. The latter can be either explosive or toxic.

It may be obvious, that the types of models that must be used in a specific risk study strongly depend upon the type of material involved:

- Gas, vapour, liquid, solid
- Inflammable, explosive, toxic, toxic combustion products
- Stored at high/low temperatures or pressure
- Controlled outflow (pump capacity) or catastrophic failure?

SELECTION OF DAMAGE CRITERIA

The damage criteria give the relation between extent of the physical effects (exposure) and the percentage of the people that will be killed or injured due to those effects. The knowledge about these relations depends strongly on the nature of the exposure. For instance, much more is known about the damage caused by heat radiation, than about the damage due to toxic exposure, and for these toxic effects, the knowledge differs strongly between different materials.

In Consequence Analysis studies, in principle three types of exposure to hazardous effects are distinguished:

1. Heat radiation, from a jet, pool fire, a flash fire or a BLEVE.
2. Explosion
3. Toxic effects, from toxic materials or toxic combustion products.

In the next three paragraphs, the chosen damage criteria are given and explained.
Heat Radiation

The consequence caused by exposure to heat radiation is a function of:

- The radiation energy onto the human body \([\text{kW/m}^2]\);
- The exposure duration [sec];
- The protection of the skin tissue (clothed or naked body).
- The limits for 1% of the exposed people to be killed due to heat radiation, and for second-degree burns are given in the table herein:

<table>
<thead>
<tr>
<th>Exposure Duration</th>
<th>Radiation for 1% lethality (kW/m²)</th>
<th>Radiation for 2nd degree burns (kW/m²)</th>
<th>Radiation for first degree burns (kW/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Sec</td>
<td>21.2</td>
<td>16</td>
<td>12.5</td>
</tr>
<tr>
<td>30 Sec</td>
<td>9.3</td>
<td>7.0</td>
<td>4.0</td>
</tr>
</tbody>
</table>

Since in practical situations, only the own employees will be exposed to heat radiation in case of a fire, it is reasonable to assume the protection by clothing. It can be assumed that people would be able to find a cover or a shield against thermal radiation in 10 sec. time. Furthermore, 100% lethality may be assumed for all people suffering from direct contact with flames, such as the pool fire, a flash fire or a jet flame. The effects due to relatively lesser incident radiation intensity are given below.
EFFECTS DUE TO INCIDENT RADIATION INTENSITY

<table>
<thead>
<tr>
<th>INCIDENT RADIATION kW/m²</th>
<th>TYPE OF DAMAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.7</td>
<td>Equivalent to Solar Radiation</td>
</tr>
<tr>
<td>1.6</td>
<td>No discomfort for long exposure</td>
</tr>
<tr>
<td>4.0</td>
<td>Sufficient to cause pain within 20 sec. Blistering of skin (first degree burns are likely)</td>
</tr>
<tr>
<td>9.5</td>
<td>Pain threshold reached after 8 sec. second degree burns after 20 sec.</td>
</tr>
<tr>
<td>12.5</td>
<td>Minimum energy required for piloted ignition of wood, melting plastic tubing etc.</td>
</tr>
</tbody>
</table>

EXPLOSION

In case of vapour cloud explosion, two physical effects may occur:

* a flash fire over the whole length of the explosive gas cloud;
* a blast wave, with typical peak overpressures circular around ignition source.

As explained above, 100% lethality is assumed for all people who are present within the cloud proper.

For the blast wave, the lethality criterion is based on:

* A peak overpressure of 0.1 bar will cause serious damage to 10% of the housing/structures.
* Falling fragments will kill one of each eight persons in the destroyed buildings.

The following damage criteria may be distinguished with respect to the peak overpressures resulting from a blast wave:

**DAMAGE DUE TO OVERPRESSURES**

<table>
<thead>
<tr>
<th>Peak Overpressure</th>
<th>Damage Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.83 bar</td>
<td>Total Destruction</td>
</tr>
<tr>
<td>0.30 bar</td>
<td>Heavy Damage</td>
</tr>
<tr>
<td>0.10 bar</td>
<td>Moderate Damage</td>
</tr>
<tr>
<td>0.03 bar</td>
<td>Significant Damage</td>
</tr>
<tr>
<td>0.01 bar</td>
<td>Minor Damage</td>
</tr>
</tbody>
</table>
From this it may be concluded that $p = 0.17 \times 10^5$ Pa corresponds approximately with 1% lethality. Furthermore, it is assumed that everyone inside an area in which the peak overpressure is greater than $0.17 \times 10^5$ Pa will be wounded by mechanical damage. For the gas cloud explosion this will be inside a circle with the ignition source as its centre.

**INTOXICATION**

The consequences from inhalation of a toxic vapour/gas are determined by the toxic dose. This dose $D$ is basically determined by:

- Concentration of the vapour in air;
- Exposure duration.

Furthermore, of course, the breathing rates of the victim, as well as the specific toxic mechanism unto the metabolism play an important role.

The dose is defined as $D = C^n . t$, with:

- $C$ = concentration of the toxic vapour, in [ppm] or [mg/m$^3$];
- $t$ = exposure duration, in [sec] or [min];
- $n$ = exponent, mostly $> 1.0$; this exponent takes into account the fact that a high concentration over a short period results in more serious injury than a low concentration over a relatively longer period of exposure. The value of $n$ should be greater than zero but less than 5.

The given definition for $D$ only holds if the concentration is more or less constant over the exposure time; this may be the case for a (semi) continuous source. In case of an instantaneous source, the concentration varies with time; the dose $D$ must be calculated with an integral equation:

$$D = \int C^n . dt$$

For a number of toxic materials, so-called Vulnerability Models (V.M.) has been developed. The general equation for a V.M. (probit function) is:

$$Pr = a + b \ln \left( C^n . t \right),$$

with

- $Pr$ = probit number, being a representation of the percentage of people suffering a certain kind of damage, for instance lethality.
Pr = 2.67 means 1% of the population;
Pr = 5.00 means 50% of the population;
a and b material dependent numbers;
C^n.t = dose D, as explained above.

The values for a and b are mostly derived from experiments with animals; occasionally, however, also human toxicity factors have been derived from accidents in past. In case only animal experiments are available, the inhalation experiments with rats seem to be best applicable for predicting the damage to people from acute intoxication. Although much research in this field have been done over the past decades, only for a limited number of toxic materials consequence models have been developed. Often only quite scarce information is available to predict the damage from an acute toxic exposition. Data transformation from oral intoxication data to inhalation toxicity criteria is sometimes necessary. Generally, in safety evaluations pessimistic assumptions are applied in these transformation calculations. The calculated damage (distance) may be regarded as a maximum. For the purposes of a response to a major incident, the IDLH value level has been chosen for the ‘wounded’criteria. This type of injury will require medical attention.

6.1.5.2 MAXIMUM CREDIBLE LOSS ACCIDENT SCENARIOS

A Maximum Credible Accident (MCA) can be characterised as the worst credible accident. In other words: an accident in an activity, resulting in the maximum consequence distance that is still believed to be possible. A MCA-analysis does not include a quantification of the probability of occurrence of the accident. Another aspect, in which the pessimistic approach of MCA studies appears, is the atmospheric condition that is used for dispersion calculations. As per the reference of the study, weather conditions having an average wind speed of 2.03 m/s have been chosen.

The Maximum Credible Loss (MCL) scenarios have been developed for the Facility. The MCL cases considered, attempt to include the worst “Credible” incidents- what constitutes a credible incident is always subjective. Nevertheless, guidelines have evolved over the years and based on basic engineering judgement, the cases have been found to be credible and modelling for assessing vulnerability zones is prepared accordingly. Only catastrophic cases have been considered and not partial or small failures (as is the case in Quantitative Risk
Assessment where contributions from low frequency - high outcome effect as well as high frequency - low outcome events are distinguished). The objective of the study is emergency planning, hence only holistic & conservative assumptions are used for obvious reasons. Hence though the outcomes may look pessimistic, the planning for emergency concept should be borne in mind whilst interpreting the results.

6.1.5.2.1 CONSEQUENCE ANALYSIS CALCULATIONS

The Consequence Analysis has been done for selected scenarios. This has been done for weather conditions having wind speed 2.03 m/s. In Consequence Analysis, geographical location of the source of potential release plays an important role. Consideration of a large number of scenarios in the same geographical location serves little purpose if the dominant scenario has been identified and duly considered.

6.1.5.2.2 SOFTWARE USED FOR CALCULATIONS

PHAST MICRO: Phast is the most comprehensive software available for performing Process Hazard Analysis (PHA), Quantitative Risk Assessment (QRA) and Financial Risk Analysis (FRA). Our extensively validated software for consequence and risk assessment is used by governments and industry helping them to comply with local safety regulation and their own corporate best practice. Phast contains all the discharge, dispersion, effects and risk models you will need to accurately assess all your major hazards and associated risks. Phast Consequence provides you with comprehensive hazard analysis facilities to examine the progress of a potential incident from the initial release to its far-field effects.

TOXIC AND FLAMMABLE IMPACT

It calculates the initial discharge, as the material expands from its storage conditions to atmospheric, through dispersion, as the material mixes with air and dilutes, and the subsequent toxic or flammable effects. Phast includes a wide range of models for discharge and dispersion as well as flammable, explosive and toxic effects.
DISCHARGE

- Phast requires basic information about storage or process conditions and material properties in order to perform discharge calculations
- The software comes with an integrated material property database containing more than 1,600 pre-defined pure component chemicals
- Various discharge scenario options have been implemented to represent common process failures, and model their behaviour. These include:
  - Leaks and line ruptures from long & short pipelines
  - Catastrophic ruptures
  - Relief valve and disc ruptures
  - Tank roof collapse
  - Vent from vapour spaces
  - In building release effects

DISPERSION

The dispersion models within Phast are able to model the following phenomena

- Dispersion of gas, liquid and two-phase releases
- Liquid droplet thermo dynamics calculations and liquid droplet rainout
- Pool spreading and vaporization
- Building wake dispersion effects for vapour releases

FLAMMABLE EFFECTS

For releases of flammable material Phast calculates

- Radiation profiles and contours from a range of fire scenarios including pool fires, flash fires, jet fires and fire balls, including cross-wind effects on a jet fire
- Vapour Cloud Explosion modeling using industry standards models including the TNO Multi-energy, Baker Strehlow Tang and TNT Equivalence models
- Overpressure contours from Boiling Liquid Expanding Vapour Explosions

TOXIC EFFECTS

- Graphs of toxic concentration profile
- Indoor and outdoor toxic dose prediction
- Reporting of distance to specific dose and concentration
- Calculated exposure time and use as “averaging time” for passive dispersion effects
PHAST RISK

Phast Risk allows you to combine the flammable and toxic consequences from each scenario in your QRA model with their likelihood to quantify the risk of fatalities. Phast Risk allows you to take account of local population distribution, sources of ignition, land usage and local prevailing weather conditions. It is designed to perform all the analysis, data handling and results presentation elements of a QRA within a structured framework.

Phast Risk allows you to quickly identify major risk contributors so that time and efforts can be directed to mitigating these highest risk activities. Based on effects calculations and population vulnerabilities, Phast Risk can integrate over all scenarios and weather conditions to estimate the total risk. The established individual and societal risk indicators are predicted by Phast Risk across your facility and surrounding area using the classical QRA methodology. Risk ranking reports can be produced at points of strategic importance to show the relative influence of the various failure scenarios and their contribution to both the individual and societal risk metrics.

A key benefit of Phast Risk is the ability to identify major risk contributors and differentiate these from incidents with worst case consequences which might otherwise dominate the safety reviews. Whilst medium scale incidents have lesser consequences, they may have a higher frequency, which, when combined with their hazardous effects, generate a higher level of risk. Time and effort directed to mitigating high consequence but often low frequency events may not be well spent. Phast Risk helps you direct this effort more effectively.

Phast Risk also provides facilities to help you manage large quantities of input data, including scenarios, parameters, wind roses, ignition and population, and combine these in many ways. This is critical when looking at sensitivity analyses and assessing the merits of a range of risk reduction measures.

Benefits

- Facilitates cost reduction in terms of losses and insurance
- Allows optimization of plant and process design
- Assist in compliance with safety regulators
- Enables quicker response to hazardous incidents
- Improve engineer’s understanding of potential hazards
- Regular software upgrades incorporate industry experience and expertise, and advances in consequence modeling technology

### 6.1.5.2.3 SCENARIOS

<table>
<thead>
<tr>
<th>Scenario</th>
<th>MCL Scenario</th>
<th>Pressure &amp; Temp</th>
<th>Quantity in MT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Release of 2- Ethylene Oxide</td>
<td>NTP</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>Release of Propylene Oxide</td>
<td>NTP</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>Release of Iso Xylene</td>
<td>NTP</td>
<td>20</td>
</tr>
<tr>
<td>4</td>
<td>Release of Toluene</td>
<td>NTP</td>
<td>15</td>
</tr>
</tbody>
</table>
Scenario –5 Unconfined Pool Fire for Ethylene Oxide Road Tanker catastrophic failure

### TABLE – 5

<table>
<thead>
<tr>
<th>Scenario</th>
<th>UNCONFINED POOL FIRE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input Data</strong></td>
<td><strong>Results of Computations</strong></td>
</tr>
<tr>
<td>Stored quantity</td>
<td>14 MT</td>
</tr>
<tr>
<td>Max. IHR at flame centre height</td>
<td>108.40 Kw/m$^2$</td>
</tr>
<tr>
<td>Pool diameter</td>
<td>45 (m)</td>
</tr>
<tr>
<td>Flame centre height</td>
<td>39.13 meter</td>
</tr>
<tr>
<td>Pool liquid depth</td>
<td>0.3 (m)</td>
</tr>
<tr>
<td>Maximum Flame width</td>
<td>38.83 meter</td>
</tr>
<tr>
<td>Wind speed</td>
<td>6 m/s</td>
</tr>
<tr>
<td>Mass burning rate liquid</td>
<td>6.96 kg/ m$^3$/min.</td>
</tr>
<tr>
<td>Liquid Density</td>
<td>869 kg/m$^3$</td>
</tr>
<tr>
<td>Flame burnout time</td>
<td>37.97 Mims.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Incident Intensity of Heat Radiation (IHR) at ground level KW / m$^2$</th>
<th>IHR- Isopleth Distance ( Meters )</th>
<th>Effect if IHR at Height of Simulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>37.5</td>
<td>34.8</td>
<td>Damage to process equipment. 100 % Fatal in 1 Min. 1 % fatal in 10 sec.</td>
</tr>
<tr>
<td>25.0</td>
<td>42.6</td>
<td>Min. to ignite wood ( without flame contact ). 100 % fatal in 1 Min. Significant injury in 10 sec.</td>
</tr>
<tr>
<td>12.5</td>
<td>60.2</td>
<td>Min. to ignite wood (with flame contact). 1 % fatal in 1 min. 1 st deg. burn in 10 sec.</td>
</tr>
<tr>
<td>4.0</td>
<td>106.3</td>
<td>Pain after 20 secs. Blistering unlikely.</td>
</tr>
<tr>
<td>1.6</td>
<td>168.1</td>
<td>No discomfort even on long exposure.</td>
</tr>
</tbody>
</table>

**Results**

- In the 34.8 meter radius area is considered as 100% fatality in 1 min.
- In the 60.2 meter radius first degree burn in 10 sec.
- In the 106.3 meter radius area will give pain after 20 seconds. Blistering unlikely.
- In the 168.1 meter radius area is considered as safe area and no discomfort even on long exposure.
A release of Xylene from storage tank.

<table>
<thead>
<tr>
<th>Input Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stored quantity</td>
</tr>
<tr>
<td>Molecular weight</td>
</tr>
<tr>
<td>Vapor density (air=1)</td>
</tr>
<tr>
<td>Wind speed</td>
</tr>
<tr>
<td>Temperature</td>
</tr>
<tr>
<td>Pressure</td>
</tr>
<tr>
<td>Tank Dimension</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Consequence Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiation Effects</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Radiation Level (KW/m²)</th>
<th>Distance (meter)</th>
<th>Effect if IHR at Height of simulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>31.68</td>
<td>This level is sufficient to cause personnel if unable to reach cover within 20s; however blistering of the skin (second degree burn) is likely; 0: lethality</td>
</tr>
<tr>
<td>12.5</td>
<td>23.75</td>
<td>This level will cause extreme pain within 20 seconds and movement to a safer place is instinctive. This level indicates around 6% fatality for 20 seconds exposure.</td>
</tr>
<tr>
<td>37.5</td>
<td>13.76</td>
<td>This level of radiation is assumed to give 100% fatality as outlined above.</td>
</tr>
</tbody>
</table>
Scenario#5: Toluene Pool Fire

**Basis:** Catastrophic Rupture unloading arm (4") of road tanker and Resultant Pool Fire due to static charge.

<table>
<thead>
<tr>
<th>Basic Input Data</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Stored quantity</td>
<td>10 KL</td>
</tr>
<tr>
<td>Molecular Weight</td>
<td>92.1</td>
</tr>
<tr>
<td>Vapor Density (Air=1)</td>
<td>3.18</td>
</tr>
<tr>
<td>Wind speed</td>
<td>2.03 m/s</td>
</tr>
<tr>
<td>Temperature</td>
<td>Room Temperature</td>
</tr>
<tr>
<td>Pressure</td>
<td>Atmospheric Pressure</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Consequence Results</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiation Level (KW/m²)</td>
<td>Distance (meter) (Category 1.5/F)</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>4</td>
<td>26.21</td>
</tr>
<tr>
<td>12.5</td>
<td>18.78</td>
</tr>
<tr>
<td>37.5</td>
<td>8.57</td>
</tr>
</tbody>
</table>

**Results:**

- 19 meter area in down wind direction is considered as evacuation area.

**Concentration foot prints for Pool Fire of Toluene:**
MITIGATION MEASURES:
- Isolate the source if possible without risk.
- If leakage is small, dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.
- Absorb with DRY earth, sand or other non-combustible material.
- Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift.
- Use water spray to reduce vapors.
- Prevent entry into sewers, basements or confined areas.
- Neutralize the residue with a dilute solution of sodium carbonate.

PREVENTIVE MEASURES:
- A dike will be provided to accommodate the full quantity stored in all the drums.
- Drums will be stored in designated area.
- Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective TLVs.
- Never add water to this product.
- In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label.
- Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, organic materials, metals, alkalis, moisture.
- Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.
- While handling always use face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent.
- Ensure that eyewash stations and safety showers are proximal to the work-station location.
## Risk Assessment

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Activity</th>
<th>Hazard</th>
<th>Possible Circumstances</th>
<th>Existing Control Measures</th>
</tr>
</thead>
</table>
| 1       | Storage  | Environment | Leakage | 1) Cylinder stored in designated area  
2) Shed area provided.  
3) Proper secured storage stand. |
|         |          | Safety  | Fire risk due to static charge and spark | 1) Flammable proof electrical fitting provided.  
2) Permit to work procedure followed.  
3) Naked flame and smoking prohibited  
4) Spark proof tools used.  
5) Natural ventilation available for storage area.  
6) Cylinder key used for open and closed the cylinder valve.  
7) Cylinder color code follow  
8) Spark arrestor provided to all vehicle.  
9) Entry restricted area |
|         |          | Health  | During dispensing solvent may come in contact with body part may leads to injury | 1) Natural ventilation provided for storage area.  
2) Exhaust fans provided in working area. |

Treat according to symptoms (decontamination, vital functions), no known specific antidote, administer corticosteroid dose aerosol to prevent pulmonary odema.
# EHS RISK ASSESSMENT

**Name of Product – Non-Flammable gases (Class 2.2)**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Activity</th>
<th>Hazard</th>
<th>Possible Circumstances</th>
<th>Existing Control Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Storage</td>
<td>Environment</td>
<td>Leakage</td>
<td>1) Cylinder stored in designated area.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2) Shed area provided.</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>3) Proper secured storage stand.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Safety</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Health</td>
<td>Gas exposure</td>
<td>1) Natural ventilation provided for storage area.</td>
</tr>
<tr>
<td></td>
<td>Handling</td>
<td>Environment</td>
<td>Leakage through process Pipeline/Flange joint or equipment</td>
<td>1) PRV system provided in gas distribution system.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2) NRV provided in the system</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>3) Pressure test done before use.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4) Exhaust duct provided connected to scrubber</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Safety</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Health</td>
<td>Gas exposure</td>
<td>1) Toxic gas handling kit available to control leak from cylinder.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2) Gas purging in close loop system</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3) Purging through PRV by controlled rate.</td>
</tr>
<tr>
<td>Sr. No.</td>
<td>Activity</td>
<td>Hazard</td>
<td>Possible Circumstances</td>
<td>Existing Control Measures</td>
</tr>
<tr>
<td>--------</td>
<td>------------------------------</td>
<td>---------------------------------</td>
<td>----------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>1</td>
<td>Solid dispensing</td>
<td>Environment</td>
<td>Solid may get spilled during dispensing</td>
<td>1) Close loop dispensing system provided. 2) Exhaust ventilation provided, connected to scrubber. 3) Dispensing done in dedicated area.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Safety</td>
<td>Fire risk due to static spark or charge</td>
<td>1) Double earthing bonding provided during dispensing. 2) All electrical fittings are flame proof.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Health</td>
<td>Exposure to dust</td>
<td>1) Close solid transfer system provided 2) Appropriate PPE used during sampling and unloading. 3) Dust collectors are provided.</td>
</tr>
<tr>
<td>2</td>
<td>Solid use in process equipment</td>
<td>Environment</td>
<td>Solid may get spill during dispensing</td>
<td>1) Close loop dispensing system provided. 2) Exhaust ventilation provided connected to scrubber. 3) Dispensing done in dedicated area. 4) Point exhaust provided near process equipments those are connected to scrubber.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Safety</td>
<td>Fire risk due to static charge and spark</td>
<td>1) Double earthing bonding provided during dispensing. 2) All electrical fittings are flame proof. 3) Nitrogen blanketing provided to process equipments.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Health</td>
<td>Exposure to dust</td>
<td>1) Close solid transfer system provided 2) Appropriate PPE used during sampling and unloading. 3) Dust collectors are provided.</td>
</tr>
</tbody>
</table>
## EHS RISK ASSESSMENT

### Name of Product – Flammable Solid (Class 4.1) Storage

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Activity</th>
<th>Hazard</th>
<th>Possible Circumstances</th>
<th>Existing Control Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Solid stored in RM stores</td>
<td>Environment</td>
<td>Solid may get spill during storage.</td>
<td>1) Solid stored in double polythene bag in closed tight container.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2) Storage done in dedicated area.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Safety</td>
<td>Fire risk due to static spark or charge</td>
<td>1) Solids stored with proper labeling and in dedicated area.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2) All electrical fittings are flame proof.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Health</td>
<td>Exposure to dust</td>
<td>1) Appropriate PPE used during transportation of flammable solids.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2) Dust collectors are provided.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3) Material handled in closed tight container.</td>
</tr>
</tbody>
</table>

