CHAPTER - 6

RISK ASSESSMENT

In order to support the environment impact assessment and environment management plan, following additional studies have been included in this report.

- Risk Assessment
- Onsite and Offsite Disaster (natural and manmade) Preparedness and Emergency Management Plan
- Occupational Health Program

6.1 SCOPE OF THIS STUDY:

The QRA study in this report has been conducted considering the Terms of References (TORs) given by Expert Appraisal Committee of MoEF and GPCB for Environment Clearance (EC).

The study has been carried out with a view to comply the following TOR points:

- **TOR No. 47**: Occupational health impacts on the workers and mitigation measures proposed to avoid the human health hazards along with the personal protective equipment to be provided. Provision of industrial hygienist and monitoring of the occupational injury to workers as well as impact on the workers. Plan for periodic medical checkup of the workers exposed.

- **TOR No. 49**: Risk assessment including prediction of the worst-case scenario and maximum credible accident scenarios should be carried out. The worst-case scenario should take into account the maximum inventory of storage at site at any point of time. The risk contours should be plotted on the plant layout map clearly showing which of the facilities would be affected in case of an accident taking place. Based on the same, proposed safeguard measures including On-Site / Off-Site Emergency Plan should be provided.

- **TOR No. 51**: Details of hazardous characteristics and toxicity of raw materials and products to be handled and the control measures proposed to ensure safety and avoid the human health impacts. This shall include the details of Antidotes also.

- **TOR No. 52**: Details of quantity of each hazardous chemical (including solvents) to be stored, Material of Construction of major hazardous chemical storage tanks, dyke details, threshold storage quantity as per schedules of the Manufacture, Storage & Import of Hazardous Chemicals Rules of major hazardous chemicals, size of the biggest storage tank to be provided for each raw material & product etc. How the manual handling of the hazardous chemicals will be minimized?
EIAREPORT OFM/S. OM SHIV INDUSTRIES, PANOLI GIDC, BHARUCH.

- **TOR No. 53:** Details of the separate isolated storage area for flammable chemicals. Details of flame proof electrical fittings, DCP extinguishers and other safety measures proposed. Detailed fire control plan for flammable substances and processes showing hydrant pipeline network, provision of DG Sets, fire pumps, jockey pump, toxic gas detectors etc.

- **TOR No. 54:** Submit checklist in the form of Do’s & Don’ts of preventive maintenance, strengthening of HSE, manufacturing utility staff for safety related measures.

- **Part A. Std TOR NO.: 3.9:** Hazard identification and details of proposed safety systems.

- **Part A. Std TOR NO.: 7.13** Onsite and Offsite Disaster (natural and Man-made) Preparedness and Emergency Management Plan including Risk Assessment and damage control. Disaster management plan should be linked with District Disaster Management Plan.

- **Part A. Std TOR NO.: 8 Occupational Health:**
  
i. Plan and fund allocation to ensure the occupational health & safety of all contract and casual workers.

  ii. Details of exposure specific health status evaluation of worker. If the workers' health is being evaluated by pre designed format, chest X-rays, Audiometry, Spirometry, Vision testing (Far & Near vision, colour vision and any other ocular defect) ECG, during pre-placement and periodical examinations give the details of the same. Details regarding last month analyzed data of above mentioned parameters as per age, sex; duration of exposure and department wise.

  iii. Details of existing Occupational & Safety Hazards. What are the exposure levels of above mentioned hazards and whether they are within Permissible Exposure level (PEL). If these are not within PEL, what measures the company has adopted to keep them within PEL so that the health of the workers can be preserved.


- **Specific TOR No. 13:** Risk assessment for storage and handling of hazardous chemicals/solvents. Action plan for handling & safety system to be incorporated.

- **Specific TOR No. 14:** Arrangements for ensuring health and safety of workers engaged in handling of toxic materials.
6.2 INTRODUCTION TO RISK ASSESSMENT

M/s. Om Shiv Industries, for its upcoming new unit in Panoli, shall handle chemicals, some of which are hazardous in nature by virtue of their intrinsic chemical properties or their operating temperatures or pressures or a combination of them. Fire, toxic release or combinations of them are the hazards associated with industrial plants using hazardous chemicals. More comprehensive, systematic and sophisticated methods of Safety Engineering, such as, Hazard Analysis and Qualitative/Quantitative Risk Assessment have been developed to improve upon the integrity, reliability and safety of industrial plants, the same has been discussed in detail under their respective headings.

6.2.1 OBJECTIVES OF RISK ASSESSMENT

Risk analysis follows an extensive hazard analysis. It involves the identification and assessment of risks the neighbouring 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 analysis is often confined to maximum credible accident studies.

Risk assessment is carried out for the following objectives:

1. To identify hazard and risk resulting from the hazards
2. To study and foresee the effects of such risks on the workers, public, property and environment and to find out necessary control measures to prevent or minimize risk.
3. To comply the legal requirement by various safety and environment laws of the country like…
   • The Factories Act, 1948 / The Gujarat Factories Act, 1963
   • The Environment Protection Act and Rules, 1986
   • Hazardous waste (Management & Handling) Rules, 1989
   • Public Liability Insurance Act & Rules, 1991
   • Chemical Accident, (Emergency, planning, preparedness and response) Rules, 1996
4. To get the necessary information for Emergency planning and evacuation.
6.2.2  PLANT LAYOUT

The below plant layout shows details of **STORAGE FACILITIES, ADEQUATE MARGIN ALL ROUND THE PERIPHERY.**

**FIGURE: 6.1**

**HAZARDOUS CHEMICAL COMPANY LAYOUT**
## TABLE 6.1

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Name of the Raw Materials</th>
<th>Quantity stored</th>
<th>Mode of Storage &amp; Material of Construction for the same</th>
<th>State</th>
<th>Possible type of hazards</th>
<th>Proposed Control Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Toluene</td>
<td>10 KL</td>
<td>Tank Liquid</td>
<td>Liquid</td>
<td>Flammable</td>
<td>Proper storage area shall be provided.</td>
</tr>
<tr>
<td>2</td>
<td>Methanol</td>
<td>5 KL</td>
<td>Tank Liquid</td>
<td>Liquid</td>
<td>Flammable</td>
<td>Eye wash station shall be provided.</td>
</tr>
<tr>
<td>3</td>
<td>N-Hexane</td>
<td>10 KL</td>
<td>Tank Liquid