### EHS RISK ASSESSMENT

### Name of Product – Flammable liquids Handling (Class 3)

#### Handling

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Activity</th>
<th>Hazard</th>
<th>Possible Circumstances</th>
<th>Existing Control Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dispensing</td>
<td>Environment</td>
<td>Leakage during dispensing</td>
<td>1) Close loop dispensing system provided.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2) Exhaust ventilation provided connected to scrubber.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3) Spill control kit provided in the dispensing area.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4) Dispensing done in dedicated area.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Safety</td>
<td>Fire risk due to static spark or charge</td>
<td>1) Double earthing bonding provided during dispensing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2) All pumps and fittings are flame proof and CCOE approved.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Health</td>
<td>Vapour exposure during dispensing</td>
<td>3) Activity performed under nitrogen blanketing.</td>
</tr>
<tr>
<td>2</td>
<td>Use in process equipment</td>
<td>Environment</td>
<td>Leakage through process equipment</td>
<td>1) Preventive maintenance done</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2) Hydro testing done for process equipments</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3) Leak test taken before use. 4) Materials handled in process equipments according to compatibility and MOC</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Safety</td>
<td>Fire risk due to static charge and spark</td>
<td>1) Double earthing bonding provided during dispensing. 2) All pumps and fittings are flame proof and CCOE approved.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health</td>
<td>Vapour exposure</td>
<td>1) Close solvent transfer system provided. 2) Appropriate PPE used during sampling and unloading.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Storage</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Solvents stored I tank farm</td>
<td>Environment</td>
<td>Leakage of tank and connecting pipes 1) Exhaust ventilation provided connected to scrubber. 2) Spill control kit provided in the dispensing area. 3) Dispensing done in dedicated area.</td>
<td></td>
</tr>
<tr>
<td>Safety</td>
<td>Fire risk due to leakage</td>
<td></td>
<td>1) Double earthing bonding provided to tanks. 2) All pumps and fittings are flame proof.</td>
<td></td>
</tr>
<tr>
<td>Health</td>
<td>During sampling and unloading solvent may come in contact with body part may lead to injury</td>
<td></td>
<td>1) Close solvent transfer system provided 2) Appropriate PPE used during sampling and unloading.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Solvent in drums</td>
<td>Environment</td>
<td>Solvent may leak from the drums in shed 1) Drain point of drum shed isolated with valve and through pit it is connected to leached collection tank. 2) Solvent drums stored in rack for protection from wear and tear, corrosion.</td>
<td></td>
</tr>
<tr>
<td>Safety</td>
<td>Fire risk due to leakage</td>
<td></td>
<td>1) Only intact drums kept in drum shed 2) For solvent drum movement stacker is provided 3) All electrical equipment in this shed is flame proof. 4) Appropriate fire extinguishers are provided in storage area.</td>
<td></td>
</tr>
<tr>
<td>Sr. No.</td>
<td>Activity</td>
<td>Hazard</td>
<td>Possible Circumstances</td>
<td>Existing Control Measures</td>
</tr>
<tr>
<td>--------</td>
<td>----------------</td>
<td>-------------------</td>
<td>---------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| 1      | Liquid dispensing | Environment       | Liquid may leak during dispensing and thus lead to land and water pollution           | 1) Close loop dispensing system provided.  
2) Exhaust ventilation provided connected to scrubber.  
3) Spill control kit provided in the dispensing area.  
4) Dispensing done in dedicated area.  |
|        | Safety          | Fire risk due to static spark or charge                                             |                                                                                                                                                    | 1) Double earthing bonding provided during dispensing.  
2) All pumps and fittings are flame proof and CCOE approved. |
|        | Health          | Vapour exposure during dispensing                                                  |                                                                                                                                                    | 1) Appropriate PPE used during sampling and unloading.  
2) Exhaust ventilation provided.  
3) Closed loop dispensing provided to avoid human contact |
| 2      | Use in process  | Environment        | Leakage through process equipment                                                   | 1) Preventive maintenance done                                                                                                                                   |

**EHS RISK ASSESSMENT**

Name of Product – Toxic (Class 6.1)

Liquid Handling

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Activity</th>
<th>Hazard</th>
<th>Possible Circumstances</th>
<th>Existing Control Measures</th>
</tr>
</thead>
</table>
| 3      | Solvents stored in Day storage Tanks | Environment       | Leakage                                                                              | 1) Day storage tanks are installed in concrete dyke wall  
2) Digital level indicator provided.  
3) Level indicators interlinked with pump through interlock to avoid overflow of tank. |
|        | Safety          | Fire risk due to static charge and spark                                             |                                                                                                                                                    | 1) Flame arrestor provided  
2) Double earthing bonding provided to tanks  
3) All pumps and fittings are flame proof and CCOE approved.  
4) Secondary valves provided to each tank. |
|        | Health          | Solvent may come in human contact during loading/unloading                          |                                                                                                                                                    | 1) Close solvent transfer system provided  
2) Appropriate PPE used during loading and unloading. |
| equipment | 2) Hydro testing done for process equipments  
3) Leak test taken before use.  
4) Materials handled in process equipments according to compatibility and MOC  
5) Scrubber facility provided to process equipments and elephant hose scrubber point exhaust provided.  
6) Spill kit provided in department. |
| --- | --- |
| Safety | Fire risk due to static charge and spark  
1) Double earthing bonding provided during dispensing.  
2) All pumps and fittings are flame proof and CCOE approved. |
| Health | Liquid may come in human contact during dispensing  
1) Close solvent transfer system provided.  
2) Appropriate PPE used during sampling and unloading. |
| **Solid Handling** | |
| 1 Solid dispensing | Environment | 1) Formation of dust  
2) Dust spillage  
1) Close loop dispensing system provided.  
2) Exhaust ventilation provided connected to scrubber.  
3) Dispensing done in dedicated area.  
4) Scrubber point exhaust and dust collector provided. |
| | Safety | Fire risk due to leakage  
1) Earthing bonding provided during dispensing.  
2) All pumps and fittings are flame proof. |
| | Health | During dispensing solid may come in contact with body part may leads to injury and irritation  
1) Close loop liquid dispensing system provided  
2) Appropriate PPE used during sampling and unloading  
3) Exhaust ventilation provided |
| 2 Solid handling in process equipment | Environment | Spillage through process equipment  
1) Materials handled in process equipments according to compatibility and MOC  
2) Scrubber facility provided to process equipments and elephant hose scrubber point |
| Safety | Fire risk due to leakage | 1) Earthing bonding provided during dispensing. 2) All pumps and fittings are flame proof and CCOE approved. |
| Health | During solid material handling dust of material may come in contact with body part may leads to injury. | 1) Appropriate PPE used during sampling and unloading. 2) General ventilation provided in working area. 3) Annual medical health check up carried out by approved certifying surgeon. |

### Storage to Toxic Liquids

| 1 | Solvents stored in Day storage Tanks | Environment | Liquid may leak during storage and thus lead to air, land and water pollution | 1) Toxic liquid chemicals stored in designated area. 2) Drain of area connected to latchet collection tank. 3) Acid alkali proof tiles floor provided in that area. 4) Shed area provided. |
| Safety | Fire risk due to static charge and spark | 1) Materials stored according to compatibility in designated place. 2) All electrical equipments in that area are flame proof |
| Health | Vapour exposure | 1) Materials kept in closed tight containers. 2) Shed area provided 3) Appropriate PPE used. |

### Storage to Toxic Solids

<p>| 1 | Storage | Environment | Spillage and dust generation. | 1) Solid materials kept in double polythene bag in a closed tightly container. 2) Drums stored in metal rack provided with railing. 3) Clod storage room available for specific materials. |
| Safety | Fire risk due to static charge and spark | 1) Materials stored according to compatibility in designated place. 2) All electrical equipments in that area are flame proof |</p>
<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Activity</th>
<th>Hazard</th>
<th>Possible Circumstances</th>
<th>Existing Control Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Liquid dispensing</td>
<td>Environment</td>
<td>Liquid leakage / spillage during dispensing</td>
<td>1) Close loop dispensing system provided. 2) Exhaust ventilation provided connected to scrubber. 3) Spill control kit provided in the dispensing area. 4) Dispensing done in dedicated area. 5) Scrubber exhaust system provided for area.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Safety</td>
<td>Fire risk due to static spark or charge</td>
<td>1) Double earthing bonding provided during dispensing. 2) All pumps and fittings are flame proof and CCOE approved. 3) Charging under nitrogen blanketing.</td>
</tr>
<tr>
<td>2</td>
<td>Use in process equipment</td>
<td>Environment</td>
<td>Leakage through process equipment</td>
<td>1) Close loop dispensing system provided. 2) Exhaust ventilation provided connected to scrubber. 3) Spill control kit provided in the dispensing area. 4) Dispensing done in dedicated area. 5) Scrubber exhaust system provided for area.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Safety</td>
<td>Fire risk due to static charge and spark</td>
<td>1) Double earthing bonding provided during dispensing. 2) All pumps and fittings are flame proof and CCOE approved.</td>
</tr>
</tbody>
</table>
### Health Exposure to fumes

1. Close loop system for dispensing provided.
2. Appropriate PPE used during sampling and unloading.
3. General ventilation provided.

### Storage of Corrosive Liquid

|   | Storage Environment | Water/ land / air pollution because of leakage and spillage of container | 1) Corrosive liquid chemicals stored in designated area.
2) Drain of area connected to leachet collection tank.
3) Acid alkali proof tiles floor provided in that area.
4) Shed area provided. |
|---|---------------------|--------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
|   | Safety Environment  | Fire risk due to static charge and spark | 1) Materials stored according to compatibility in designated place.
2) All electrical equipments in that area are flame proof |
|   | Health Environment  | Vapor exposure | 1) Close loop liquid dispensing system provided
2) Appropriate PPE used during sampling and unloading.
3) Exhaust ventilation provided |
| 2 | Solid handling in process equipment Environment | Spillage through process equipment | 1) Materials handled in process equipments according to compatibility and MOC
2) Scrubber facility provided to process equipments and elephant hose scrubber point exhaust provided.
3) Dust collectors provided. |
|   | Safety Environment  | Fire risk due to leakage | 1) Earthing bonding provided during dispensing. 2) All pumps and fittings are flame proof and CCOE approved. |
|   | Health Environment  | During solid matrial handling dust of material may come in contact with body part may leads to injury. | 1) Appropriate PPE used during sampling and unloading.
2) General ventilation provided in working area.
3) Annual medical health check up carried out by approved certifying surgeon. |

### Storage to Toxic Liquids
<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Activity</th>
<th>Hazard</th>
<th>Possible Circumstances</th>
<th>Existing Control Measures</th>
</tr>
</thead>
</table>
| 1      | Dispensing                        | Environment             | Leakage                                                                              | 1) Close loop dispensing system provided.  
2) Exhaust ventilation provided, connected to scrubber.  
3) Dispensing done in dedicated area.                                                                                                                                  |                                                                                                                                                                                                                           |
|        |                                   | Safety                  | Fire risk due to static spark or charge                                               | 1) Double earthing bonding provided during dispensing.  
2) All pumps and fittings are flame proof and CCOE approved.  
3) Activity performed under nitrogen blanketing.                                                                                                                                 |                                                                                                                                                                                                                           |
|        |                                   | Health                  | Vapour exposure                                                                       | 1) Appropriate PPE used during sampling and unloading.  
2) Exhaust ventilation provided.                                                                                                                                                                                                 |                                                                                                                                                                                                                           |
| 2      | Use in process equipment          | Environment             | Leakage through process equipment                                                     | 1) Preventive maintenance done  
2) Hydro testing done for process equipments  
3) Leak test taken before use.  
4) Materials handled in process equipments according to compatibility and MOC                                                                                                                                               |                                                                                                                                                                                                                           |
|        |                                   | Safety                  | Fire risk due to static charge and spark                                              | 1) Double earthing bonding provided during dispensing.  
2) All pumps and fittings are flame proof and CCOE approved.                                                                                                                                                                      |                                                                                                                                                                                                                           |

EHS RISK ASSESSMENT

Name of Product – Miscellaneous (Class 9.0)

Handling

Solvents stored in Day storage Tanks

Environment

Liquid may leak during storage and thus lead to air, land and water pollution

1) Toxic liquid chemicals stored in designated area.
2) Drain of area connected to latchet collection tank.
3) Acid alkali proof tiles floor provided in that area.
4) Shed area provided.

Safety

Fire risk due to static charge and spark

1) Materials stored according to compatibility in designated place.
2) All electrical equipments in that area are flame proof

Health

Vapour exposure

1) Materials kept in closed tight containers.
2) Shed area provided
3) Appropriate PPE used.
3) Before charging such chemicals in process equipment, equipment ensured for dryness and moisture free.

| Health | Vapour exposure | 1) Appropriate PPE used during sampling and unloading.  
  2) Exhaust ventilation provided. |

### Storage

|   | Stored in drums | Environment | Solvent may get leakage from drums. | 1) Stored in separate water reactive storage area.  
  2) Exhaust ventilation provided in that area.  
  3) Spill control kit and vermiculate kept in that room for spill control. |
|---|----------------|-------------|-------------------------------------|--------------------------------------------------------------------------------------------------|
| Safety | Fire risk due to leakage | 1) Only intact drums kept in store  
  2) For solvent drum movement stacker is provided  
  3) Stored in cool and dry place. |
| Health | Material may come in contact with body part | 1) Appropriate PPE used.  
  2) Exhaust ventilation provided in that area. |
6.1.6 PRELIMINARY HAZARD ANALYSIS

<table>
<thead>
<tr>
<th>Extremely Flammable Liquids</th>
<th>Flash Point &lt; 23°C &amp; Boiling Point &lt; 35°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Highly Flammable Liquids (Class A)</td>
<td>Flash Point &lt; 23°C &amp; Boiling Point &gt; 35°C</td>
</tr>
<tr>
<td>Highly Flammable Liquids (Class B)</td>
<td>Flash Point 23°C to 60°C</td>
</tr>
<tr>
<td>Flammable Liquids (Class C)</td>
<td>Flash Point 60°C to 90°C</td>
</tr>
</tbody>
</table>

**Major Hazards from Storage**

**Ethylene Oxide**

About 20 tons of this highly flammable chemical is stored in two storage tanks under Nitrogen pressure. Boiling point of EO is 10.7°C, disaster can occur by leakage from storage. The escaped vapours can travel in the nearby areas and cause toxicity and fire in the vicinity. There can be BLEVE under certain circumstances that can blow up EO tank with a fire ball. The toxic and flammable vapours can travel along the ground to a distance and cause toxicity or fire damaging environment, property, life etc.

Various facilities in the storage areas which will be provided are as follows:

- All safety provisions as per SMPV rules and regulations.
- One storage tank will always be empty for emergency transfer of material.
- Dykes provided.
- Gas detectors are installed at various locations.
- Manual sprinkler system is provided to all storage tanks.
- Isolated storage area with fencing, two gates with lock and key arrangements; only authorized persons are allowed inside the fenced areas, only the trained people do all critical operations.
- All storage tanks are provided with pressure, temperature and level indicator cum transmitter. The signals of pressure, temperature and level are transmitted to the control room where they are connected to indicating controllers, which in turn are connected to an “Annunciation Unit”.

6-50
All the tanks are provided with cooling coils to keep the temperature of the content below 10°C, similarly all tanks are provided with Nitrogen connection to give inert gas blanketing, EO is kept under 6 kg/cm² pressure.

All the vents of the tanks are connected to water scrubber and the vent is let to atmosphere through a flame arrester.

All the electrical switchgears and fittings in this area are flameproof type.

Propylene Oxide
Maximum quantity stored at a time is 25 tons. Other safety facilities are provided like EO tanks as it is stored along with EO.

Styrene Monomer
This can polymerize in absence of proper inhibitor and lead to explosion. The vapours are toxic and flammable. The drums in storage are provided with water flooding arrangement.

‘Class A’ Godown
Acetone, Acrylonitrile, Isopropyl alcohol, Benzene, Toluene, Acrylic Acid, Methyl Acrylate, Methanol, Methyl methacrylate etc. will be stored in ‘Class A’ godown that conform to PESO requirements as per the Petroleum Rules. It will be situated in isolated area to avoid spread of fire in case it takes place. Fire fighting arrangements has been made for this godown.

Underground Tank Farm
o-Xylene/ mixed Xylene and Toluene will be stored in the underground storage tank as per Petroleum Rules. Though these are flammable chemicals, the chances of fire in underground tanks are very remote. All electrical switchgears, motors will be of flameproof type and tanks/pipelines will be adequately bonded/ earthed.

Flammable, Explosive Material Storage
A small quantity of raw materials stored on the production floor can prove dangerous in case of small fire or spillage during material handling.
Most of the other chemicals are in a liquid state and will be stored in properly sealed barrels. They will be kept on wooden pallets and stacked maximum 2 tier in the stores (open shed).
Major Hazards from Processing

EO/PO Condensation Reaction

The raw material is charged in the reactor and heated to 150°C to 155°C. The pressure in the reactor is 3 kg/cm². At 150°C, the EO/PO are introduced into the reactor. The temperature during the reaction is controlled between 160°C to 170°C by means of oil cooling. The reaction is exothermic in nature.

Likely Hazards:
The leakage occurring during the reaction will have the dissolved EO if any, in the liquid phase. The EO/PO is introduced in the reactor in the liquid form, in case of leakage on the line from the storage tank to the reactor, the main valve on the storage tank outlet will have to be closed. This can be operated remotely (pneumatically).

Conditions to be avoided

i. High temperature and pressure in the reactor during process.

ii. Possibility of heat or flame source.

iii. Possibility of generation of spark.

Reactions involving solvent

Following reactions fall under this category:

i. Pour Point Depressant

ii. Pesticide Emulsifier

iii. Miscellaneous Surfactants

The reactors are designed accordingly where above reactions are taken. All the safety measures are taken during solvent handling, charging and necessity safety provisions are made to the reactor, likely flameproof motor, bonding and earthing.

Conditions to be avoided:

Generation of open flame and contact with sparks.

In pesticide Emulsifiers and miscellaneous surfactants actually there is no reaction taking place in the process. The process is carried out at an atmospheric pressure initially and under vacuum at the end.
Polymerization Reaction

It consists of different type of Acrylates, Styrene, Monomers, Formaline etc. All the reactions are exothermic and run away type if not controlled properly. Escape of toxic phenol and formaldehyde vapours is possible through safety valve release when over pressurized. Proper implementation of SOP and material control can avoid accident. In the phenol formaline reactions, escape of toxic fumes of phenol and formaldehyde by bursting or over pressurizing of reaction vessel is possible as the reaction is exothermic. Proper weighing of all raw materials and strictly following of SOP will avoid dangers.

Sulphonation Reactions

Molten Sulphur is burnt and converted to SO\(_2\) which by a catalyst is converted in to SO\(_3\). This SO\(_3\) is used as sulphonating agent for raw material to produce sulphonated products. The reaction is mildly exothermic and no possibility of runaway reaction. The leakage of SO\(_2\), SO\(_3\) can be detected easily because of its smell, under such cases, the plant can be shut down immediately and the leak can be repaired. The exit gases/ unreacted gases are scrubbed with dilute alkali to avoid any atmospheric discharge of vapour or gases. Hazard associated are leakages of SO\(_2\), SO\(_3\), and Oleum and spillage of Oleum. Possibility of Oleum leakage and spillage is very remote. However, portable suction and scrubber is kept handy to absorb leaking gases. People working in that area wear suitable PPEs. Emergency procedure in case of Oleum leak is well known and people are well trained to respond in such case.

6.1.7 RISK ASSESSMENT SUMMARY

- From the Risk Assessment studies conducted, it would be observed that by and large, the risks are confined within the factory boundary walls.
- Based on these studies company has been proposed to plan its facility sitting as well as location of operator cabin, open area, etc.
- Company has to increase awareness programme in the surrounding vicinity and educate people for safe evacuation at the time of toxic release.
- A HAZOP study to be carried out for all product plant and storage facilities.
- Induction safety course to be prepared and trained all new employees before starting duties in plant.
6.1.7.1 PROCESS SAFETY

- Safety measures will be adopted from the design stage.
- Safety Valve and pressure gauge will be provided on reactor and its jacket (if jacket is provided).
- Utility like Chilling, cooling, vacuum, steaming and its alternative will be provided to control reaction parameters in a safe manner.
- Free Fall of any flammable material in the vessel will be avoided.
- Static earthing provision will be made at design stage to all solvent handling equipments, reactors, vessels & powder handling equipments.
- Any reaction upsets will be confined to the reaction vessel itself.
- All emergency valves and switches and emergency handling facilities will be easily assessable.
- Further all the vessels will be examined periodically by a recognized competent person under the Gujarat Factory Rules.
- All the vessels and equipments will be earthed appropriately and protected against Static Electricity. Also for draining in drums proper earthing facilities will be provided.
- Materials will be transferred by pumping through pipeline or by vacuum from drums.
- All solvents and flammable material storage tanks will be stored away from the process plant and required quantity of material will be charge in reactor by pump.
- Jumpers will be provided on all solvent handling pipeline flanges.
- Caution note, safety posters, stickers, periodic training & Updation in safety and emergency preparedness plan will be displayed and conducted.
- Flame proof light fittings will be installed in the plant.
- All the Plant Personnel will be provided with Personal Protection
- Equipments to protect against any adverse health effect during operations, leakage, spillages or splash. PPE like Helmets, Safety Shoes, Safety Glasses, Acid-Alkali Proof Gloves etc. will be provided to the employees.
- All employees will be given and updated in Safety aspects through periodic training in safety.
- Material Safety Data Sheets of Raw Materials & Products will be readily available that the shop floor.
6.1.7.2 FOR HAZARDOUS STORAGE TANK FARM

- Tank farm will be constructed as per explosive department requirement and separation distance will be maintained.
- Tanks shall be located and marked in designated area of hazardous chemical storage.
- Static earthing provision will be made for road tanker as well as storage tank.
- Tanks of proper MOC will be selected.
- Flame arrestor with breather valve will be provided on vent line.
- Road tanker unloading procedure will be prepared and implemented.
- Fire load calculation will be done and accordingly fire load Hydrant System will be provided as per NFPA std. and Fire extinguishers will be provided as per fire load calculation.
- Spark arrestor will be provided to all vehicles in side premises.
- Flame proof type equipments and lighting will be provided.
- Lightening arrestor will be provided on the top of chimney.
- Trained and experience operator will be employed for tank farm area.
- NFPA label (hazard identification) capacity and content will be displayed on storage tank.
- Solvents will be transferred by pump only in plant area and day tank will be provided. Overflow line will be return to the storage tank or Pump On-Off switch will be provided near day tank in plant.
- Jumpers will be provided on solvent handling pipe line flanges.
- Flexible SS hose will be used for road tanker unloading purpose and other temperature connection.
- All tanks shall be uniformly tagged.
- Level indicator shall be provided in tanks.
- Dyke will be provided.
- Industrial type electric fittings shall be provided.
- Adequate fire fighting equipments will be provided.
- Anti corrosive paint shall be done.
- Safety instruction board will be displayed.
6.1.7.3 FOR DRUM/CARBOY STORAGE AREA

Some chemicals will be received at plant in drums/Carboys by road truck and stored in a drum/Carboy storage area.

- FLP type light fittings will be provided.
- Proper ventilation will be provided in godown.
- Proper label and identification board /stickers will be provided in the storage area.
- Conductive drum pallets will be provided.
- Drum handling trolley / stackers/fork lift will be used for drum handling.
- Separate dispensing room with local exhaust and static earthing provision will be made.
- Materials will be stored as per its compatibility study and separate area will be made for flammable, corrosive and toxic chemical drums storage.
- Smoking and other spark, flame generating item will be banned from the Gate.

6.1.7.4 TRANSPORTATION

- Road tanker unloading procedure will be in place and will be implemented for safe unloading of road tanker.
- Static earthing provision will be made for tanker unloading.
- Earthed Flexible Steel hose will be used for solvent unloading from the road tanker.
- Fixed pipelines with pumps will be provided for solvent transfer up to Day tanks/reactors.
- Double mechanical seal type pumps will be installed.
- NRV provision will be made on all pump discharge line.

6.1.7.5 OTHER RISK REDUCTION OPPORTUNITIES

The following opportunities shall be considered as a potential means of reducing identified risks during the detailed design phase:

- Buildings and plants structures shall be designed for cyclone floods and seismic events to prevent structural collapse and integrity of weather (water) proofing for storage of goods;
• Provision for adequate water capacity to supply fire protection systems and critical process water;

• Isolate people from load carrying/mechanical handling systems, vehicle traffic and storage and stacks locations;

6.1.8 RECOMMENDATIONS FOR ALARP
The following actions are particularly recommended to be implemented in order to ensure ALARP (As Low As reasonably practical) performance in the operation: Maintain and ensure effectiveness of all the safety measures, among others through the following actions:

Raw Material Storage Area
- The raw material storage area should be declared as a prohibited area and should be provided having at least two exits, “No Smoking” and “Prohibited Area” display boards, as applicable should be provided at site.
- Regular inspection of tanks/drums/carboys containing raw material to be done to take care.
- Periodic site inspection should be carried out to ensure that there is no leakage from any of the drums in the warehouse.
- Fire hydrant system needs to be provided in storage area as per TAC standards.
- Smoke detector and fire alarm systems need to be provided.
- Provision of fire doors in warehouse area.

Fire access for Tank Farm area and Warehouses
- Fire access roads should be provided to storage area. The storage tanks/area should have suitable fire protection and fire fighting facility.

The following features are also important for the project by taking the layout into consideration:-
• Hinged doors swing outward in an explosion.
• Window panes (if installed) are shatterproof or plastic in frame.
• Floors, walls and ceilings are designed and installed to limit the generation and accumulation of static electricity.
• All doors must be fire resistant. Floors, walls and ceilings are designed for at least 2 h of fire resistance.
• Walls or partitions are continuous from floor to ceiling, and securely anchored.
• Integrity of the wall should be ensured i.e. blast wall not to be broken or drilled as that can leads to weak spots.
• The building is constructed of non-combustible materials, on a substantial frame.
• Restrained deflagration vent panels are present.
• There is adequate ventilation, and any heating in rooms is limited to steam, hot water, or other indirect means.

**Electrical Safety for Whole Facility**

• Electrical Safety: All cables and electric fittings shall be constructed, installed, protected, operated and maintained in such a manner so as to prevent risk of open sparking.

**6.1.9 FIRE FIGHTING SYSTEM**

M/s. DIKL management will take into consideration fire prevention measures at the project planning and during plant commissioning stage to avoid any outbreak of fire. But looking to the hazardous nature of process and the chemicals that are handled and processed, the chances of outbreak of fire cannot be totally ignored. Hence to tackle such a situation a good well laid fire protection system will be provided in the factory. Details of fire fighting are given in Table 6.3.
TABLE 6.4
PROPOSED FACILITIES TO BE MAINTAINED FOR FIRE FIGHTING:

List of Portable Fire Extinguishers

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Location</th>
<th>CO2 type with Capacity</th>
<th>DCP Ext. with Capacity</th>
<th>Foam Ext. with Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Total</td>
<td>Total</td>
</tr>
<tr>
<td>1</td>
<td>Main Gate</td>
<td>2x2kg, 2kg</td>
<td>2 5kg</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Admin</td>
<td>6.8 kg, 2kg</td>
<td>2 2x5kg, 1kg</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>ERC</td>
<td>2x6.5kg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>QCL</td>
<td>2kg, 6.5kg, 6.8kg</td>
<td>3 5kg</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Pilot Plant</td>
<td></td>
<td>5kg</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>Sulfonation Plant</td>
<td>6.5kg, 6.8kg</td>
<td>2 3x5kg</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>Canteen</td>
<td>2kg</td>
<td>2 5kg</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>Liquid Nirogen Area</td>
<td></td>
<td>2x10</td>
<td>2</td>
</tr>
<tr>
<td>11</td>
<td>Plant - 1 (EO)</td>
<td>6.8kg, 2x2kg, 6.5kg</td>
<td>4 2x5kg</td>
<td>2</td>
</tr>
<tr>
<td>12</td>
<td>Plant - 2 (EO)</td>
<td>3x22.5, 6.8kg</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Plant - 3 (PPD)</td>
<td>2x22.5kg, 6.5kg, 6.8kg</td>
<td>4 5kg,</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td>Plant - 4 (PPD)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Plant - 5 (MP)</td>
<td>22.5kg</td>
<td>1 4x10kg</td>
<td>4</td>
</tr>
<tr>
<td>16</td>
<td>Work Shop</td>
<td>22.5kg, 2x6.5kg</td>
<td>3 2x5kg</td>
<td>2</td>
</tr>
<tr>
<td>17</td>
<td>Class A Godown</td>
<td></td>
<td>2x5kg</td>
<td>2</td>
</tr>
<tr>
<td>18</td>
<td>R.M. Stores</td>
<td>2x6.8kg</td>
<td>2 5kg, 3x12kg, 22kg,</td>
<td>5 5x9kg</td>
</tr>
<tr>
<td>19</td>
<td>F.P. Stores</td>
<td>2x5kg, 3x10kg</td>
<td>5 3x9kg</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Boiler House</td>
<td>2x10kg, 4x5kg</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>UG Tankfarm</td>
<td>2x10kg</td>
<td>2 9kg (chemical)</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>EO/PO Tankfarm</td>
<td>2x10kg</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Material Gate 1</td>
<td>9kg</td>
<td>1 2x10</td>
<td>2</td>
</tr>
<tr>
<td>24</td>
<td>Material Gate 2</td>
<td>9kg</td>
<td>1 2x10</td>
<td>2</td>
</tr>
<tr>
<td>25</td>
<td>Power House</td>
<td>9kg,</td>
<td>1 10kg</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>Total 34</td>
<td>Total 20</td>
<td>Total</td>
</tr>
</tbody>
</table>

Other fire fighting facilities proposed to be installed at site:

- Fire load calculation will be carried out and Fire Extinguishers at different locations will be provided (as mentioned in above table) as per the TAC guidelines.
- Working staff will be given training to operate DCP and CO₂ extinguishers.
- Fire Hydrant Network will be installed as per the calculated requirement for fire fighting.
- A main fire pump with a capacity of 50 M3/Hr @ 10 Bar/cm² will be installed.
- A stand-by diesel pump with equal capacity (50 M3/Hr @ 10 Bar/cm²) will be installed. This pump will be used for fire fighting in case of power failure.
- A fire water reservoir with holding capacity of 300 m³ of water shall be provided.
- First Aid Training will be imparted to employees by designated first aid trainers.
6.2 DISASTER MANAGEMENT PLAN

M/s. DIKL will develop the emergency management system to tackle the emergency situation, apart from its emergency management system. The detail of disaster management system is discussed in the following section.

6.2.1 DEFINING THE NATURE OF EMERGENCY

6.2.1.1 LEVEL OF EMERGENCY CAN BE CLASSIFIED IN THREE CATEGORIES.

LEVEL - 1:
The leakage or emergency, which is confinable within the plant, premises. It may be due to -

a) Small fire in the plant
b) Low toxic gas release for short duration.
c) Collapsing of equipment that do not affect outside premises.

LEVEL - 2:
The emergency, which is confinable within the factory premises. It may arise due to -

a) Major fire inside the factory premises.
b) Medium scale explosion confined to the factory premises.
c) Heavy toxic / flammable gas leakage for short duration.

LEVEL - 3:
The emergency, which is not confinable within the factory premises and general public in the vicinity likely to be affected. It may arise due to -

a) Explosion of high magnitude affecting the adjacent area
b) Heavy / Profuse leakage of toxic / flammable gases for a long duration.

6.2.2 OBJECTIVES OF EMERGENCY MANAGEMENT SYSTEM

The objectives of the emergency management system are summarized as under.

• To identify and assess types of emergencies due to different types of hazards.
• To work out plan with all provisions to handle emergencies and safeguard employees and people in the vicinity of the factory.
• To provide for emergency preparedness and the periodical rehearsal of the plan.
• To plan mode of proper communication and actions to be followed in the event of emergency.

• To keep all necessary information with respect to hazard/accident control and emergency contacts in one document for easy and speedy reference.

• To inform employees, general public and the authorities about the hazards/risk if any and the role to be played by them in the event of emergency.

• To control and contain the accident.

• To effect rescue and treatment of casualties.

• To inform and help relatives of casualties.

• To secure rehabilitation of affected area and restore normalcy.

• To provide information to media and government agencies.

• To preserve record, equipment etc. for investigating cause of emergency.

• To be ready for “mutual aid” if need arises to help neighboring units.

6.2.3 STRUCTURE OF EMERGENCY MANAGEMENT SYSTEM

M/s DIKL shall develop an emergency management team. The management structure includes the following personnel’s;

• Chief Emergency Controller

• Incident Controllers and Deputy Incident Controllers

• Site Main Controllers

• Key Personnel’s

• Essential Workers

• Assembly points

• Emergency control center

• Fire control arrangements

• Medical arrangements

• Other arrangements

6.2.3.1 CHIEF EMERGENCY CONTROLLER

He will be Chief Manager in his absence, the Plant Supervisor will be the Chief Controller till any one of the designated Manager arrives at Site and assumes overall charge of the
situation. His task will be to co-ordinate all internal and external activities from the Emergency Control Centre at Main Security Gate from where all operations will be directed. He shall:

1. Immediately on being informed of the emergency and its location, will arrive at the scene & handle the situation.
2. Relieve the Incident Controller from responsible of the Main Controller.
3. Co-ordinate to avail services from external agencies like fire brigade, hospitals etc, if called for, following the declaration of major emergency. If necessary, major installations in the vicinity may also be informed of the situation.
4. Exercise direct operational control of the unaffected section of the plant.
5. In consultation with the advisory team, expedite the shutting down of loading / unloading operations of tankers and if necessary, instruct the supervisor / security personnel to evacuate tankers.
6. Ensure that all employees are evacuated from the affected area and the casualties, if any, are given necessary medical attention. Instruct P & A Assistant / Security for rushing casualties to hospitals if required.
7. Liaise with fire and police officials, pollution control board officials and other statutory bodies and advise them of all possible consequence effects outside the premises.
8. Arrange for relief of personnel when emergency is prolonged.
10. Ensure preservation of evidence for enquiries to be conducted by statutory authorities.
11. Authorize the sounding of “All Clear” and “Evacuation Siren”.
12. Arrange for obtaining the head – count of all personnel within the premises and cross-checking with the data from records available for no. of persons within the premises.
13. Nominate a person from advisory team, to maintain chronological log of event during the entire period of emergency.
6.2.3.2 INCIDENT CONTROLLER AND DEPUTY INCIDENT CONTROLLER

His primary duties are to take charge at the scene of the incident. In the initial stage he may be required to take decisions involving the operation of the other plants or to stop or continue any process and to take technical decisions to control the incident. The deputy incident controller should take the charge of incident controller, if he is not available due to any reason. As our factory is running 24 hrs, so each plants shift in charge are being nominated as I.C (after 'G' Shift) and they will be always available in the shift and can take charge till the arrival of IC.

Responsibilities/Duties of Incident Controller and Deputy Incident Controller:

- He shall take charge at the scene of incident.
- He may be required to take decisions whether to stop or continue any Process and take a control the incident or to isolate affected area of the plant and simultaneously inform / consult senior officers as per requirement.
- He shall immediately assess the gravity of risk and alert panel and field operators to start controlling their respective section.
- After assessing the level of emergency likely to exist, he shall ad emergency. As per the assessment of risk, if necessary inform concerned Senior Officer to declare major emergency and active on-site/off site emergency plan accordingly. As Per the situation ensure that Site Main Controller (SMC) will be informed.
- He will work under the direction of the SMC, but till his arrival he may have to execute following responsibilities.
- Ensure that all the Key Personnel are called.
- Direct for evacuation of plant and areas likely to be affected by the emergency.
- He shall communicate to the SMC the type of outside help needed.
- He shall direct all emergency operations within the affected area with the following priorities.
  - Personnel safety, including of surrounding community.
  - Minimum damage to Plant, Property and Environment.
  - Appropriate actions to minimize loss of Production and Material.
• Give information to the head of fire fighting and rescue team and other emergency services.
• Depending on the incident, instruct partial or total shut down, isolations, depressurization, Nitrogen purging, fire fighting, rescue operations.
• Instruct upstream/down stream units to take emergency shut down /cutting off supply and other appropriate actions and emergency evacuation help etc.
• Direct for search of casualties.
• Evacuate non-essential workers/visitors/contractors to safe assembly points.
• Brief site main controller and keep him informed about the developments.
• Pressure evidences. This will be necessary for investigation for cause and concluding preventive measures.
• Send runners, if telephones are out of order.

6.2.3.3 SITE MAIN CONTROLLER
He will have an overall responsibility for directing operations & calling outside help from Emergency Control Centers. He is required to take decisions after consultation with the Senior Manager available at site.

The Shift Engineer of non-affected Plant will act as SMC till arrival of the designated SMC at Emergency Control Centre (ECC). Until the arrival of SMC, he may have to execute following responsibilities.
• As soon as he received the information or comes to know about the incident, he shall proceed to Emergency Control Room (Control Room) and shall take charge of the incident. If Control Room gets affected due to unfavorable wind direction, Fire Control Room shall be used as alternate Emergency Control Room.
• He has overall responsibility for directing emergency action, operation and calling outside help.
• He shall ensure that all the Key Personnel are called.
• He shall assess the gravity of situation with the help of Incident Controller (IC), Plant Manager and Key Personnel and after quickly assess the situation, shall find out the of emergency from Incident Controller (IC), and declare the emergency.
• Level-1: Emergency - may be handled within the plant premises.
• Level-2: Emergency - On Site Emergency plant shag be activated.
• Level-3: Emergency - Action to be taken to operate Off-Site Emergency Plan.
• He shall direct all emergency operations within the affected area with the following priorities.
  • Personnel safety, including of surrounding community.
  • Minimum damage to Plant, Property and Environment.
  • Appropriate actions to minimize loss of Production and Material.
• He shall direct for evacuation of plant and areas likely to be affected by the emergency.
• He shall continuously review and assess possible developments to determine most probable course of events and actions.
• He shall assess the situation and ensure that whatever resources needed is made available and utilized in a co-ordinate manner.
• He shall direct the safe shut down of plants in construction with incident controller and Key Personnel, if necessary.
• He shall check that all non-essential workers, visitors, contractors are evacuated to safe assembly points and head count is completed.
• He shall give instructions to the Incident controllers, Fire fighting and Rescue teams.
• He shall, if necessary arrange for evacuation of neighboring population.
• He shall ensure that search for casualties, within the affected area has been carried out and arrange for hospitalization of victims and additional medical help, if required.
• He shall ensure that liaison will be made with outside agencies such as Police Services, Fire Services, Expert on Health and Safety, Meteorological Office, District Emergency Authorities, Collector and Senior Inspector of Factories. Provide advice on possible effects to areas outside the factory.
• He shall arrange for up to date records of emergencies.
• He shall advice not to re-start the plants unless it is declared safe to start by competent authorities.
6.2.3.4 KEY PERSONNELS

Key Personnel are required to provide and to implement the decisions made by the SMC in the light of information received on the developing situation at the time of emergency. As necessary, they will decide the actions needed to shutdown plants, evacuate personnel, carryout emergency engineering work, arrange for supplies of equipments, utilities, carryout environment monitoring, provide catering facilities, liaise with police, fire brigade and other local authorities, relative of casualties, hospital, press & neighboring industries. Action at assembly points, outside shelters and mutual aid center under the direction of the SMC. All the key personnel and other called in so to assist shall report to the ECC. They shall be available at any time on duty or on call or on oil duty or holiday.

6.2.3.5 ESSENTIAL WORKERS

A task force of essential trained workers (expert’s team) is available to get the work done by the Incident Controller and the Site Main Controller. Such work will include:

1) Fire fighting and spill control till a Fire Brigade takes the charge.
2) To help the Fire Brigade and mutual aid teams, if it is so required.
3) Shutting down plant and making it safe.
4) Emergency engineering work e.g. isolating equipment, material process, providing temporary by-pass lines, safe transfer of materials, urgent repairing or replacement, electrical work, etc.
5) Provision of emergency power, water, lighting, instruments, equipments, materials, etc.
6) Movement of equipment, special vehicle and transport to or from the scene of the accident.
7) Search, evacuation, rescue and welfare.
8) The injured is given First Aid.
9) Moving tankers or other vehicles from area of risk.
10) Carrying out atmospheric test and pollution control.
11) Manning of assembly points to record the arrival of evacuated personnel. Manning for outside shelters and welfare of evacuated persons there.
12) Assistance at causalities reception areas to record details of causalities.
13) Assistance at communication centers to handle out going and in coming calls and to act as messengers if necessary.
14) Manning of works entrances in liaison with the police to direct emergency vehicles entering the work, to control traffic leaving the works and to turn away or make alternative safe arrangements for visitors, contractors and other traffic arriving at the works.

15) Informing surrounding factories and the public as well as directed by the Site Main Controller.

16) Any special help required.

6.2.3.6 ASSEMBLY POINT
In affected & vulnerable plants, all nonessential workers (who are not assigned any emergency duty) are evacuating the area & report to a specified Assembly Points. Each assembly Point will be clearly marked by a Conspicuous notices & provided with an identification numbers e.g. Assembly Point No. 1, 2 and so on. Assembly Points are located at a safe place, well away from area of risk and least affected by the down wind direction. To ensure that workers do not have to approach the affected area to reach the Assembly Point proper location and numbers have been marked at Assembly Points. Each Assembly Point in manned by a nominated person to record the names and dept. Further telephone to communicated SMC has been provided at each assembly Points. At each Assembly Point duties of Assembly Point In-charge has been also displayed in brief Before reaching an Assembly Point or subsequently, if it is required to pass through an affected area or due to presence of toxic substances. Suitable PPE's including respirators, helmet etc., are issued & made available with workers.

6.2.3.7 EMERGENCY CONTROL CENTER
The Emergency Control Center is the place or room from where the operations to handle the emergency are directed and coordinated. Main Control Room will be earmarked/identified as the Emergency Control Room. Fire Control Room shall be earmarked/identified as the alternative Emergency Control Room to be operated in case of unfavorable wind direction. Adequate Telecommunication System will be available in the Emergency Control Room i.e. Hot Lines, Intercom Walkie-Talkies & External Phones. The ECC center shall be equipper with the following facilities.
1. Internal and external telephone including STD facility
2. Telephone directory
3. Telephone nos. of mutual aid centers
4. Factory layout plan
5. Map of the area
6. Employee blood group and their address
7. Messengers / Runners for sending messages
8. Adequate numbers of PPE'S

6.2.3.8  FIRE CONTROL ARRANGEMENTS
6.2.3.8.1 FIRE FIGHTING, GAS LEAK CONTROL AND RESCUE OPERATION

A) Role of Manager (Fire and Safety) / Shift In-Charge (Fire & Safety)
1. Incident Controller will be the only person to direct the fire fighting and Emergency operation.
2. Keep the constant touch with the SMC / In charge - EHS.
3. Direct the crew members to the scene of emergency and arrange replenishment of Manpower / equipment / extinguishing media etc.

B) Role of EHS Representative:
1. On being notified about the location of fire/ gas leakage immediately proceed to the help.
2. Decide his line of action in consultation with Incident controller and take appropriate measures to handle the emergency.
3. Assessing the severity of the incident immediately report to emergency controller about the gravity of the situation.
4. He will assess the extra requirement required if any from the neighboring industry.

C) Fire crew members
1. On hearing fire alarm, emergency siren they shall immediately report to control room and proceed to the scene of emergency and work under the direction of IC/ Dy IC.
2. The personal availability at the scene of incident to be made optimize.
6.2.3.9 MEDICAL SERVICES

The roles of Medical officers are as follows;

(a) He will contact immediately to the SMC/IC.
(b) He will render necessary treatment, at Occupational Health Center.
(c) He will arrange for Hospitalization and Treatment at outside hospitals, if required.
(d) He will mobilize in getting the services of External medical agencies, other Para – medical services etc. and transportation services etc.
(e) He will arrange for extra medical assistance/antidotes, from out, if required.
(f) He will arrange for first-aid trained volunteers for necessary help.
(g) He will liaise with the Government Health Authorities for treatment of the affected persons nearby.

6.2.3.10 OTHER ARRANGEMENTS

Other arrangements include external transport, cranes, generator sets to supply emergency power, environment monitoring equipment, rescue items etc. when available resources do not meet the requirement.

STANDARD OPERATING PROCEDURE (EMERGENCY)

- As soon as emergency alarm is heard, all essential workers shall report to IC or SMC.
- They shall carefully listen to the instructions given by IC or SMC
- According to the type of emergency/accident, they shall get equipped with PPE/Fire fighting equipment and devices.
- The runner among the workers shall inform SMC/IC and key personnel if they are not at site.
- The messenger amongst the workers shall deliver messages to nearby units as per the instructions of SMC/IC.
- The in-charge of medical arrangements shall prepare first-aid and other required facilities for the injured.
- The other essential workers shall try to control the emergency as per the instructions given to IC.
IC would keep SMC informed about the status of control measures being taken at the site and ask for other requirements e.g. Mutual aid, equipment etc., if he find necessary.

SMC would co-ordinate with outside agencies regarding control measures being taken, need for external help, evacuation, medical treatment etc.

6.3 COMMUNICATION SYSTEM

After the assessment of risk & their possible environmental impact and after making an organization for the preparedness to control the emergency, the next most essential step is to make us ready for Communication at the time of emergency. Communication System is a Crucial Factor while handling emergency.

Company will have quick & effective Communication System through which, any situation, which can lead to emergency, can be informed or known to.

i. All working inside the plant.
ii. Key Personnel outside during normal working hours & during off-duty hours.
iii. Outside emergency services, Statutory and Local Authorities and
iv. Neighboring facilities and public leaving in vicinity.

Each and every section, Plant & Department of the Factory shall be connected by internal telephones. External Phone at Office and Residence and Mobile shall be also available with Key Personnel and top executive of the factory. Hot lines shall be provided with mutual aid Partner through the Emergency Control Center. The Communication System begins with raising the alarm declaring the emergency, Telephone messages and Procedure to communicate the emergency to other persons & General Public.

6.3.1 RAISING THE ALARM

As soon as incident takes place inside the factory and is noticed by someone, the first step is to raise the nearest manual emergency bell to alert the nearby people. Next, he/she informs the security persons to raise the emergency siren located at the factory gate. The security personnel sound the siren, raising and lowering the sound three times in a 10 second “ON”, 5 second “OFF” sequence. All the security employees shall be trained for operating the siren to announcing the emergency. In case of power failure, manual bell shall be also provided.
The alarm sound informs the I.C and the S.M.C that an emergency has been created and emergency organization is to be activated. The I.C. rushes to the site and takes charge of the scene.

6.3.2 DECLARING THE MAJOR EMERGENCY
Major emergency has to be declared after sufficient and through check because the declaration of major emergency puts many agencies on action and it may disturb the running system, which may be Costly at, time or its Consequence may be Serious. Therefore major emergency must not be decided on whims or immature judgment or without proper thought. Looking to all the above, we will have taken care to nominate the persons who can declare the emergency; we will have selected them on the basis of their knowledge & experience. These persons will be technically qualified and experienced. They shall advice the Incident Controller or Site Main Controller regarding the type of emergency. On being convinced, the Site Main Controller or Incident Controller shall declare an ON-SITE emergency. The decision about major emergency shall be taken as early as possible and without wasting time so that control action can be started immediately.

6.3.3 TELEPHONE MESSAGES
After hearing the emergency alarm and during emergency or even while just receiving the emergency message on phone, Telephone operator should be precise, sharp, attentive and quick in receiving and noting the message and subsequently effective in further Communication A form to record emergency telephone calls shall be available with telephone operator or Person available in Emergency Control Center, who has to record such calls during emergency. Telephonic messages shall be given out by the telephone operator to Site main Controller and key personnel as per the instructions of the Incident Controller. Telephonic messages shall also be given to authorities and external agencies to describe the type of emergency. All details of emergency shall be collected/delivered according to this format shall available with the telephone operator.

6.3.4 COMMUNICATION OF EMERGENCY & STATUTORY INFORMATION
6.3.4.1 COMMUNICATION OF EMERGENCY
An effective system to communicate emergency shall be available.
• Inside the factory i.e. workers including key personnel and essential workers, on duty & inside during normal working hours.
• To key personnel and essential workers not on duty and outside during normal working hours.
• To the outside emergency services and the Government authorities.
• To the neighboring factory & the General Public in the vicinity.

a) Information to Workers
All personnel inside the factory shall be informed by the sounding of the siren or in case of electricity by ringing the bell.

b) To key personnel outside during normal working hours
The key personnel outside the factory premises shall be informed as per the need by external telephones or runners.

c) To the outside Emergency Services and the Authorities
Once the emergency is declared, it is essential that the outside emergency services should be informed in the shortest possible time. Responsibilities shall be fixed as per the Incident/Emergency Command structure/plan to contact outside agencies for help and to communicate to the all the Government and other Authorities such as Fire Brigade, Police, District Emergency Authorities, Factory Inspectorate & Hospital etc. In case of major emergency, outside agencies like mutual aid, hospitals, policies, Factory Inspector, Collector, Fire-brigade etc. shall be informed by telephone or by sending special messenger from emergency control center.

d) To neighboring factories and the General Public
A major emergency will affect areas outside the works and it is essential that neighboring factory and General Public, should be informed to enable them to take prompt action to protect their own workers and to take whatever measures may be possible to prevent further escalation of the emergency due to effects on their own installations, at the same time, they may be able to provide assistance as part of a prearranged mutual aid plan. Further responsibilities shall be fixed to inform the neighboring factories and the General
Public leaving in the vicinity. The neighboring units shall be informed about an emergency through external telephones or runners. The general public shall be informed about an emergency using loudspeaker on scooter or rickshaw or car. Help from police shall be sought if required.

6.3.4.2 STATUTORY INFORMATION

a) Information to Workers
Set of Statutory information regarding types of hazards and their prevention and control as directed in the Factories Act shall be prepared by the unit. This information shall be printed in the local language and given in the form of booklet to all workers including contract workers.

b) To the outside emergency services and authorities
Statutory information in the form of booklet shall be given to outside emergency services and authorities.

c) To neighboring firms and the general public
Statutory information in the form of booklet will be given to neighboring units and the general public of the villages in the vicinity of the unit.

6.4 ACTION ON SITE
The activities related to emergency time activities shall be divided into two parts. These are
- Pre-emergency activities
- Post-emergency Activities

6.4.1 PRE-EMERGENCY ACTIVITIES
6.4.1.1 INTERNAL SAFETY SURVEY
A safety committee shall be constituted as per Factories Act. The nominated members of the committee shall be assigned the responsibility to conduct safety survey once in a month before safety meeting. The internal safety survey includes –
- Identify various hazards in the factory
- Check whether protective equipments are in sound working condition
- Check various safety installations located at various plants for proper working
• Check sprinklers, showers, etc. in all plants
• Suggest extra modifications/requirements to make systems more reliable
• Check presence of toxic gases by the help of dragger tube

Frequency of Internal Safety Survey: Once in a month

6.4.1.2 THIRD PARTY SURVEY
A safety survey shall be carried out once in a year by an external agency. It shall include –
• Inspection of building, structures for strength and stability
• Identify and study the hazards inside individual plants and within the factory premises.
• Check safety system for its adequacy.
• Suggest modifications or additions in the operating practices and safety system, if necessary.

Frequency of Third Party Safety Survey: Once in a year

6.4.1.3 PRESSURE VESSEL TESTING/EXAMINATION
• To prepare list of pressure vessels in the plant with details of operating conditions and manufacturing details.
• To carry out preventive maintenance of valves & fittings on all pressure vessels (valves, pipelines, pressure gauge, temperature recorders and emergency vent lines)
• To arrange for testing and examination of all pressure vessels as per the rules of Factories Act by govt. certified competent person on due date.
• To maintain record of testing and certificates issued by competent person and make them available to Factory Inspector at the time of inspection.

Frequency of Pressure Vessel Testing/Examination: Twice in a year

6.4.1.4 NON-DESTRUCTIVE TESTING (NDT)
• To prepare list of equipment and pipelines in the plant which require NDT as per the rules of Factories Act.
• To arrange for Non-Destructive Testing (NDT) as per the rules under Factories Act by govt. certified competent person on due dates.
• To maintain record of testing and certificates issued by competent person and make them available to Factory Inspector at the time of inspection.

Frequency of Non-Destructive Testing : Once in a year

6.4.1.5 SAFETY RELIEF VALVES TESTING
• To prepare list of Safety Relief Valves installed on various equipment and pipelines in the unit along with detailed specifications.
• To prepare schedule for testing and calibration as per the rules under Factories Act by govt. certified agencies on due dates.
• To maintain record of testing and certificates and mark dates of testing and calibration on the valves.
• To carry out repairs/replacement as suggesting by the testing authority.

Frequency : Twice in a year

6.4.1.6 FIRE SYSTEM TESTING
• To prepare list of various fire-fighting equipment (Fire Extinguishers, etc.) installed at various locations in the unit along with detailed specifications.
• To prepare schedule for testing of all these equipment and check operability
• To maintain record of testing and mark dates of testing on the equipment.
• To carry out repairs/replacement of defective equipment

Frequency: Once in a month

6.4.1.7 MUTUAL AID SCHEME
• To prepare Mutual Aid Scheme and enter into agreement with the neighboring units for getting or extending help during emergency
• To appoint coordinator for follow-up under mutual Aid Scheme
• To review the scheme once in a year with coordinators of neighboring units w.r.t. scope of help, type of aid, contact persons, etc.
• To include the scheme in mock drills
6.4.1.8 MOCK-DRILLS

- To conduct minor mock drills to train employees about their role / duties during emergency
- To refresh training to the employees for fire fighting, spill control, use of personal protective equipments etc.
- To check whether various members of emergency control committee remember their role / duties properly and to find out the faults and points of improvement in their performance.
- To check whether the various equipment for emergency control are operating satisfactorily and find and rectify the draw-backs if any.
- To conduct major mock-drills with permission from the authorities

Mock drills shall be regularly conducted in our unit by our Emergency Control Organization and the findings are compiled to analyze whether employees are familiarized with the emergency control procedures and what sort of training is required to be given.

6.4.1.9 SAFETY TRAINING

To organize regular training for the employees for handling of safety equipment, use of personal protective equipment, first-aid, etc. by internal/external faculty, as well as by sending persons outside to attend safety programs etc. The topics covered in safety training will be –

- Training on fire fighting
- Training on spill control
- Training on toxic release control
- Training on good housekeeping
- Training on use of PPE

The records of the training programs shall be maintained by the Safety Committee. New topics will be included in the safety training programs year by year to upgrade safety knowledge among the workers.

Frequency: Once in a year
6.4.1.10 PERSONAL PROTECTIVE EQUIPMENT

- To procure adequate number of personal protective equipment (aprons, hand gloves, safety goggles, helmets, nose masks, safety belts, gas cartridges, self-breathing apparatus, safety shoes etc.) suitable for plant operations and maintain records of use.
- To have proper system for issuing the PPE and disposal of used PPE
- To train the workers about proper use of PPE.
- To check the fresh air blowers provided at confined spaces for fresh air to workers.

6.4.1.11 COMMUNICATION

- To maintain internal/external telephones in working order
- To check alarms / siren / loudspeakers for workability
- To provide manual emergency bells at various location for use during power failure
- To periodically check wind cock for wind direction
- To check lightning arrestors installed at different locations for physical condition and proper earthing connection.

6.4.1.12 EMERGENCY LIGHTS

- To keep sufficient number of emergency torch/ batteries in ECC as well as at the production site
- To maintain the three DG sets available in the factory as stand-by for power failure. The D.G. sets are set to start functioning within two minutes of failure of electricity.

6.4.1.13 EMERGENCY CONTROL ROOM

It is necessary to maintain the Emergency Control Room and keep it equipped with all necessary items, documents, telecommunication systems, PPE etc. required in case of an emergency.

6.4.1.14 ASSEMBLY POINTS

- To fix assembly points in the factory for non-essential workers
- To fix assembly points for plant emergency staff and coordinators
- To maintain record of no. of workers gathered at the assembly points at the time of emergency. The Safety Committee shall nominate a person for this duty.
6.4.1.15 LIAISON WITH STATE AUTHORITIES

- To liaison with civil authorities, local hospitals, Fire-Brigade, Collector, factories Inspector, Police, etc regarding emergency activities and need for external aid.
- To keep the details regarding name, address & telephone numbers of various govt. authorities and neighboring units available and update the details from time to time.
- To inform about Mock-drill in advance and if required conduct mock-drill in presence of any of these authorities.
- To submit report of Mock-drill conducted and the out comings with photograph to Factories Inspector.

6.4.1.16 HOSPITAL FACILITIES

- To equip Occupational Health Centre with First-Aid and medicines
- To keep Health records (esp. blood-group records) of all employees
- To liaison with hospitals in the area of the unit
- To keep list of blood donors ready for reference
- To update arrangements with neighboring units for emergency first aid.

6.4.1.17 OUTSIDE SHELTER

- To reserve space in nearby schools/hospitals/buildings for temporary shelter during emergency
- To arrange for clothing, food, medicine in temporary shelter

6.4.1.18 STATUTORY INFORMATION

Statutory Information about chemicals handled in the unit, manufacturing process, the hazards in the unit, methods of prevention and control, first aid measures etc. shall be given to
- Workers
- Public and Neighboring units
- Government authorities & outside emergency services

6.4.1.19 PROTECTIVE DEVICES & ENGINEERING MAINTENANCE

- Installation of safety valve and pressure gauges on vessels used for high pressure operations.
- Installation of temperature indicators on reactors, temperature switch or alarm at critical reactors
• Maintenance of cooling water systems and pumps. To keep standby pump at cooling tower.
• Installation of overhead water tank for emergency. To keep it filled and regular cleaning of the same
• Periodic cleaning of heat transfer surfaces (jacket, reactors, shell & tube heat exchangers, boilers)
• To keep minimum inventory of hazardous materials with records
• To maintain good housekeeping and ensure safety compliance

6.4.1.20 LIST OF SUPPLIERS OF SAFETY EQUIPMENT
• To prepare and preserve list of suppliers of safety equipment e.g. first aid box, medicines, fire extinguishers, PPE, communication, self breathing apparatus, etc.
• To check all supplies every three months
• To update the list and keep it ready-to-refer location in the plant as well as at ECC

6.4.1.21 FIRE PREVENTION PLAN
• List of major work-place fire hazards
• Potential ignition sources
  Sparks from electrical fitting / motors
  Sparks from welding operations
  Ignition system of boiler house
  Sparks from static electricity
• Fire prevention & control measures
• Use of flameproof electrical fittings and electric motors wherever necessary
• No welding shall be done anywhere in the plant without prior permission from safety officer and necessary precautions from in charge of the area.
• Ignition system of boiler should be provided with guard
• All vessels and pipeline should be properly earthed to prevent static electricity
• The vent lines of all vessels and tanks holding flammable materials should be provided with flame arrestors
• Fire extinguishers shall be provided at all critical locations in the unit
6.4.2 POST EMERGENCY ACTIVITIES

These activities are to be carried out after an emergency is over so as to establish the cause of the emergency and decide the measures to be taken to prevent its re-occurrence. These activities are –

1. Collection of records of accident, injury, damage to property, buildings, equipment, material and loss of production
2. Conducting enquiries and concluding preventive measures
3. Making insurance claim for the materialistic loss / damage
4. Implementation of enquiry report’s recommendations
5. Rehabilitation of affected persons within and outside the plant
6. Restarting the plant and normalizing the operations.

6.4.3 EMERGENCY TIME ACTIVITIES

The probable emergency situation that can arise in the unit and the corresponding control actions are describes below.

6.4.3.1 FLAMMABLE RELEASES

Source / Incident – Fire involving spilled combustible material near or in flammable storage areas

Control action –

1. Any one who notices fire shall sound emergency alarm.
2. SMC/IC who is at site, shall immediately rush to the scene and assess the situation.
   For fire due to spillage of combustible material, he activates the on-site plan as -
   • He cuts off electric supply to that area and evacuates all the persons to safe assembly points.
   • He calls in DIC (if DIC is not present there) and asks essential workers to fight fire with dry chemical / CO₂ fire extinguisher or sand.
   • He inform fire brigade telling them in briefly about kind of fire and type of extinguishers required
   • He informs mutual aid teams and asks for necessary help.
   • He arranges first-aid / hospitalization for the affected persons.
   • Fire officer on reaching the site, takes charge of the fire-fighting operations
   • Mutual aid teams shall be asked for help in the form of first-aid, transport etc.
• If fire is growing, fire officer informs IC who alerts neighboring units and through SMC gets more fire-fighting help.
• Fire fighting shall be continued till fire is fully overcome
• After extinguishing fire, fire officer cools the entire area with water spray and checks that no re-ignition shall be likely. After that, he declares the area safe.
• IC tells essential workers to sound all clear
• The incident shall be recorded
• SMC arranges to inform families / relatives of injured / dead.
• SMC issues authorized statement to press / media.
• SMC informs Factories Inspector about the incident and related information

6.4.3.2 TOXIC RELEASES

Source / Incident – Pressure release due to failure of
- Stuffing box gland packing
- Pressure release valve
- Vessel / pipeline failure

Control action –
1. Any one who notices the release shall sound emergency alarm.
2. SMC/IC who is at site, shall immediately rush to the scene and assess the situation.
   For toxic release from a reactor, he activates the on-site plan as -
   • He evacuates all the persons to safe assembly point.
   • He calls in DIC (if DIC is not present there) and asks essential workers to wear self-breathing apparatus and if the reaction is exothermic, start cooling water flow in the reactor jacket and cool the reactor as soon as possible.
   • The essential workers stop all the charging pumps of that reactor and the nearby reactors.
   • He informs mutual aid teams and asks for necessary help.
   • He arranges first-aid / hospitalization for the affected persons.
   • Mutual aid teams shall be asked for help in the form of first-aid, transport etc.
   • When the leak stops and the air shall clear of toxic release, IC tells essential workers to sound all clear.
• The vessel / rupture disc/gland packing will be attended by maintenance department.
• The incident shall be recorded
• SMC arranges to inform families / relatives of injured / dead.
• SMC issues authorized statement to press / media.
• SMC informs Factories Inspector about the incident and related information

6.4.3.3 CHEMICAL SPILL
Most of the storage tanks shall be located in Storage Tank Yards. Dyke walls of sufficient size will be connected around the tank yard. Neutralizing material shall be kept nearby. For dilution, water connection will be provided on all sides of tank farms. Sand buckets shall be provided for covering spillage of flammable / corrosive materials.

6.4.4 EVACUATION & TRANSPORTATION
All non-essential workers shall be evacuated from incident area and adjacent areas to safe assembly points. Assembly points shall be clearly marked and assembly point in-charge will also be designated. The assembly point in-charge will be a well-trained supervisor who shall keep record of persons arriving at the assembly point and direct them for proper gathering. He shall also inform the ECC about the persons gathered at the assembly point. Those in need of medical treatment shall be transported to first-aid center / hospital as the case may be. In case of major emergency all non-essential workers shall be transported to temporary shelter.

6.4.5 SAFE CLOSE-DOWN
As per the instructions from IC or SMC, some parts or full of the plant shall be closed down by the essential workers. The procedure for safe shut-down and start-up will be given in safety manual given to all workers.

6.4.6 USE OF MUTUAL AID
Mutual aid from neighboring units shall be called up as and when required. The aid shall be taken under the supervision of SMC.

6.4.7 HELP OF EXTERNAL AUTHORITIES
Outside authorities such as Police, District Emergency Authority (DEA), Factory Inspector, Disaster Management Centre, GIDC officer, Industries Association, Regional Pollution
Control Board, nearby hospitals etc. shall be informed of the on-site and off-site emergency plans and called in as per need.

6.4.8 MEDICAL TREATMENT
Injured workers shall be located and given prompt first-aid by essential workers and key personnel. Those requiring medical treatment shall be taken to the hospital / outside medical center.

6.4.9 ACCOUNTING FOR PERSONNEL
Through daily muster rolls and with the help of shift-in-charge the head count shall be undertaken to find out whether persons are missing and if so immediate search shall be carried out to locate them. The list shall include company employees, contract workers as well as visitors. Help from local authority or fire-brigade shall be taken if required. This list shall be kept with time keeper / security officer at any time and shall be used to account for personnel. Injured shall be taken to hospitals and their families/relatives shall be informed. Casualties would be identified, their families and local authority shall be informed.

6.4.10 ACCESS TO RECORDS
In order to inform families/relatives of injured/dead, a up-to-date list of names and addresses of all the workers is maintained in addition to the muster roll where shift-wise attendance is marked. Such list includes health records. This list will be available at the ECC and one such copy shall be available at our head office.

6.4.11 PUBLIC RELATIONS
Our General Manager shall be the only nominated person to issue administrative statement about the accident or emergency to news/media. No other person shall divulge any information to any news / media person.

6.4.12 REHABILITATION
In case of Toxic release or chemical spillage, Senior Fire Brigade Officer would ensure that the incident area shall be safe and cleaned up of all mess. Then only, he would allow people to re-enter the location.

In case of fire, the Senior Fire-Brigade Officer shall ensure that the area is cooled down and there are no chances of re-ignition. IC shall arrange for clean-up of the area and then only people shall be allowed to re-enter the area for work.
Even when all clear has been given, great care shall be taken when re-entering affected areas and no work in connection with the salvage, collection of evidence or start up shall be taken up until a thorough examination of the area has been carried out. The statutory powers of the Factory Inspector shall be kept in mind before any evidence is disturbed. Particular care shall be taken to avoid the introduction of possible sources of ignition, such as diesel engines, hand or power operated tools, flame cutting equipment, etc. until it has been established that no flammable materials are present where they could be ignited.

6.5 OFF – SITE EMERGENCY PLAN

6.5.1 NEED OF THE OFF – SITE EMERGENCY PLAN

An off-site emergency plan shall be prepared to deal with those incidents which have the potential to harm persons or the environment outside the boundary of the factory premises. A major accident, major emergency and disaster may affect areas outside the plant. An explosion can scatter debris over wide areas and its effects of blasts can cover considerable distances. Wind can spread burning fumes of toxic gases. Thus the events like these described above can affect outside areas and combating them needs an Off-site Emergency plan.

Envisaging such a rare incident, an off-site emergency plan should be drawn up for the following purpose.

1. To provide basic information about the risk and environmental impact assessment related to the unit to local / district authorities, police, fire-brigade, surrounding units, and the general public. To appraise them of consequences and the protection / prevention measures and control actions and to seek their help to communicate with public in case of a major emergency. The information from all industries shall enable district authorities to educate public about what could go wrong, and to train them of measures to be taken as an individual.

2. To enable district authorities to prepare the off-site emergency plan (contingency) for the district or particular area and to organize rehearsals and initiate actions learnt from these incidents.
Our Emergency Plan shall be made after considering the all possible effects of incidents on
the neighboring population and the remedial measures will be devised in consultation with
the local authorities and emergency services.

6.5.2 STRUCTURE OF THE OFF-SITE EMERGENCY PLAN

<table>
<thead>
<tr>
<th>IC</th>
<th>District Authorities</th>
<th>Mutual Aid teams, outside</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMC</td>
<td>(Collector, Factory</td>
<td>services, voluntary</td>
</tr>
<tr>
<td>Essential</td>
<td>Inspector, Police)</td>
<td>organizations</td>
</tr>
<tr>
<td>Workers</td>
<td>(Implementing</td>
<td>(Fire-fighting, Gas leak</td>
</tr>
<tr>
<td>(Implementing</td>
<td>Information, Evacuation</td>
<td>control, First-aid, Shelter,</td>
</tr>
<tr>
<td>Action plan,</td>
<td></td>
<td>Hospitalization,</td>
</tr>
<tr>
<td>Informing</td>
<td></td>
<td>Transportation)</td>
</tr>
<tr>
<td>nearby</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.5.3 ROLE OF FACTORY MANAGEMENT

The Off-Site emergency Plans are dovetail so that the emergency services shall be
summoned at the appropriate time and shall be provided with accurate information and a
correct assessment of the situation. The responsibility for this is with the Site Main
Controller. The Site Main Controller shall provide a copy of our On-Site and Off-Site
Emergency Plan to the District authorities, the Factories Inspectorate and the Emergency
Services, so that on the basis of information and such authorities can make their emergency
preparedness plan to formulate and execute the District / Area off Site Emergency Plan.
Further on the advice of the authorities we can also modify our plan to make our plan more
effective and perfect.

6.5.4 ROLE OF EMERGENCY CO-ORDINATION OFFICER (ECO)

The various emergency services will be co-ordinated by the Emergency Co-ordination officer
(ECO), who will likely to be a Collector. The ECO will liaise closely with the Site Main
Controller. The Emergency Control Centre of the factory can be utilized by the ECO to keep
liaison with the Site Main Controller.

6.5.5 ROLE OF THE FIRE AUTHORITIES

The control of fire is normally the responsibility of the senior fire officer who would take
over the handling of fire from the IC on arrival at the site.
• The senior fire brigade officer may also have similar responsibility for other events such as explosion and toxic releases. Fire authority having major hazard units in the area shall- Familiarize themselves with the location and site of all stages of flammable materials, water and foam supply points, fire fighting equipment.

• Act as observer of an on-site exercise involving only site personnel

6.5.6 ROLE OF THE HEALTH AUTHORITIES
Health authorities, including Doctors, Surgeons, Hospitals, and Ambulances so on, have a vital part to play following a Major Accident and they should form an integral part of any emergency plan. In case of major fires, injuries will be the result of the effects of thermal radiation to a varying degree, and the knowledge and experience to handle this type of injuries cases may be generally available in most of the hospitals. But in case of major toxic releases, the effects vary according to the chemical, which has leaked, and it is important for health authorities that might be involved in dealing with the aftermath of a toxic release to be familiar with the treatment appropriate to such casualties. Major Off-Site incidents are likely to require medical equipment and facilities additional to those available locally and a Medical 'Mutual Aid' scheme should exist to enable the assistance of neighboring authorities to be obtained in the event of an emergency.

6.5.7 ROLE OF TELEPHONE DEPARTMENT
The communication system between the factory and the various above role-playing authorities must be effective. The ineffective public telephone system will not be useful in emergency. Therefore, telephone department should maintain the phones and if required temporary telephone connection may be provided to various above authorities to deal the emergency.

6.5.8 ROLE OF POLICE AND EVACUATION AUTHORITIES
• To protect life and property
• To control traffic movement
• To inform people to remain indoors or evacuate
• To carry-out evacuation
• To identify dead, deal with casualties and inform relatives of dead or injured.

For evacuation, the following criteria are useful:
a) In case of major fire, only houses close to fire and in the direction of smoke need evacuation
b) If fire is escalating and in turn threatening a store of hazardous material, it is necessary to evacuate people nearby if time is available; otherwise they should be informed to keep themselves indoor and shield from the fire.
c) For release of toxic gases, limited evacuation may be appropriate in downwind direction with windows closed and provides good protection. Toxic gases which are hazardous down to much lower concentration cover a long distance. This factor must be considered while deciding upon the need and extent of evacuation.

6.5.9 ROLE OF THE MUTUAL-AID AGENCIES
Mutual-aid arrangements shall be made in areas of fire & toxicity control, medical and transport & evacuation. All partners of mutual-aid shall extend all possible help in these areas.

6.6 OCCUPATIONAL HEALTH AND SAFETY
For large industries, where multifarious activities are involved during construction, erection, testing, commissioning, operation and maintenance; the men, materials and machines are the basic inputs. Along with the boons, industrialization generally brings several problems like occupational health and safety.

The industrial planner, therefore, has to properly plan and take steps to minimize the impacts of industrialization and to ensure appropriate occupational health and safety including fire plans. All these activities again may be classified under construction and erection, and operation and maintenance.

6.6.1 OCCUPATIONAL HEALTH
Occupational health needs attention both during construction & erection and operation & maintenance phases. However, the problem varies both in magnitude and variety in the above phases.

6.6.1.1 CONSTRUCTION AND ERECTION
The occupational health problems envisaged at this stage can mainly be due to constructional accident and noise. To overcome these hazards, in addition to arrangements to reduce it within TLV's, necessary protective equipments shall be supplied to workers.
6.6.1.2 OPERATION AND MAINTENANCE

The problem of occupational health, in the operation and maintenance phase is primarily due to noise which could affect consultation. The necessary personal protective equipments will be given to all the workers. The working personnel shall be given the following appropriate personnel protective equipments.

- Industrial Safety Helmet;
- Face shield
- Zero power plain goggles with cut type filters on both ends;
- Zero power goggles with cut type filters on both sides and blue color glasses;
- Welders equipment for eye and face protection;
- Cylindrical type earplug;
- Ear muffs;
- Canister Gas mask;
- Self contained breathing apparatus;
- Leather apron;
- Aluminized fiber glass fix proximity suit with hood and gloves;
- Boiler suit;
- Safety belt/line man's safety belt;
- Leather hand gloves;
- Asbestos hand gloves;
- Acid/Alkali proof rubberized hand gloves;
- Canvas cum leather hand gloves with leather palm;
- Lead hand glove;
- Electrically tested electrical resistance hand gloves; and
- Industrial safety shoes with steel toe.

6.6.1.3 HOSPITAL FACILITIES

It is proposed that client will make formal agreements with nearby hospital having facilities to attend fire and toxic effect cases for attending the affected persons in the emergency arising out of accidents, if any.
6.6.1.4 FACTORY MEDICAL OFFICER

A qualified doctor will be appointed as FMO on retainer ship basis. Apart from him, Paramedical Staff will be employed.

6.6.1.5 PROPOSED FACILITY TO BE MADE AVAILABLE AT OHC

One Room is proposed to be provided to be operated as OHC. The centre will be equipped with following medical equipments:—

1. Examination Table
2. Dressing Tables For performing Dressing
3. Glucometer For measurement of Blood Sugar
4. Vision chart To evaluate vision acuity
5. Nebuliser For relieving coughs & Breathing Difficulty
6. Infra red light for relieving muscular pain
7. Suction machine For cleaning airway
8. Autoclave machine For sterilizing cotton & dressing material
10. Medical Oxygen Cylinder kit
11. Sphygmomanometer To measure blood pressure
12. Refrigerator To preserve medicines
13. Thermometer

6.6.1.6 AMBULANCE VAN

An ambulance van is proposed to be made available 24 hours at Fire Station.

6.6.1.7 FIRST AID BOX

First Aid Boxes are proposed to be made available at the different location in the plant, Training to be given to employees for First Aid.

6.6.1.8 PERIODIC MEDICAL EXAMINATION

It is proposed that client will ensure that...

(1) Workers employed shall be medically examined by a qualified medical practitioner/ Factory Medical Officer, in the following manner:

(a) Once in a period of 6 months, to ascertain physical fitness of the person to do the particular job;
(b) Once in a period of 6 months, to ascertain the health status of all the workers in respect of occupational health hazards to which they are exposed and in cases where in the opinion of the Factory Medical Officer it is necessary to do so at a shorter interval in respect of any workers;

© In periodic and pre-medical examinations, various parameters will be checked. Viz., LIVER FUNCTION TESTS, Chest X-rays, Audiometry, Spirometry, Vision testing (Far & Near vision, color vision and any other ocular defect) ECG and other parameters as will be found necessary as per the opinion of Factory Medical officer.

(2) No person shall be employed for the first time without a certificate of granted by the Factory Medical Officer.

6.6.1.9 EMP FOR THE OCCUPATIONAL SAFETY & HEALTH HAZARDS SO THAT SUCH EXPOSURE CAN BE KEPT WITHIN PERMISSIBLE EXPOSURE LEVEL (PEL)/THRESHOLD LEVEL VALUE (TLV) SO AS TO PROTECT HEALTH OF WORKERS

1. It is proposed to formulate and implement an EMP for Occupational Safety and Health with following aims...
   • To keep air-borne concentration of toxic and hazardous chemicals below PEL and TLV.
   • Protect general health of workers likely to be exposed to such chemicals
   • Providing training, guidelines, resources and facilities to concerned department for occupational health hazards.
   • Permanent changes to workplace procedures or work location to be done if it is found necessary on the basis of findings from workplace Monitoring Plan.

2. It is proposed that this EMP be formulated on the guidelines issued by Bureau of Indian Standards on OH&S Management Systems: IS 18001:2000 Occupational Health and Safety Management Systems

3. Proposed EMP will be incorporated in Standard Operating Procedure also.

4. The proposed EMP will also include measure to keep air-born concentration of toxic and hazardous chemicals below its PEL and TLV, like...
   a. Leak Surveys
   b. Separate storage for toxic chemicals
   c. Exhaust Ventilation
   d. Proper illumination
e. On-line detectors toxic chemicals like Chlorine and Bromine

f. Close processes to avoid spills and exposures

g. Atomization of process operations to hazards of manual handling of chemicals

h. Supply of proper PPEs like Air mask, Berating canisters, SCBA sets, On-line breathing apparatus at the places where there is possibility of presence of toxic chemicals

i. Decontamination procedure for empty drums and carboys.

j. Regular maintenance program for pumps, equipment, instruments handling toxic and corrosive chemicals

k. Display of warning boards

l. Training to persons handling toxic and corrosive chemicals

5. Workplace Monitoring Plan

- It is proposed that a Workplace Monitoring Plan to be prepared & implemented in consultation with FMO and industrial hygienists.

- Each workplace must be evaluated to identify potential hazards from toxic substances or harmful physical agents. Air-borne concentration of toxic chemicals will be measured and record will be kept.

- The current state-of-the-art exposure measurement model is as follows: For purposes of measuring worker exposure across a single shift it is sufficient to place a reasonably accurate exposure measuring device on the worker, within the worker’s breathing zone, and have it operate for nearly the full shift. Client has been proposed to study the exposure data when the plant is operative.

6. Health Evaluation of Workers

1. It is proposed that management will device a plan to check and evaluate the exposure specific health status evaluation of workers

2. Workers will be checked for physical fitness with special reference to the possible health hazards likely to be present where he/she is being expected to work before being employed for that purpose. Basic examinations like Liver Function tests, chest x ray, Audiometry, Spirometry Vision testing (Far & Near vision, color vision and any other ocular defect) ECG, etc. will be carried out. However, the parameters and frequency of such examination will be decided in consultation with Factory Medical Officer and Industrial Hygienists.
3. While in work, all the workers will be periodically examined for the health with specific reference to the hazards which they are likely to be exposed to during work. Health evaluation will be carried out considering the bodily functions likely to be affected during work. The parameters and frequency of such examination will be decided in consultation with Factory Medical Officer and Industrial Hygienists. Plan of monthly and yearly report of the health status of workers with special reference to Occupational Health and Safety.

### 6.6.1.10 EXPOSURE LIMITS OF CHEMICALS TO WHICH WORKERS ARE LIKELY TO BE EXPOSED

<table>
<thead>
<tr>
<th>Name of Chemical</th>
<th>PEL (OSHA)</th>
<th>TLV (ACGIH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethylene Oxide</td>
<td>1 ppm</td>
<td>1 ppm</td>
</tr>
<tr>
<td>Propylene Oxide</td>
<td>100 ppm</td>
<td>2 ppm</td>
</tr>
<tr>
<td>Xylene</td>
<td>--</td>
<td>434 ppm</td>
</tr>
<tr>
<td>Toluene</td>
<td>200 ppm</td>
<td>50 ppm</td>
</tr>
</tbody>
</table>

Mitigation Measures for the Occupational Safety & Health hazards so that such exposure can be kept within permissible exposure level (PEL)/Threshold Level value (TLV) so as to protect health of workers.

### 6.6.1.11 MEDICAL SURVEILLANCE PROGRAM

**Pre-employment Medical Check Up**
1. Chest X-ray
2. Cardiogram
3. Audiometry
4. Hematological Examination:- CBC, SGOT, SGPT, Cholesterol, Blood Sugar etc
5. Urine Examination
6. Vision test
7. Colour blindness test
8. Lung function test- Spirometry

**Periodical Medical Check up**
1. Lung Function test
2. Cardiogram
3. Audiometry
4. Hematological Examination
5. Urine examination
6. Vision test
7. Colour blindness test
8. Biomarker in Blood & Urine
6.6.2 SAFETY PLAN

Safety of both men and materials during construction and operation phases is of concern. Safety plan shall be prepared and implemented in the proposed project activity. The preparedness of an industry for the occurrence of possible disasters is known as emergency plan. The disaster in the plant is possible due to collapse of structures and fire/explosion etc.

- The proposed project would formulate safety policy keeping in view the safety requirement during construction, operation, maintenance phases, with the following regulations:
- To allocate sufficient resources to maintain safe and healthy conditions of work;
- To take steps to ensure that all known safety factors are taken into account in the design, construction, operation and maintenance of plants, machinery and equipment;
- To ensure that adequate safety instructions are given to all employees;
- To provide wherever necessary protective equipment, safety appliances and clothing and to ensure their proper use;
- To inform employees about materials, equipment or processes used in their work which are known to be potentially hazardous to health or safety;
- To keep all operations and methods of work under regular review for making necessary changes from the point of view of safety in the light of experience and up to date knowledge;
- To provide appropriate facilities for first aid and prompt treatment of injuries and illness at work;
- To provide appropriate instruction, training, retraining and supervision to employees in health and safety, first aid and to ensure that adequate publicity is given to these matters;
- To ensure proper implementation of fire prevention methods and an appropriate fire fighting service together with training facilities for personnel involved in this service;
- To organize collection, analysis and presentation of data on accident, sickness and incident involving people injury or injury to health with a view to taking corrective, remedial and preventive action;
- To promote through the established machinery, joint consultation in health and safety matters to ensure effective participation by all employees;
- To publish/notify regulations, instructions and notices in the common language of employees;
• To prepare separate safety rules for each type of occupation/processes involved in a plant; and

• To ensure regular safety inspection by a competent person at suitable intervals of all buildings, equipments, work places and operations.

6.6.3 SAFETY ORGANIZATION

Construction and Erection Phase
A qualified and experienced safety officer shall be appointed. The responsibilities of the safety officer include identification of the hazardous conditions and unsafe acts of workers and advice on corrective actions, conduct safety audit, organize training programs and provide professional expert advice on various issues related to occupational safety and health. He is also responsible to ensure compliance of Safety Rules/ Statutory Provisions.

Operation and Maintenance Phase
When the construction is completed the posting of safety officers shall be in accordance with the requirement of Factories Act and their duties and responsibilities shall be as defined there of.

6.6.4 SAFETY CIRCLE
In order to fully develop the capabilities of the employees in identification of hazardous processes and improving safety and health, safety circles would be constituted in each area of work. The circle would consist of about five to six employees from that area. The circle normally shall meet for about an hour every week.

6.6.5 SAFETY TRAINING
Safety training shall be provided by the Safety Officers with the assistance of faculty members called from Professional Safety Institutions and Universities. In addition to regular employees, limited contractor labors shall also be provided safety training. To create safety awareness safety films shall be shown to workers and leaflets shall be distributed.

Some precautions and remedial measures proposed to be adopted to prevent fires are:

• Compartmentalization of cable galleries, use of proper sealing techniques of cable passages and crevices in all directions would help in localizing and identifying the area of occurrence of fire as well as ensure effective automatic and manual fire fighting operations;
• Spread of fire in horizontal direction would be checked by providing fire stops for cable shafts;

• Reliable and dependable type of fire detection system with proper zoning and interlocks for alarms are effective protection methods for conveyor galleries;

• Housekeeping of high standard helps in eliminating the causes of fire and regular fire watching system strengthens fire prevention and fire fighting; and

• Proper fire watching by all concerned would be ensured.

6.6.6 HEALTH AND SAFETY MONITORING PLAN
The health of all employees shall be periodically monitored for early detection of any ailment due to exposure to heat and noise.

6.7 TRAINING, REHERASAL & RECORDS

6.7.1 NEED OF TRAINNING & REHEARASAL
Training is important in order to –

• Teach worker’s how to handle chemicals safely, how to act as a runner/messenger, how to use PPE, how to start and shut down the plant, how to carry out emergency repairs etc.

• Teach one to be a safe and alert worker.

Rehearsal is essential for -

• Explaining and making key personnel and essential workers aware of their role in case of an emergency.

• Testing the emergency procedure, emergency arrangements and ability of all involved with it to grasp the procedure and implement the same.

• Testing the effectiveness of communication system including the alternative arrangement in case of failure.

• Testing the speed of mobilization of resources, search, rescue and treatment of casualties, emergency isolation and shut down.

• Detecting the shortcomings in the emergency plan and incorporating remedial measures.
• Allowing professional emergency services to test their parts of the plan and testing co-ordination.
• Building confidence in workers which is helpful in facing real situations.

Training shall be given to regular employees and contract personnel also. Effective and latest teaching aids will be used to train workers and supervisory staff. Such training courses shall be conducted once in a year and co-ordination with offsite personnel shall be sought during such training. Records will be maintained for training.

6.7.2 SOME CHECK POINTS

Following points can be checked at the time of training/assessing the adequacy of the Emergency Plan.

- Does the plan cover the range of incidents that can realistically be anticipated?
- Have the consequences of the various incidents considered been adequately assessed?
- Are there sufficient resources in terms of personnel and equipment on the site to carry out the Emergency Plan for the various incidents in conjunction with the public emergency services?
- Have the time scales been assessed correctly?
- Is there a logical sequence of actions for each person given a role in the plan? Whether key personnel, especially the nominated incident controllers, consulted in the preparation of the plan?
- Is there 24 hours cover, to take account of absences due to sickness and holidays, minimum shift manning, operator only periods, silent hours, shutdown periods, only security personnel being present, or for unmanned sites etc.?
- Is there satisfactory co-operation with the local emergency services and district emergency planning officers?
- At sites where an off-site plan to protect people and the environment outside the site in the event of an incident is appropriate what is the procedure for initiating the off-site plan and is this satisfactory?
6.7.3 RECORDS AND UPDATING THE PLAN

All records of On-Site and Off-Site Emergency Plan and modifications by experience and suggestion, the rehearsals and conclusions of such plans and the enquiries shall be well maintained and preserved. The necessary data bank shall be also maintained for the utility of industries and others. New information and the deficiencies identified during the rehearsal is reviewed and incorporated in the document for continual updating of the plan and such information shall be communicated to the concerned authorities.
CHAPTER - 7

ENVIRONMENTAL MANAGEMENT PLAN

7.1 BACKGROUND
The industry shall adopt a comprehensive Environmental Management Plan (EMP) which will cover several environmental protection measures, not only for abatement of environmental pollution resulting from the project, but also for the improvement in the ambient environment. The various components of the EMP are outlined in subsequent sections. An EMP is a site-specific plan developed to ensure that all necessary measures are identified and implemented in order to protect the environment and comply with environmental legislation.

7.2 OBJECTIVES OF ENVIRONMENTAL MANAGEMENT PLAN
The Environment Management area will be handled by a Qualified Manager with adequate training and experience in operation of ETP and management of other pollution control measures. He will be assisted by a Qualified Executive and one operator (in each shift) to run ETP and other pollution control system.

All the necessary controls w.r.t. management of Liquid / Hazardous / Gaseous pollutants will be exercised.

For all liquid effluents, full fledged effluent treatment plant consisting of primary, secondary and tertiary treatment will be installed to ensure adequate treatment prior to discharge.

Process stacks will be equipped at safe height with scrubbers where required to ensure emissions within prescribed limits.

DG sets will be provided with acoustic enclosures and stack.


Hazardous waste will be disposed off at the common Incinerator / secured land fill facility available in the nearby vicinity.

- Fixed gas detection system will be installed in the workplace area.
• Work place monitoring will be carried out regularly through continuous monitoring systems and periodic checking.
• Ambient air quality will be monitored regularly.
• Good green belt will be maintained inside and outside the premises by planting trees, developing lawns.
• To work in R&D for continuous improvement in process to reduce Pollution Load & moving towards adopting cleaner production technology.

7.3 ORGANOGRAM OF ENVIRONMENT MANAGEMENT PLAN
Apart from having an environmental management plan, it is also necessary to have a permanent organizational set up charged with the task of ensuring effective implementation. In this effect, M/s. Dai Ichi Karkaria Ltd (DIKL) will assign responsibilities to officers from various disciplines to co-ordinate the activities concerned with management and implementation of environment control measures.

An organogram of Environment management plan is shown in Figure 7.1. This department shall undertake the monitoring of environment pollution level by measuring stack emissions, Ambient air quality, water and effluent quality, Noise level, etc. either departmentally or by appointing external agency whenever necessary. M/s. DIKL will have its own laboratory equipped with different equipment for environmental monitoring.

M/s. DIKL shall carry out the regular monitoring in future as well as ensure that pollution is limited below prescribed limits and shall take corrective action by providing new pollution control equipment if required. In case the monitored results of environment pollution are found to exceed the prescribed limits, remedial actions are taken through the concerned plant authorities. The actual operation and maintenance of pollution control equipment of each department is under respective department heads.

The environmental department shall also look after preparation and submission of Water Cess Return, Environmental statement and Consolidated Consent & Authorization application/ renewal under water (Prevention and Control of Pollution) Act, 1974, Air (Prevention and Control of Pollution) Act, 1981, Ambient Air Quality as per NAAQS

**FIGURE - 7.1**

ORGANOGRAM OF ENVIRONMENT MANAGEMENT PLAN

![Organogram of Environment Management Plan]

- **DIRECTOR / CEO**
- **GENERAL MANAGER**
- **MANAGER / ASST. MANAGER**
- **EXECUTIVES / OFFICERS**
- **OPERATORS**
7.3.1 ENVIRONMENTAL POLICY

The Management of Dai-Ichi Karkaria Ltd. is committed to safety and Health of its employees and the preservation of the environment that supports it. The company has established a well laid out policy to maintain higher standards of Environment, Safety & Health whilst operating with integrity.

The Company commits:

- To implement Safety, Health and Environmental (SHE) Policy in such a way that, it is most appropriate to the activities, services and products of company.
- To prevent land, water, air and noise pollution arising out of our manufacturing activities.
- To comply with all applicable legal and other requirements related to the occupational Health & Safety and Environmental Aspects.
- To work towards continuous improvement and to conserve the natural resources Like water, energy etc.
- To minimize the generation of waste whilst conserving resources through better technology, processes and practices, thus minimizing the adverse impact on environment and risks to the community.
- To provide adequate training among employees / vendors / contractors, partner to demonstrate our commitment and involvement, responsibility and accountability to achieve SHE performance.
- To provide adequate resources to support the SHE initiatives and regularly monitor, review and report the progress for continual improvement in our SHE performance.

Ms. S.F.Vakil
Managing Director
7.3.2 CORPORATE ENVIRONMENT RESPONSIBILITY

- To develop & to promote the technology having minimum pollution of Air, Water & Land.
- Educating & promoting staff & workers for creating safe working atmosphere.
- More & more tree plantation in the surrounding open area within site.

7.3.3 MANAGEMENT RESPONSIBILITY

- CEO is overall responsible for effective implementation of Occupational Health, Safety & Environment Management System (HSEMS)

- Core Committee conducts management review every Six months to assess the effectiveness of HSE Management System. If necessary the committee allocates resources for taking Corrective and Preventive action on Non-Conformance.

- The Core Committee advises and monitors the establishment and implementation of HSEMS

- HODs, Dept. in-charges, Supervisors, are responsible for implementing HSE Management Programs. Safety Officer to lead the programme. All the employees are responsible for implementing and maintaining HSE Management System.

- HODs are responsible to define and monitor the key characteristics for measure of performance in HSE. HODs are responsible for control of all the documents and data as per the requirement of ISO-14001 and OHSAS 18001

- Verification activities, including internal HSE Audits, are carried out at the direction of Core committee and team of Internal Auditors.

The organization structure of M/s. DIKL at Plot No. D2/20, GIDC, Dahej – II, District: Bharuch, Gujarat. Gujarat, will be as per Organization Chart. The Roles, responsibilities, accountabilities and authorities of key personnel have been defined in the following paragraphs:
ROLE – 1: GENERAL MANAGER (OPERATION HEAD)

RESPONSIBILITIES:

- He is responsible for entire activities of the Unit.
- He is responsible to define HSE policy and ensure that this policy is understood, implemented and maintained at all levels in the organization.
- He is also responsible to provide adequate resources for achieving improved Occupational Health Safety and environmental performance.
- He is responsible for setting organizational HSE objectives and targets.
- He is also responsible to review HSE management system at appropriate intervals, to ensure its continuing and effectiveness. Monitoring of effectiveness of the system shall be done through Management Reviews.
- He is also responsible to appoint Management Representative and extend support and resources in implementing HSE management system.
- He is responsible for procurement of raw material (Indigenous & Imported) and engineering goods as per the specifications.
- He is overall responsible to ensure that legal requirements are met as per the legal register.
- Review the implementation of HSE Management System and its effectiveness, at appropriate intervals, to ensure continual improvement of the organization’s overall performance.

In absence of General Manager, other unit’s Operations Head oversees his functions. CEO also may look into the delegation of authority, during his absence.
ACCOUNTABILITY

He is accountable for all operations being carried out in the organization. His scope of
accountability in terms of HSE is as follows

1. Establishment, operation and maintenance of ISO 14001 and OHSAS 18001 systems
   in all spheres of manufacturing site.
2. Review of performance and progress of the management systems by periodic
   review through Management review.
3. To ensure availability of resources essential to establish, implement, maintain and
   improve the HSE management system.

MRM INCLUDES

1. The AMR shall obtain the findings of statutory inspection and testing reports from
   concerned departments and present in the management review meeting for
   discussion and action
2. The minutes of the Management Review Meeting are recorded and circulated to all
   members of the HSE Apex Committee.

Assistant MR shall prepare minutes of meeting within two days after the meeting. He shall
ensure that the review outputs are recorded in the “Action decided” column of format of
Minutes of Management review meeting.
7.4 ENVIRONMENT MANAGEMENT PLAN

The Environment Management plan is meant for mitigation/management of the adverse impacts and the strengthening positive impacts during proposed project. Environment Management Plan is tabulated in Table:-7.1

7.4.1 CONSTRUCTION PHASE

During Construction Phase sanitation facilities are required. Temporary facilities shall be made available to construction personnel. Necessary PPE’s shall also be provided.

- **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.

- **Noise Environment**
  Noise effect on the nearly habitation during construction activities will be negligible as the nearest habitat is more than 3 km from the plant. However, construction labor would be provided with noise protection devises like ear muffs and occupational safety ware, as per requirement. And noise generating equipment shall be stopped during night hours.

- **Construction Equipment & Waste**
  The waste oil generated by construction equipment, if any, would be disposed through authorized recyclers and unauthorized dumping of waste oil shall be avoided. Other wastes shall be disposed-off by adopting environmentally compatible methodology.

- **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.
• 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 Hazardous Waste (Management, Handling & Trans-boundary Movement) Third Amendment Rules, 2010 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.
  ✓ 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
### TABLE:-7.1

**ENVIRONMENT MANAGEMENT PLAN**

<table>
<thead>
<tr>
<th>ENVIRONMENT ISSUE/COMPONENT</th>
<th>REMEDIAL MEASURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazardous waste generation &amp; disposal</td>
<td>Proper collection, Safe Handling, Storage within premises and disposal of waste at approved TSDF, incineration facility, re-cyclers, re-processors.</td>
</tr>
<tr>
<td>Effluent generation and treatment</td>
<td>New Effluent treatment plant, RO &amp; MEE will be provided for treatment of wastewater generated from new project.</td>
</tr>
</tbody>
</table>
| Emission from stack | Adequate pollution control system will be provided for control of gaseous emission.  
  - Adequate stack height for better dispersion of pollutants  
  - Bag Filter & Scrubbers at Stack & Process Vents |
| Noise | Acoustic enclosure on DG sets, engineering control at high noise level areas like compressors etc, wherever feasible, proper oiling, lubrication and maintenance of equipment, development of greenbelt around plant boundary and inside plant |
| Greenbelt | Greenbelt will be developed. |
| Rainwater harvesting | Rainwater harvesting will be provided in non-plant area. |
| Information and awareness about hazardous chemicals plant | Awareness and information will be provided within 10 km of the study area about the hazardous situations. |
| Preparedness to handle onsite & offsite emergency | Onsite & Offsite Emergency Management Plan will be prepared |
| Monitoring of Environmental parameters | Regular monitoring of various environmental parameters will be carried out to check the effectiveness of the control system. |
7.4.2 WATER ENVIRONMENT

Water requirement shall be met through GIDC Water supply. However, record of water consumption for different usages should be maintained.

Water Pollution and Its Mitigation Plan

Total water requirement will be 226 m$^3$/day which will be met through GIDC water supply. The wastewater generation is 120 m$^3$/da. The treated effluent will be sent to propose RO unit. The RO permiate (84 m$^3$/day) will be reused for industrial purpose. RO Reject (36 m$^3$/day) will be allowed in MEE.

Construction Phase

- The drinking water and sanitation facilities at the project site are available 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 final treated effluent will be treated in effluent treatment plant, ultimately will be reused in plant premises.
- Annual environmental audit will be carried out every year from recognized Schedule-I environmental auditor.
- Records of analysis results of treated and untreated wastewater along with MLVSS in aeration tanks should also be maintained.
- Adequate spares for effluent collection, handling, treatment and disposal system should be maintained.
- Proper housekeeping should be adopted to prevent spillages and contaminated surface runoff going to storm water drains.
- 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 by 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.

7.4.3 AIR ENVIRONMENT

DIKL proposes to manufacture nonionic, anionic, cationic surface active agents, additives for oil field industries, sizing agents, construction chemicals & other specialty performance chemicals at at Plot No. D2/20, GIDC, Dahej – II, District: Bharuch, Gujarat. There are 3 types of sources of air pollution in Proposed Scenario at M/s. DIKL i.e. stack attached to Boiler, Thermic Fluid Heater (TFH) & DG Set. The Multy Cyclone Separator & Bag Filter/Scrubber will be installed to prevent air pollution. The baseline ambient air quality monitoring is carried out during study period (October’ 14 to December’ 14) around Project site (within the study area), clearly reveals that the concentrations of PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub>, NO<sub>x</sub>, O<sub>3</sub>, Pb, CO, NH<sub>3</sub>, C<sub>6</sub>H<sub>6</sub>, Benzo (a) Pyrene (BaP), Arsenic (As), Nickel (Ni) & VOCs are well within the prescribed limits as per the National Ambient Air Quality Standards for residential & Industrial.

- The major sources of air emission from the proposed project are:
  1. Non point sources emissions
  2. Point source emissions
  3. Fugitive emissions
Atmospheric Distillation of Solvents:

**Primary Condenser HE-01**: Cooling Tower water will be used to condense the solvents and the non condensed vapors will be condensed in a Secondary Condenser

**Secondary Condenser HE-02**: Chilled water at 6 °C will be used to condense the non condensed vapors in the Secondary Condenser

**VOC Trap Condenser HE-03**: Chilled Brine at -35 °C will be used to trap any traces of Solvent which is slipped from Secondary condenser

Vacuum distillation of Solvent:

**Primary Condenser HE-01**: Cooling Tower water or Chilled water will be used to condense the solvents depend on the vapor pressure at its operating conditions and the non condensed vapors will be condensed in a Secondary Condenser
**Secondary Condenser HE-02:** Chilled Brine at -17°C will be used to condense the non-condensed vapors in the Secondary Condenser

**VOC Trap Condenser HE-03:** Chilled Brine at -35°C will be used to trap any traces of Solvent which is slipped from Secondary condenser

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**Note: 1** Normal Operating pressure for all vacuum distillations for solvents is 100 mm Hg (Hence no Solvent escapes from the VOC vent Trap)

**Note: 2** A TIC (Temperature Indicator and Controller) is placed at the outlet of Secondary Condenser vent gasses line and a set point (just above room temperature) will be put to control heating of the Reactor. If Vapor temperature at TIC is more than set point automatically the Heating media Valve to the reactor will be shut. Hence the system itself will ensure no vapor is escaping without condensing.
7.4.3.1 ACTION PLAN TO CONTROL AMBIENT AIR QUALITY AS PER NAAQES STANDARDS:

**Control Measures:**

The design stage endeavors to mitigate the problems related to environment and health at the process technology/source level itself. Besides standards, emphasis would be given to comply with all design standards/regulatory norms as specified by CPCB/MoEF/GPCB etc. Following measures would be taken right from the design stage to ensure compliance with applicable regulatory standards:

- Use of low sulfur fuels in D.G.Set.
- 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 (Non point sources emissions)**

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 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 (Point sources emissions)**

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.
• Emission at M/s. DIKL will be in the form of the gas emission from Boiler, TFH and DG Set. Moreover, regular monitoring of stacks shall be carried out to check the emissions. Record should be maintained for changing of scrubbing media on printed logbook. In case emissions exceed, the corrective measures should immediately be taken and records of the same should be maintained.
• Regular ambient air quality monitoring shall be carried out within premises and should also be carried out in the nearby area for PM$_{10}$, PM$_{2.5}$, SO$_2$, NOx & VOCs.
• A greenbelt around the factory will be developed for reducing the air pollution and attenuation of noise.
• Adoption of good house-keeping.

7.4.3.2 INFORMATION FOR CONTROL OF FUGITIVE EMISSIONS
The emissions are normally defined as emissions to the atmosphere resulting from leaking piping sources and equipments such as valves, flanges, pump seals, connections, and compressor seals open end lines and pressure relief valves. The emissions are not visually observed but can be measured in relatively low concentration at each area of source.

Fugitive emissions are expected to be generated during construction and operation stages of the proposed project. During construction stage, main source of fugitive emission is dust which is expected mainly due to movement of vehicles carrying construction material and vehicles used for construction. During operation stage, leakage through valves, pumps, emission from open drum containing chemicals, open feeding; storage tanks, etc. are the major sources of fugitive emissions of organic chemicals and VOCs. Excess use of solvent may also results fugitive emission from the process vessels.

M/s. DIKL shall have fully closed system. Adequate dust collector will be installed for control of fugitive emission during loading of raw material and product. Condenser will be provided to trap VOC. All the Flange joints of the pipe lines which carry solvents will be covered with flange guards. All the rotating equipments like pumps will be installed with Mechanical Seals to arrest any sort of emissions. VOC detectors will be installed at various places to identify any fugitive emissions. A regular preventive maintenance schedule will be in place to
replace or rectify all gaskets and joints etc as a part of ISO systems to ensure no fugitive emissions shall take place.

Following measures will be adopted to prevent and control fugitive emissions:
1. Airborne dust at all transfers operations/ points will be controlled either by spraying water or providing enclosures.
2. Care will be taken to store construction material properly to prevent fugitive emissions, if any.
3. Adequate ventilation will be provided.
4. Regular maintenance of valves, pumps, flanges, joints and other equipment will be done to prevent leakages and thus minimizing the fugitive emissions of VOCs.
5. Entire process will be carried out in the closed reactors with proper maintenance of pressure and temperature.
6. Periodic monitoring of work area will be carried out to check the fugitive emission.
7. Breather valves will be provided on solvent tanks.
8. Solvent tank vents will be connected to vent chillers.
9. To eliminate chances of leakages from glands of pumps, mechanical seal will be provided at all solvent pumps.
10. Stand by pumps will be provided on all scrubbers. Besides, scrubbers will be equipped with on-line pH meter with hooter system for better operational control.
11. Close feeding system will be provided for centrifuges. Centrifuge and filtrate tank vents will be connected to vent chillers.
12. Minimum number of flanges, joints and valves in pipelines.
13. Regular inspection of floating roof seals and proper preventive maintenance of roofs and seals for tanks
14. Fugitive emission over reactors, formulation areas, centrifuges, chemical loading, transfer area, are collected through hoods and ducts by induced draft and controlled by scrubber/ dust collector.
15. Dedicated scrubbers are provided are used for fugitive emissions to control
16. For dust emissions, cyclones / bag filter provided.
17. Emphasis will be given to solvent management / solvent loss prevention as shown in the solvent management plan.

18. Enclosures to chemical storage area, collection of emission from loading of raw materials in particular solvents through hoods and ducts by induced draft, and control by scrubber / dust collector to be ensured.

19. Nitrogen blanketing will be provided, besides special care needs to be taken for control in respect of odorous chemicals.

7.4.4 NOISE ENVIRONMENT

The sound pressure level generated by a noise source decreases with increasing distance from the source due to wave divergence. The propagation and attenuation of noise pressure wave is dependent on many parameters amongst which, the medium of travel and the ambient conditions are the most significant parameters. In order to minimize adverse impact on the noise environment, due attention shall be given for implementing noise control measures. Comprehensive measures shall be taken at design stage for noise from proposed unit. 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.
• There may be small addition to the ambient noise level, due to the increased transportation activities. This creates a slight adverse impact on the sound environment.
• Regular oiling, lubrication and maintenance of the equipment shall be carried out to minimize noise generation.

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 premises as well as outside the greenbelt.

**During Operation Phase**

However, due to the attenuation of noise level within the factory and due to the fact that the project site is situated in a well developed industrial estate and not in the immediate vicinity of human settlement, significant impact is not expected in the nearest present human settlement. The volume of transport vehicles to be handled is very low. The company shall develop a green belt around the periphery of the premises, which shall act as a barrier to the propagation of noise from the factory premises. This shall further reduce the noise levels appreciably.

- It is recommended to measure and maintain records of noise level at various places within and outside factory premises.
- Manufacturers/ suppliers of major noise generating equipment/ machines like compressors, turbines, generators should be asked to take required measures for minimizing the noise levels generated by machines by using noise absorbing material
for various enclosures or using appropriate design/technology for fabricating/assembling the machines.

- Audiometric tests should be conducted periodically for the employees working close to the high noise sources.

### 7.4.5 LAND ENVIRONMENT

#### 7.4.5.1 HAZARDOUS WASTE MANAGEMENT

Six categories of hazardous wastes will be generated from the Proposed Project. Treatment, Storage & Disposal mode for the same will be followed as per Hazardous Waste (Storage, Handling & Trans-boundary Movement) Third Amendment Rules, 2010.

Record of hazardous waste generation and disposal shall be maintained on printed logbook. All necessary precautions shall be taken during handling, loading and unloading of hazardous wastes.

**Storage of Hazardous Waste:**

- Hazardous waste shall not be stored for a period more than 90 days. And shall maintain records and make them available for inspection.
- Store at a designated Onsite-secured area with impervious floor that affords protection from sun & rain fall, spreading of leachate, mixing of wastes etc.

**Transportation of Hazardous Waste:**

- Properly packed & labeled waste transport through dedicated vehicle to a captive facility/authorized TSDF facility.

**Disposal of Hazardous Waste:**

**Proposed**

- ETP Sludge will be Collected, Stored, Transported and Disposed at common TSDF by M/s. BEIL, Dahej. Incinerable Waste & Filter Cake will be Collected, Stored, Transported and Disposed at common Incineration by M/s. BEIL, Dahej.
- Used Oil will be Collected, Stored, and Transported & disposed by selling to Registered Reprocessors.
- Discarded Drus/Empty Bags will be Collected, Stored, Decontaminated; Detoxified & Sold to GPCB authorized vendors.
- Fly Ash will be Collected & sold to Brick Manufacturers.
7.4.5.2 IDENTIFICATION OF RECYCLE/REUSE, CLEANER PRODUCTION AND CO-PROCESSING OPTION OF HAZARDOUS WASTE

- It is recommended to analyze each hazardous waste periodically and maintain records.
- Check the calorific value of the ETP Sludge and then explore possibilities of Co-Processing in Cement Industry as Primary fuel. Waste materials used for co-processing are referred to as alternative fuels and raw materials (AFR).
  1. On-site recovery of solvent in distillation column. Recovered solvent will be recycled back for re-use and residue will be sent for incineration.
  2. All the non-biodegradable effluents generated from plant will be converted into biodegradable effluents followed by conventional treatment in wastewater treatment plant. Treated effluent will be reused within the plant premises.
  3. Second wash of plant/equipment will be re-used as first wash in the same equipment/reactor to reduce fresh water consumption.

7.5 GREEN BELT DEVELOPMENT

Tree plantation is known for improving the aesthetic and climatological environment of an area and properly designed green belt can help in ameliorating air pollution to a very significant degree. It should be borne in mind that the green belt will be most effective as a sink for particulate matter and gaseous emissions from ground level sources, such as, fugitive emissions. Effectiveness of green belt for the elevated sources is rather limited but its action as a green lung greatly helps in improving the air quality of the area. However, considerable scope exists for strengthening the existing green belt and developing the same in future.

BREAK UP OF DIFFERENT LAND USE OF FACTORY

Total Plot Area is of 15856 m² out of which 4200 m² (approx.) i.e. 26% of land shall be utilized for the green belt area.

Good greenery shall be maintained in and around the site by planting various types of trees and maintaining lawns. 4200 m² areas (approx.) shall be utilized for tree plantation / development of lawns. A green belt with width of min. 1 meter shall be developed within
the site boundary and across the premises inside roads. Trees like Asopalav, Neem, Gulmohar, Champa, Gauva, Babul, Palm Trees, Nariyal, Ghaneri, Shevga, Jangli badam, Sag, Jamun, Mango, Rain tree etc. shall be planted in and around the site.

**Green Belt to Trap and Absorb Pollutants**

A green belt traps and absorbs pollutants without altering the biogeochemical cycle of water and nutrients. Absorption and trapping capacity of trees depend on height of plant, canopy structure, physiognomy and morphological character of leaf. Once fully developed, such tree plantations can serve as buffer and shock absorber against transient and accidental release of pollutants caused by power, equipment and human failures. Green belt is usually designed in such a way that the first few rows in a green belt have a shorter height and dense canopy. Plants native to an area are generally used to suit the prevailing ecosystem and biogeochemical cycle. Native plants are more tolerant to disease, grow at a faster rate and result in better attenuation of pollutants.

**Plantation Design**

In view of the different functional requirements of the plant in an industrial area, the pattern of plantation within plant is discussed as below:

**A. Curtain Plantation**

To help in restrict the movement of pollutants from inside to outside and from outside to inside, a thick green belt shall be developed at the peripheral limits of the plant along the boundary walls whenever feasible. The curtain will be an effective buffer against gases, dust and noise.

**B. Avenue Plantation**

Linear plantations along road-sides help reduce air and noise pollution from automobiles as well as general emissions from the industrial units. To combine bio-aesthetic and pollution abatement needs, parallel rows of trees (inner and outer rows) shall be planted on the roads and boundary.

**C. Field Plantation**
Plantation on the open stretches of land helps improve the general ecological conditions of the habitat by adding greenery to the landscape and by providing a vast canopy of foliage for sink of pollutants generated in the area. The open land spaces, not used for industrial purposes, shall be filled with plant species.

D. Ornamental Plantation

The immediate area of each building shall be arranged into a lawn, fringed by flower beds. In some strategic corners flowering climbers been used to highlight the visual effect.

Plantation Details

Actual Status of Plantation/Green Belt

Trees species to be planted at plant are in line with trees species recommended in CPCB’s guidelines for developing Greenbelts. For plantation at the plant in future, it is suggested that these guidelines should also be followed for selecting pollutants tolerant and absorbent species.

(a.) Species of tree planted

<table>
<thead>
<tr>
<th>No.</th>
<th>Tree species</th>
<th>Common Name</th>
<th>No. of Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Plumeria pudica</td>
<td>Bridal bouquet</td>
<td>35</td>
</tr>
<tr>
<td>2</td>
<td>Cassia siamea</td>
<td>Kashid</td>
<td>40</td>
</tr>
<tr>
<td>3</td>
<td>Pongamia pinnata</td>
<td>Indian Beach Tree</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>Ficus glomerita</td>
<td>Cluster fig</td>
<td>40</td>
</tr>
<tr>
<td>5</td>
<td>Azadirachta indica</td>
<td>Neem</td>
<td>45</td>
</tr>
<tr>
<td>6</td>
<td>Nerium indicum</td>
<td>Oleander</td>
<td>45</td>
</tr>
<tr>
<td>7</td>
<td>Delonix regia</td>
<td>Gold Mohar</td>
<td>55</td>
</tr>
<tr>
<td>8</td>
<td>Bauhinia varie</td>
<td>Orchid Tree</td>
<td>50</td>
</tr>
<tr>
<td>9</td>
<td>Samanea saman</td>
<td>Rain tree</td>
<td>55</td>
</tr>
<tr>
<td>10</td>
<td>Sapindus emarginatue</td>
<td>Soapnut tree</td>
<td>35</td>
</tr>
<tr>
<td>11</td>
<td>Tamarindus indica, Linn</td>
<td>Tamarind</td>
<td>35</td>
</tr>
<tr>
<td>12</td>
<td>Anogeissus latifolia</td>
<td>axlewood</td>
<td>25</td>
</tr>
<tr>
<td>13</td>
<td>Syzygium cimini,</td>
<td>Jamun</td>
<td>40</td>
</tr>
<tr>
<td>14</td>
<td>Mangifera indica</td>
<td>Mango</td>
<td>30</td>
</tr>
<tr>
<td>15</td>
<td>Saraca asoca</td>
<td>Ashok</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>600</strong></td>
<td></td>
</tr>
</tbody>
</table>

Note:- Out of 4200 m² area in 3000 m² will be allotted for trees, in 800 m² are shrub species will be planted and in the remaining area i.e. of 400 m² will be used for Lawn development
(b.) Co-relation of Trees with pollution control

<table>
<thead>
<tr>
<th>Trees</th>
<th>Air pollution</th>
<th>Dust</th>
<th>Noise</th>
<th>Salt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trees</td>
<td>Nilgiri</td>
<td>Karen</td>
<td>Pendula</td>
<td>Neem</td>
</tr>
<tr>
<td>Pangara</td>
<td>Pendulla</td>
<td>Bahunia</td>
<td>Peltophorum</td>
<td>Gulmohar</td>
</tr>
<tr>
<td>Babool</td>
<td>Neem</td>
<td>Paras pipal</td>
<td>Jamun</td>
<td></td>
</tr>
<tr>
<td>Cadamba</td>
<td>Bogunvelia</td>
<td>Cassia fistula</td>
<td>Pendula</td>
<td></td>
</tr>
<tr>
<td>Vinca</td>
<td>Croton</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tecoma var.</td>
<td>Spethodia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alstonia</td>
<td>Gulmohar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jackranda</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Places: Green-Belt  Plant Area  Plant Area  Plant Area  Plant Area

GREEN BELT DEVELOPMENT PROGRAMME

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Year</th>
<th>Species</th>
<th>Number of trees</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2015-16</td>
<td>Bridal bounquet, Kashid, Indian Beach Tree, Cluster fig, Neem, Oleander tree, Gold Mohor, Orchid Tree, Rain tree, Tamarind, Jamun, Mango, Ashok etc.</td>
<td>120</td>
</tr>
<tr>
<td>2</td>
<td>2016-17</td>
<td>Bridal bounquet, Kashid, Indian Beach Tree, Cluster fig, Neem, Oleander tree, Gold Mohor, Orchid Tree, Rain tree, Tamarind, Jamun, Mango, Ashok etc.</td>
<td>120</td>
</tr>
<tr>
<td>3</td>
<td>2017-18</td>
<td>Bridal bounquet, Kashid, Indian Beach Tree, Cluster fig, Neem, Oleander tree, Gold Mohor, Orchid Tree, Rain tree, Tamarind, Jamun, Mango, Ashok etc.</td>
<td>120</td>
</tr>
<tr>
<td>4</td>
<td>2018-19</td>
<td>Bridal bounquet, Kashid, Indian Beach Tree, Cluster fig, Neem, Oleander tree, Gold Mohor, Orchid Tree, Rain tree, Tamarind, Jamun, Mango, Ashok etc.</td>
<td>120</td>
</tr>
<tr>
<td>5</td>
<td>2019-20</td>
<td>Bridal bounquet, Kashid, Indian Beach Tree, Cluster fig, Neem, Oleander tree, Gold Mohor, Orchid Tree, Rain tree, Tamarind, Jamun, Mango, Ashok etc.</td>
<td>120</td>
</tr>
</tbody>
</table>

7.6 OCCUPATIONAL HEALTH AND SAFETY

Health hazards associated with the occupation are called occupational hazards. In chemical industry due to handling of toxic and hazardous chemicals there are possibilities of developing occupational diseases. M/s. DIKL shall carry out the following checks to curb the problem:

i) Pre - employment medical check up at the time of employment.

ii) Annual medical check up shall be done for all employees.

iii) First aid training shall be given to the employees.

iv) Monitoring of occupational hazards like noise, ventilation, chemical exposure shall be carried out at frequent intervals, the records of which shall be documented.

OHC Room will be provided at Security building. Professional doctor will be called every week at factory. And routine checkup of all employees will be carried out annually for all
standard tests needed as per Factory Inspector Office. Employees will be trained frequently through special master faculties on various points related to occupational health to create more awareness on the subject. All precautions shall be taken to avoid foreseeable accidents like spillage, fire and explosion hazards and to minimize the effect of any such accident and to combat any emergency at site level. Some of the preventive safety measures shall be taken to minimize the risk of accident with respect to Technical Safety, Organizational Safety and Personal Safety are listed below:

- Company shall take all reasonably practicable measures to minimize the risk of such accident in compliance with the legal obligation under the relevant safety.
- All building plans and installations shall be as per relevant acts and duly approved by competent government authorities.
- Process and Equipment shall be designed by qualified and experienced professionals and fabricated to applicable national / international codes with stage wise inspection.
- Pressure Relief Valves and rupture disks shall be installed on the reactor and jackets wherever required.
- Hazardous processes shall be operated by trained workers and shall be looked after by qualified & experienced supervisors.
- Safety features such as fire extinguishers, fire hydrant system and suitable Personal Protective Equipment (PPE) shall be provided. Regular operations and testing of fire hydrant system and fire extinguishers shall be carried out.
- Suitable provisions for control of critical process / storage parameters within specified safe limits (use of pressure relief valves, rupture discs, safety valves, trip circuits, wherever necessary) shall be done.
- Use of flameproof electrical equipment, flame arresters and breather valves shall be done.
- Provision of Earthing and lightening arrester to prevent electrical fires and explosions in flammable / explosive chemicals storage / processing areas shall be done.
• Tanks storing hazardous liquid chemicals shall be provided with dyke wall to confine any spillage and facilitate easy collection. Necessary separation distance shall be maintained.

Personal Protective Equipment (PPE) like goggles, safety shoes, helmet, apron, earplugs, facemask & clothing shall be provided to employees as per the job requirements. The company shall prepare a comprehensive on-site emergency plan with well-defined responsibilities to face any eventuality caused under adverse circumstances and unforeseen reason.

7.7 INFORMATION FOR RAIN WATER HARVESTING

Rain water harvesting refers to the collection and storage of rain water and also other activities aimed at harvesting surface and ground water, prevention of losses through evaporation and seepage and all other hydrological studies and engineering interventions, aimed at conservation and efficient utilization of the limited water endowment of physiographic unit such as a watershed. The total amount of water that is received in the form of rainfall over an area is called the rainwater endowment of that area. Out of this, the amount that can be effectively harvested is called the water harvesting potential.

Rain Water can be harvested for two purposes:

• Stored for ready use in containers above ground or below ground
• Charged into soil for withdrawal later i.e. ground water recharging

The main elements of rain water harvesting systems are:

• Catchments
• Conduits
• Storage facility
• Recharge facility

The proposed project will have rain water harvesting system with ground water recharge technique by using rain water from non-process buildings and roof top water of all other buildings. All storm water drains are routed such as to reach extreme corner of site & then
shall harvest the same to ground water through well. Various kinds of recharge structures are possible which can ensure that rainwater percolates in the ground instead of draining away from the surface. While some structures promote the percolation of water through soil strata at shallower depth, others conduct water to greater depths from where it joins the ground water. Besides, possibility will be explored to utilize uncontaminated rain water in cooling towers during monsoon.

**Maintenance of the recharging system:**
Periodic maintenance required for reliable and higher quality water supply. During raining season the entire system to be checked before and after rains and cleaned after every dry period. Before first shower storage tanks should be cleaned and flushed of all sediments and debris.

### 7.8 MEASURES FOR CONSERVATION OF ENERGY
M/s. DIKL shall adopt various measures for energy conservation:
- Energy efficient machineries will be used during operation phase.
- Installation of economizer & high efficiency burner on steam boilers.
• Company shall try to utilize renewable sources of energy for conservation of non-renewable sources of energy.
• Enough care will be taken to prevent/minimize energy losses at each stage.
• Energy audit will be used as a tool for monitoring purpose.
• External lights will be controlled through timers for auto on/off function based on timings.
• The cable size will be selected so as to minimize the power losses.
• The power factor improvement capacitors will be provided individually for AC loads.
• Using water cooled chillers, variable frequency drives for secondary pumps and public area and building management system for HVAC equipments with non-CFC and non-HCFC based refrigerants.
• Use of VFDs for various utilities in variable load application to optimize pump and air handling unit performance, wherever required.
• Automated day light control.
• Efficient lamps and ballasts.
• Automated control for external lighting (Astronomical/Sensor)
• Occupancy Sensors.
• Phase-wise implementation of Advance Process Control (APC) in the process plants
• 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.
• Use of FRP blade on Cooling Tower

Company shall explore possibility of use of solar energy for various infrastructure operations. Also use of Energy Efficient Lighting, Transformers, HVAC system, Use of Energy Efficient Motors, electrical appliances to minimize the energy consumption in addition to Process Planning.

7.9 NATURAL RESOURCES CONSERVATION
The substances that are found in nature and are used by the man for his welfare directly or indirectly are called as natural resources. Sun, wind, soil, fossil fuels, wood, forest, flora and
fauna are some of the examples of natural resources. The judicious or wise use of natural resources in such a way that the present generations make use of natural resources without compromising the needs of the natural resources for the future generation is called as **conservation of natural resources**.

**Conservation of Natural Resources**

As natural resources are beneficial to human beings, maintain ecological balance and at the same time are in a threat of getting depleted due to its indiscriminate over exploitation, there is an urgent need for **conservation of natural resources**. This can be accomplished by the following ways:

- Alternative forms of energy such as solar energy etc. shall use more in comparison to fossil fuels. Alternative forms of energy are eco-friendly, do not cause pollution and are renewable.

- Avoid using plastics, synthetic materials etc as these materials cause damage to the soil.

- Water is precious natural resources and hence avoids wasting water. Taps shall be closed when not in use.

- Coal/Lignite shall be used as a source of fuel in Boiler.

- Adopt **3 R's** for conservation viz, **Re-use, Reduce and Re-cycle**.

- Trees shall be planted along roadsides, railway tracks and waste lands and deforestation should be avoided.

- Don’t waste electricity. Fans and lights shall be switched off when not in use.

**7.10 SKILLED AND TRAINED MANPOWER**

Employment would be as per prevailing norms of state government for skilled and trained people for the proposed project. The company has sufficient skilled manpower for the existing project and our technical, administration and other staff are sufficient to take care of the proposed plant. M/s. Meghaarika Enterprises Pvt. Ltd will give employment to about 50 employees (Including Contract Workers).
7.11 SOCIO-ECONOMIC DEVELOPMENTAL ACTIVITIES

All organisations have an impact on the society and the environment through their operations, products or services, and through their interactions with key stakeholder groups including employees, customers/clients, suppliers, investors and the local community. Generally speaking, it can be stated that Corporate Social Responsibility (CSR) was born as a response to a growing gap between two societies in terms of economic, social and environmental development. Because of that, CSR has become a very important component of today’s business world, mainly because of its potential to minimize the gap between those countries - thus creating true equality. This is demonstrated in the diagram given below.

DIKL has identified 6 key principles of CSR, as follows:

- Must take care of their employees and investors
- Must satisfy market demands and gain new customers
- Must improve their relationships with providers
- Must listen to community expectations
- Must be concerned about the environment
- Must promote and facilitate intercultural dialogue

In order to incorporate each of those principles into their everyday activities, DIKL shall include them in every project activity as well.
7.11.1 IMPORTANCE OF CORPORATE SOCIAL RESPONSIBILITY

Corporate social responsibility in business isn’t just a do-gooders’ charter or latest example of regulatory overdrive. It is about creating sustainable businesses through the best possible relationships with their communities and stakeholders.

The expectations of the traditional stakeholders – shareholders, customers, and employees are increasing and so, too, is the list of groups wanting to know how an organization is run.

As a result, more and more companies are working harder not only to make a positive impact on society and the environment through their operations, products or services, but also to demonstrate it to these groups.

A comprehensive set of policies, practices and programs incorporated throughout a business can increase productivity, contribute to competitiveness, improve staff recruitment and retention rates and create a more positive corporate image.

Unfortunately, many companies only use the responsible business approach as a risk management tool. This limits the benefits that could be achieved through focusing on opportunity rather than risk. Socially responsible business is not about restricting business growth; it’s about creating new opportunities, the better way of doing business.

7.11.2 EXAMINING REQUIREMENTS OF CSR

The main aim of the research was to examine how far the notion of Corporate Social Responsibility has permeated the DIKL organization in both attitudinal and behavioral sense.

The essence of the research study was to explore the underlying attitudes, beliefs and assumptions of DIKL with regard to social, ethical and environmental issues and to investigate what actions have been taken by the enterprise in pursuit of a more socially responsible approach.

The research was designed to focus specifically on a number of key areas. These include:

- Understanding attitude of CSR
- Actions taken in pursuit of a more socially responsible approach especially relating to,
  - Human Resources,
  - Environment
  - Community, at local and national level
  - Structural arrangements for CSR
  - Barriers to involvement in social, ethical and environment
7.11.3 CSR PROVISION BY DIKL

DIKL is planning to develop nearby villages as per the identified requirement of the region under CSR activity. This will increase the social and economical sector of the region. DIKL has decided to adopt three nearby villages to implement CSR. These villages were selected on the basis of shortfall of basic amenities. Majorly these villages are depending on agriculture. Following are the identified provision for the area:

- Capacity Building and Training for vocational Courses
- Village infrastructure
- Sustainable power development
- Drinking water facility
- Women Empowerment through training and financial support
- Education Support through Extension of Building, Scholarship, Books
- Primary Health Centers through health camps, upgradation of Building, New Building etc
- Agriculture Development Program

7.11.4 CAPACITY BUILDING AND TRAINING FOR VOCATIONAL COURSES

DIKL will provide vocational training for youth as per their qualification and interest. This will enable them to get employment at proposed plant. It will increase their social and economical status.

DIKL will implement this by hiring the proper and renowned institute from nearby area to arrange the trainings. DIKL will form a supervisory committee to inspect all the activities and also take care of the requirement for the training program.

7.11.5 ACTION PLAN FOR IDENTIFICATION OF LOCAL EMPLOYEE

Employee youth for training in skill relevant to the project for eventual employment in the project itself shall be as under –

Identification of employable Youth

DIKL will continuously have interactions with Schools, Junior Colleges, Industrial Training Schools located near Dahej.

Training Division of DIKL will have campus interview in the Schools, Junior College, Industrial training Schools located in Dahej.

After selecting the youth they will be provided ITI training in the following areas
1. Fitters
2. Welders
3. Carpenters
4. Bar bending
5. Mason
6. Maintenance of Pumps and other mechanical equipments
7. Electrical Maintenance
8. Environment Monitoring
9. Green belt Development (Gardner Training)
10. Laboratory Chemist (Water Testing)
11. Brick Manufacturing
12. Vehicle Driver

After successful training the youths will be appointed at appropriate position in DIKL.

7.11.6 VILLAGE INFRASTRUCTURE

DIKL shall support villagers in Road, sanitation facilities, shopping centers, solar lighting, community development, construct school building, primary health centers etc.

7.11.7 DRINKING WATER FACILITY

DIKL has proposed to make provision for drinking water at the said villages. DIKL will meet this requirement by constructing water storage tank, bore wells and hand pumps.

7.11.8 WOMEN EMPOWERMENT THROUGH TRAINING AND FINANCIAL SUPPORT

DIKL has proposed to develop the training center as handy craft making, household goods making, tailoring etc. It will increase the economic level of the region.

7.11.9 EDUCATION SUPPORT THROUGH EXTENSION OF BUILDING, SCHOLARSHIP, BOOKS

DIKL is planning to improve educational level of the region. It will be implemented by helping school building construction, providing books to poor student, scholarship to financially poor students per year as per their previous academic record. This will motivate the student in education. DIKL will give opportunity to educated youth to work in plant.
7.11.10 PRIMARY HEALTH CENTERS THROUGH HEALTH CAMPS, UP-GRADATION OF BUILDING, NEW BUILDING ETC

DIKL is willing to help in setup of primary health center, running free checkup camps, help in building hospitals and buying machineries, funding to health centers etc,

7.11.11 AGRICULTURE DEVELOPMENT PROGRAM

Training on agriculture extension service e.g fertilizer application, pest management, agri clinic, and will regularly be conducted by reputed agriculture institutes.

7.11.12 BUDGETARY COMMITMENT OF CSR

Details of expenditure estimates during construction period of 5 years are given below:

<table>
<thead>
<tr>
<th>Sr. no</th>
<th>Activity</th>
<th>Rs, in lakhs/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Capacity Building Training for vocational Courses</td>
<td>10.0</td>
</tr>
<tr>
<td>2</td>
<td>Village infrastructure</td>
<td>30.0</td>
</tr>
<tr>
<td>3</td>
<td>Drinking water facility in villages nearby</td>
<td>10.0</td>
</tr>
<tr>
<td>4</td>
<td>Women Empowerment trough training and financial support</td>
<td>10.0</td>
</tr>
<tr>
<td>5</td>
<td>Education Support through Extension of Building, Scholarship, Books</td>
<td>15.0</td>
</tr>
<tr>
<td>6</td>
<td>Primary Health Centers through health camps, upgradation of Building, New Building etc</td>
<td>15.0</td>
</tr>
<tr>
<td>7</td>
<td>Agriculture Development Program</td>
<td>10.0</td>
</tr>
<tr>
<td>8</td>
<td>Total</td>
<td>100.00</td>
</tr>
<tr>
<td>9</td>
<td>Cost of implementation 5% of 1 to 7</td>
<td>5.0</td>
</tr>
<tr>
<td>10</td>
<td>Administrative and Misc. Expenses for monitoring and evaluation 5% of 1 to 7</td>
<td>5.0</td>
</tr>
<tr>
<td>11</td>
<td>Contingency @5 % of 1 to 7</td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>115.0</strong></td>
</tr>
<tr>
<td></td>
<td><strong>For Five years</strong></td>
<td><strong>575.0</strong></td>
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</tbody>
</table>
7.12 SOLVENT RECOVERY PLAN

<table>
<thead>
<tr>
<th>Name of Solvent</th>
<th>Total Input Kg</th>
<th>Qty of Solvent Recycled Kg</th>
<th>Qty of Losses Kg</th>
<th>% Recovery</th>
<th>% Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xylene</td>
<td>5622</td>
<td>5454</td>
<td>168</td>
<td>97</td>
<td>3</td>
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<tr>
<td>Toluene</td>
<td>2863</td>
<td>2763</td>
<td>100</td>
<td>96.5</td>
<td>3.5</td>
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<tr>
<td>Remax-II</td>
<td>2540</td>
<td>2464</td>
<td>76</td>
<td>97</td>
<td>3</td>
</tr>
</tbody>
</table>

SOLVENT MANAGEMENT PLAN

- All the solvents shall be directly distilled from product mixes and; if required shall be purified in packed column with the help of reflux and therefore there is no generation of any distillation residue from the solvent distillation.

- The solvent distillation system shall be designed so as to achieve minimum 99.0 % recovery of solvent.

- Pure solvent, crude solvent and distilled (recovered) solvent shall be stored only in storage tanks and we shall not be using drums at any stage in the Solvent Management System.

- Wherever required, the solvents shall be directly pumped into day tanks from the storage tanks and shall be charged into the reactors without involving any manual handling.

- All the pumps shall be mechanical seal type to avoid any leakage of solvent.

- All necessary fire fighting systems shall be provided with alarm system. Flame proof wiring and flame proof electrical accessories shall be provided to avoid any mishap.

- All the storage tank and day tank shall be connected to a vent system through cooling water and chilled brine condensers to prevent loss of solvents in the atmosphere.

- All the distillation column vents are also connected to cooling water/ chilled brine condensers for maximum possible recovery of the solvents.

- All the vents will be connected to a common carbon Adsorber for removing traces of solvent from vent gases.

- Residue generated from the distillation will be incinerated in-house or sent to BEIL incinerator site.
• Coolant to be used
  
  Primary Condensers  
  Secondary Condensers  
  Vent Condensers  
  
  Cooling Water  
  Chilled Brine up to -15°C  
  Chilled Brine up to -15°C
### 7.13 CAPITAL COST FOR ENVIRONMENTAL MANAGEMENT.

Capital and operating expenditures for environment protection measures i.e EMP EMP BUDGET. Capital and operating expenditures for environment protection measures i.e EMP

<table>
<thead>
<tr>
<th>Sr.No</th>
<th>Particulars</th>
<th>Capital Cost Lac</th>
<th>Recurring Cost per Annum in Lac</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Air pollution control</td>
<td>150</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Water pollution control</td>
<td>800</td>
<td>27</td>
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<tr>
<td>3</td>
<td>Solid/hazardous waste management</td>
<td>20</td>
<td>65</td>
</tr>
<tr>
<td>4</td>
<td>Noise pollution control</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Occupational Health</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>Environment Monitoring and Management</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>Green Belt Development</td>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>Others-Consultation and Training</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>Construction Safety</td>
<td>5</td>
<td>30</td>
</tr>
<tr>
<td>10</td>
<td>Total</td>
<td><strong>1040</strong></td>
<td><strong>134</strong></td>
</tr>
</tbody>
</table>
CHAPTER - 8

SUMMARY & CONCLUSION

SUMMARY

for

PROPOSED SPECIALITY CHEMICAL MANUFACTURING PLANT

of

M/S. DAI –ICHI KARKARIA LTD.

PLOT NO. D2/20, GIDC, DAHEJ – II,

DISTRICT: BHARUCH,

GUJARAT.
8.1 INTRODUCTION

Dai Ichi Karkaria Ltd. (DIKL) is a part of the Neterwala Group of companies. DIKL began its operations in 1963 and pioneered production of Textile Auxiliaries in India at its plant located at Kasarwadi, 15 km. from Pune. Today DIKL has become a reputed name in development and manufacture of Surfactants and Specialty Chemicals with more than 52 years of experience.

M/s. Dai –Ichi Karkaria ltd. intends to set up a unit for manufacturing specialty chemicals at plot no. D2/20, GIDC, Dahej – II, District: Bharuch, Gujarat

COMPANY PROFILE

DIKL, cater to Oil exploration and Refining, Textiles including synthetics, Plastics, Effluent Treatment, Coal and Iron ore, Mining, Paper, Pharmaceutical and Cosmetics Industries. Its manufacturing techniques cover

- Surfactants (Anionic/ Cationic/ Non Ionic)
- Oil field Chemicals
- Sizing agents/ Formulated Products/ Construction chemicals/ Miscellaneous

The production facility is flexible and is well equipped with sophisticated automatic controls, suitable for carrying out different types of reactions to cover range of products.

a. Research & Development

Their research and development facility will be well equipped with advanced equipments for chemical analysis, process design and quality control. Quality research is the foundation on which their production capitalizes. Every aspect of purchase, manufacturing and marketing revolves around the performance of the product.

b. Environment

Their respect for the environment is reflected in their commitment & common objectives for continuous efforts by ensuring environmentally sound practices followed at all levels. They not only adhere to the statutory norms but have a holistic approach towards environmental protection. The major environmental issues addressed are:
Proposed manufacturing processes are studied in detail with a view to minimize
 generation of liquid/gaseous waste streams as a part of continuous improvement.

A specially constituted Pollution Control Cell at their R&D centre will be
developed for environment protection at their manufacturing plants. Their
Pollution Cell in fact will also help out smaller industrial units that do not have
capabilities and infrastructure for such jobs. The efforts of their team will be not
aimed at just pollution minimization but also to conserve energy, improve
process yields and product quality.

At their proposed manufacturing sites they ensure a clean environment by:

- Continuously operating Effluent Treatment Plants
- Controlling NOx, SO2 emission
- Monitoring of ambient air quality
- Monitoring of effluents and emission quality
- Safely disposing solid wastes
- A regular review of the Safety measures and HAZOP study is undertaken to
  ensure that the plants and those working there are protected.

The above practices help in achieving strict compliance with statutory standards laid
down by Gujarat Pollution Control Board for plant effluent and emission quality.

**PROMOTERS AND THEIR BACK GROUND**

The Company’s Board of Directors comprises of a Chairperson & Managing Director and
other Non-Executive Directors. Out of the Non-Executive Directors, some are
Independent Directors. The Chairperson is a promoter of the Company. The Board’s
composition meets with the stipulated requirement of at least one-half of the Board
comprising of Independent Directors.
8.2 Product and Capacity

LIST OF PRODUCTS ALONG WITH THEIR PRODUCTION CAPACITY

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of Products</th>
<th>Quantity MT/Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Non Ionic Surface Active Agents</td>
<td>1000</td>
</tr>
<tr>
<td>2.</td>
<td>Additives for Oil Field Industries</td>
<td>1000</td>
</tr>
<tr>
<td>3.</td>
<td>Anionic &amp; Cationic Surface active agents</td>
<td>1100</td>
</tr>
<tr>
<td>4.</td>
<td>Sizing Agents (construction &amp; misc.)</td>
<td>900</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>4000</strong></td>
</tr>
</tbody>
</table>

8.3 Water Requirement, Waste Water Generation and Treatment:

Total water requirement will be 226 m$^3$/day which will be met through GIDC water supply. The wastewater generation is 120 m$^3$/day. The treated effluent will be sent to propose RO unit. The RO permeate (84 m$^3$/day) will be reused for industrial purpose. RO Reject (36 m$^3$/day) will be allowed in MEE.

8.4 Air Pollution Source and Control Management:

The source of air pollution due to the project will be Flue Gas Emissions. The source of Flue Gas will be from the stack attach to Steam Boiler, Thermopack & DG Set efficient Dust collector & Bag Filter will be installed to prevent air pollution. D.G. Set will be provided for emergency power backup.

**Flue Gas Emission**

1. DETAILS OF FLUE GAS EMISSION

<table>
<thead>
<tr>
<th>SR. NO.</th>
<th>STACKS ATTACHED TO</th>
<th>FUEL</th>
<th>APCM</th>
<th>HEIGHT (m)</th>
<th>DIA (m)</th>
<th>Temp $^\circ$C</th>
<th>Velocity m/sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Boiler Combi pack</td>
<td>Biomass Briquette@960 Kg/ hr</td>
<td>Bag Filter &amp; Scrubber</td>
<td>36</td>
<td>1.0</td>
<td>120</td>
<td>7.02</td>
</tr>
<tr>
<td></td>
<td>(6 T/Hr)</td>
<td>960 Kg/ hr</td>
<td>36</td>
<td>1.0</td>
<td>120</td>
<td>7.02</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Boiler RF 40</td>
<td>Furnace Oil@240 Lts/ hr</td>
<td>Scrubber</td>
<td>36</td>
<td>1.0</td>
<td>120</td>
<td>6.87</td>
</tr>
<tr>
<td></td>
<td>(4 T/Hr)</td>
<td>240 Lts/ hr</td>
<td>36</td>
<td>1.0</td>
<td>120</td>
<td>6.87</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Thermic Fluid Heater</td>
<td>HSD @ 35 lit/hr</td>
<td>-</td>
<td>30.5</td>
<td>0.3</td>
<td>200</td>
<td>5.7</td>
</tr>
<tr>
<td></td>
<td>(4Lac cal/ Hr)</td>
<td></td>
<td>-</td>
<td>30.5</td>
<td>0.3</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>D.G.Set -1</td>
<td>25Lit/hr</td>
<td>-</td>
<td>11</td>
<td>0.3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(750 KVA)</td>
<td></td>
<td>-</td>
<td>11</td>
<td>0.3</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STACK EMISSIONS</th>
<th>SPM – 150 mg/Nm$^3$</th>
<th>SO$_2$ – 100 ppm *</th>
<th>NOx – 50 ppm *</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8- 4
2. Details of Process Vent

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Emission</th>
<th>APCM</th>
<th>HEIGHT (m)</th>
<th>DIA (m)</th>
<th>Temp °C</th>
<th>Velocity m/sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO₂</td>
<td>40 mg/Nm³</td>
<td>Two Stage Scrubber</td>
<td>15</td>
<td>0.2</td>
<td>40</td>
<td>2.41</td>
</tr>
</tbody>
</table>

8.5 Hazardous Waste:
Six Categories of Hazardous/Solid Wastes shall be generated from this Unit.
ETP Sludge will be Collected, Stored, Transported and Disposed at common TSDF by M/s. BEIL. Incinerable Waste & Filter Cake will be Collected, Stored, Transported and Disposed at common Incineration by M/s. BEIL, Dahej. Used Oil will be Collected, Stored, and Transported & selling to GPCB Authorised Re-refiners/recyclers. Fly Ash will be Collected & sold to Brick Manufacturers.
Hazardous waste generation quantity, physical characteristics and mode of disposal are given in Table bellow

DETAILS OF HAZARDOUS WASTE AND ITS MODE OF DISPOSAL

<table>
<thead>
<tr>
<th>SR. NO.</th>
<th>NAME OF WASTE</th>
<th>WASTE CATEGORY</th>
<th>TOTAL QTY.</th>
<th>MODE OF DISPOSAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Chemical Sludge from Waste Water Treatment</td>
<td>34.3</td>
<td>400 MT/Year</td>
<td>Collection, Storage, Transportation and Disposal by land filling at nearest TSDF site (BEIL)</td>
</tr>
<tr>
<td>2</td>
<td>Filters and filter material which have organic liquids in them</td>
<td>35.1</td>
<td>200 MT/Year</td>
<td>Collection, Storage, Transportation and Disposal by Common incineration CHWI of M/s. BEIL.</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Quantity</td>
<td>Rate</td>
<td>Disposal Method</td>
</tr>
<tr>
<td>---</td>
<td>---------------------------</td>
<td>----------</td>
<td>--------</td>
<td>---------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>3</td>
<td>Used/Spent oil</td>
<td>5.1</td>
<td>1 KL/Year</td>
<td>Collection, Storage, Transportation and Disposal by selling to GPCB Authorised Re-refiners/recyclers</td>
</tr>
<tr>
<td>4</td>
<td>Organic Residue</td>
<td>33.1</td>
<td>400 MT/Year</td>
<td>Collection, Storage, Transportation and Disposal by Common incineration CHWI of M/s. BEIL.</td>
</tr>
<tr>
<td>5</td>
<td>Discarded Drum</td>
<td>33.3</td>
<td>6000 Nos./Year</td>
<td>Collection, Storage, Transportation and Disposal by selling to GPCB Authorised Vendors</td>
</tr>
<tr>
<td>6</td>
<td>Fly Ash</td>
<td>--</td>
<td>96 Kg/hr</td>
<td>Sell to Brick Manufacturer or Collection, Storage, Transportation &amp; Disposal by land filling at TSDF site (BEIL)</td>
</tr>
</tbody>
</table>

### 8.6 Green Belt:

Total Plot Area is of 15856 m² out of which 4200 m² (approx.) i.e. 26 % of land shall be utilized for the green belt area.

### 8.7 Power Requirements:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Particulars</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Power Requirement</td>
<td>2212.5 KVA</td>
</tr>
<tr>
<td>2</td>
<td>Source of Supply</td>
<td>D.G.SET (Standby Facility)– 1 NOS. X 750 KVA &amp; 1 NOS. X 200 KVA</td>
</tr>
</tbody>
</table>

### 8.8 Fuel requirement:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Particulars</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 1      | Fuel & its consumption | Biomass Briquette@960 Kg/ hr  
HSD @ 35 lit/hr  
Furnace Oil@ 240 Lts/hr  
HSD = 25 LIT/HR FOR 200KVA DG SET, 100 LIT/HR FOR 750KVA DG SET |
## 8.9 Storage details of Hazardous Chemicals

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Tank-1</th>
<th>Tank-2</th>
<th>Tank-3</th>
<th>Tank-4</th>
<th>Tank-5</th>
<th>Tank-6</th>
<th>Tank-7</th>
<th>Tank-8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Stored</td>
<td>EO</td>
<td>EO</td>
<td>PO</td>
<td>XYLENE</td>
<td>XYLENE</td>
<td>XYLENE</td>
<td>XYLENE</td>
<td>TOLUENE</td>
</tr>
<tr>
<td>Location</td>
<td>Above ground</td>
<td>Above ground</td>
<td>Above ground</td>
<td>Underground</td>
<td>Underground</td>
<td>Underground</td>
<td>Underground</td>
<td>Underground</td>
</tr>
<tr>
<td>Diameter</td>
<td>2 m</td>
<td>2 m</td>
<td>2 m</td>
<td>3 m</td>
<td>3 m</td>
<td>3 m</td>
<td>3 m</td>
<td>1.94 m</td>
</tr>
<tr>
<td>Length</td>
<td>10 m</td>
<td>10 m</td>
<td>10.9 m</td>
<td>10.5 m</td>
<td>10.5 m</td>
<td>10.5 m</td>
<td>10.5 m</td>
<td>5.24 m</td>
</tr>
<tr>
<td>Thickness</td>
<td>12 mm</td>
<td>12 mm</td>
<td>12 mm</td>
<td>8 mm</td>
<td>8 mm</td>
<td>8 mm</td>
<td>8 mm</td>
<td>8 mm</td>
</tr>
<tr>
<td>Type</td>
<td>Horizontal Bullet</td>
<td>Horizontal Bullet</td>
<td>Horizontal Bullet</td>
<td>Horizontal with flat ends</td>
<td>Horizontal with flat ends</td>
<td>Horizontal with flat ends</td>
<td>Horizontal with flat ends</td>
<td>Horizontal with flat ends</td>
</tr>
<tr>
<td>Capacity (water filled)</td>
<td>31 KL</td>
<td>31 KL</td>
<td>34 KL</td>
<td>72 KL</td>
<td>72 KL</td>
<td>72 KL</td>
<td>72 KL</td>
<td>14.4 KL</td>
</tr>
<tr>
<td>Capacity (Liq Stored)</td>
<td>20 KL</td>
<td>20 KL</td>
<td>27 KL</td>
<td>75 KL</td>
<td>75 KL</td>
<td>75 KL</td>
<td>75 KL</td>
<td>15 KL</td>
</tr>
<tr>
<td>Operating Pressure kg/cm²</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>Atmospheric pressure</td>
<td>Atmospheric pressure</td>
<td>Atmospheric pressure</td>
<td>Atmospheric pressure</td>
<td>Atmospheric pressure</td>
</tr>
<tr>
<td>Dyke Details (m x m x m)</td>
<td>5 x 14 x 0.45</td>
<td>5 x 14 x 0.45</td>
<td>6 x 15 x 0.45</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Dyke Capacity (m³)</td>
<td>31.5</td>
<td>31.5</td>
<td>40.5</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Cooling area provided</td>
<td>Yes (limpet coil)</td>
<td>Yes (limpet coil)</td>
<td>Yes (limpet coil)</td>
<td>Not Applicable</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Relief valve release rate</td>
<td>8.46 x 2</td>
<td>8.46 x 2</td>
<td>46 x 2</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
</tr>
</tbody>
</table>
8.10 Capital and recurring cost earmarked for environmental protection measures:

<table>
<thead>
<tr>
<th>Sr.No</th>
<th>Particulars</th>
<th>Capital Cost Lac</th>
<th>Recurring Cost per Annum in Lac</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Air pollution control</td>
<td>150</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Water pollution control</td>
<td>800</td>
<td>27</td>
</tr>
<tr>
<td>3</td>
<td>Solid/hazardous waste management</td>
<td>20</td>
<td>65</td>
</tr>
<tr>
<td>4</td>
<td>Noise pollution control</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Occupational Health</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>Environment Monitoring and Management</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>Green Belt Development</td>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>Others-Consultation and Training</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>Construction Safety</td>
<td>5</td>
<td>30</td>
</tr>
<tr>
<td>10</td>
<td>Total</td>
<td>1040</td>
<td>134</td>
</tr>
</tbody>
</table>

8.11 Conclusion

It can be concluded that the proposed project is beneficial in the interest of common man, the society, the state and as the country as a whole. The benefits can be summarized as below:

- The proposed project will provide quality product at lower cost to the users.
- There should be positive impact on the socio-economic condition of the area in terms of direct and indirect employment due to the proposed project.
- Numbers of local trained persons are likely to get jobs.
- Country will save valuable foreign exchange as import of these products will be reduced by corresponding amount.
- These products also have export potential. Hence, possibility of earning foreign exchange.
CHAPTER – 9:
DISCLOSURE OF CONSULTANTS ENGAGED

Aqua-Air Environmental Engineers Pvt. Ltd.

Environmental Management Consultants & Equipments Supplier

NABL LABORATORY

ISO 9001:2008 Certified Company
COMPANY PROFILE

Aqua-Air Environmental Engineers Pvt. Ltd. is a Surat based company; one of the leading and multidiscipline Environmental Management Consulting firms of the region.

Aqua-Air Environmental Engineers Pvt. Ltd. was founded by Mr. Jayesh S. Patel & Mrs. Archana J. Patel on May 7, 2008 and Aqua-Air Environmental Engineers Pvt. Ltd. was registered under the companies Act on May 7, 2008.

Office having 3756 Sq. Ft. of area covering EC/EIA Department, R & D Centre (Environmental Laboratory), Consent (NOC/CC&A) Department, ETP/Civil Department and Account Department, Library, Conference room and Administration Department, etc. with experienced and qualified staff to render services in the field of Environmental Management of various types of industries.

Aqua-Air Environmental Engineers Pvt. Ltd. has a well-established track record in monitoring legislation and developing and implementing strategies for organizations that enable them to manage the impact of environmental issues on their business.

The company has built a reputation for delivering innovative and practical solutions to environment related business issues. These solutions help our clients to achieve successful business outcomes and make sustainable environment serving improvements within their business operations.


Aqua-Air Environmental Engineers Pvt. Ltd. received the Certificate of Registration of Trade Mark, Section 23 (2), Rule 62 (1) from Trade Marks Registry, Govt. of India on January 18, 2011.

The company’s work is spread over all the region of Gujarat in India. Company have already conducted EIA studies and EIA / EMP reports prepared for more than 276 units that includes Water related Projects / Pesticide Industry Projects / Textile Industry Projects / Sugar Industry Projects / Chemical Industries / Chemical Fertilizer Industry Projects / Cement Plants / Thermal Power Plants / Mining Projects / Infrastructure Projects / Construction Projects / Distilleries / Petrochemical Industry Projects/ SEZ Project/ CRZ Project etc.

Company’s NABL Accredited Testing Laboratory has conducted Environmental Monitoring & Analysis with Environmental Institute and Gujarat Pollution Control Board in Industrial Estates of Ankleshwar, Panoli & Jhagadia. Company is also doing Turnkey/Consulting Projects for M/s. BASF (Detail
Engineering for Effluent Treatment Plant) & M/s. Reva Proteins Ltd. (Design of Effluent Treatment Plant, supply of mechanical items, Commissioning and operation of Effluent Treatment Plant).
2. ABOUT US

Aqua-Air Environmental Engineers Pvt. Ltd. has registered office in one of the top five fastest growing cities of India – Surat. We are one of the most trusted and reliable environmental and engineering consultancy service providers. With complete hold in the related domain and proficiency, we execute our work all over Gujarat region.

In addition to engineering consultancy, we also execute turnkey projects for effluent treatment plants at the client's site.

Aqua-Air Environmental Engineers Pvt. Ltd is:
- One of the leading companies in the region providing high quality services in environmental engineering to the best of client's satisfaction.
- Posses a well - developed design office with Computer Center and Laboratory -cum- R&D Center to carry out designing and analysis in the field of environmental engineering.
- Recognized as Schedule-II Environmental Auditor under the Environment Audit Scheme proposed by the Hon'ble High Court of Gujarat.
- Listed with Gujarat Pollution Control Board as Consultants and proposing to get enlisted with GPCB as Pollution Control Equipment Suppliers.
- Going to become a member of Consulting Engineers Association of India.
- Having well-developed library to render services in the field of environmental auditing, consulting, monitoring and analysis.

3. ACHIEVEMENTS

1. Registered under the companies Act on May 7, 2008.
4. Solvency Certificate of Rs. 1,40,00,000/- received from Bank of India, Gopipura branch, Surat on Sept. 3, 2010.

6. Certificate of Registration of Trade Mark, Section 23 (2), Rule 62 (1) from Trade Marks Registry, Govt. of India on Jan. 18, 2011.

7. Certificate of Authorization as dealer in India received from Spectrum Technologies, Inc., USA on May 1, 2011.


4. SERVICE PROVIDE

M/s. AQUA-AIR ENVIRONMENTAL ENGINEERS PVT. LTD. offers following specialized services in Environmental Engineering, Water Supply Engineering and Civil Engineering.

4.1 TURN KEY/BOOT/BOO PROJECTS

4.1.1 ENVIRONMENTAL ENGINEERING

- Detailed design
- Construction
- Fabrication
- Piping
- Electrification
- Supply
- Erection
- Testing and Commissioning of Effluent Treatment Plants (ETPs)
- Sewage Treatment Plants (STPs)
- Water Treatment Plants (WTPs)
- Common Effluent Treatment Plants (CETPs)
- Recycling Plants (RPs)
- Zero Discharge Plants (ZDPs)
- Incineration System Plants (ISPs)
- Hazardous waste Storage areas (HWSAs)
- Secured/ Sanitary Landfill Facilities
- Bio–Medical Waste (BMW) Treatment Facilities on a turnkey or BOOT/BOO basis.

4.1.2 CIVIL ENGINEERING
Construction of

- Water Treatment Plan
- Sewage Treatment plant
- Industrial Wastewater Treatment plant
- Elevated Service Reservoirs (ESRs)
- Underground Reservoirs (UGRs)
- Sewage Pumping Stations, etc.
4.2 CONSULTING

4.2.1 ENVIRONMENTAL ENGINEERING

1. **Complete study of the Pollution Problem in industries from wastes generation to disposal and providing necessary technical knowledge like:**
   - How including design
   - Basic engineering, detailed engineering
   - Water Treatment Plants (WTPs)
   - Tender preparation for Effluent Treatment Plants (ETPs) for industrial wastewater
   - Sewage Treatment Plants (STPs) for residential wastewater
   - Common Effluent Treatment Plants (CETPs) for more than two industries
   - Zero Discharge Plants (ZDPs)
   - Recycling plants (RPs) for reuse of water up to maximum extent
   - Incineration System Plants (ISPs) for various non-biodegradable or toxic industrial wastes on Consulting basis
   - Design of Hazardous waste Storage area and Consultancy Services for Secure/ Sanitary Landfill Facilities
   - Design and Consultancy Services for Bio – Medical Waste Treatment Facilities.

2. **Water Supply Distribution System**
   - Analysis
   - Design
   - Tender preparation

3. **Laboratory Analysis of**
   - Air
   - Water
   - Sewage
   - Waste Water
   - Industrial Effluent
   - Industrial Sludge

4. **Process Study**
   - Reduce the pollution at source
   - Reuse / Recycle effluent

5. **Pollution Control Facility**
   - Performance study of existing
   - Suggesting scheme for the optimization of the facility

6. **Environment Management**
   - Environmental Clearance from
     - MoEF
     - New Delhi or DoEF
     - Gandhinagar
   - Environmental Impact Assessment Studies (EIAs)
     - Short term (Rapid)
     - Long term (Comprehensive)
   - Environmental statements
   - Environmental Auditing

7. **Statutory Requirements under Factory Act**
   - Safety Audit
   - On-site / Off-site Emergency Plan
   - HAZOP study

8. **For Various Energy Conservation Schemes**
   - Energy Audit
   - Design
9. Environmental Management System
   - Preparing Adequacy Report
   - Preparing Efficacy Report

10. Operation and Maintenance (O & M)
    - Effluent Treatment Plants (ETPs)
    - Water Treatment Plants (WTPs)
    - Sewage Treatment Plants (STPs)

11. Air Monitoring
    - Ambient Air
    - Stack
    - Vent

12. Design of Pollution Control Equipment
    - Cyclone
    - Scrubbers
    - Bag Filters, fume extraction systems
    - Blowers
    - Aerator
    - Agitators
    - Flash mixers
    - Reaction Vessels
    - Clarifloculators
    - Scraper Mechanisms
    - Incinerators
    - Scrubbers, etc.

13. Pollution Control
    - Effluent Survey
    - Environmental review of Pollution control equipment and systems
    - Feasibility Studies
    - Laboratory bench scale Treatability studies
    - Pilot Plant studies etc.

14. Consulting Service
    - NOC
    - Water Consent
    - Air Consent
    - Hazardous Waste Authorization Application, etc.

15. As per requirements under Factory Act-1948 and Gujarat Factory Rules
    - Monitoring
    - Analysis of Work Area Environment
    - filling up Form-37
    - Clearance
    - Consents

16. Technical Consultation & assistance to ensure and assure compete Environ-Legal compliance
    - Liaison with statutory bodies in order to get the required permits

4.3 EQUIPMENT MFG. /TRADING

4.3.1 ENVIRONMENTAL ENGINEERING

1. Manufacture and supply of Pollution Control Equipment such as
   - Incinerators With scrubbers
   - Autoclaves
   - Hydro-claves
   - Fixed Aerator
   - Floating Aerator
   - Submersible Aerator (EOLO2)
   - Submersible Mixers (RIO or BRIO)
   - Dissolved Air Flotation (DAF) units
   - Cyclone
   - Scrubbers
   - Bag Filters
   - Oil Skimmers
   - Deoiler Pipes
   - API separators
- Cascade Aerators
- Clarifier mechanisms
- Agitators
- Clariflocculator
- Clariflocculator mechanism
- Flash mixes
- Oil skimmers
- Vacuum Drum filters
- Solid bowl centrifuges
- Filter presses
- Belt filters
- Reaction vessels
- Reverse Osmosis, etc.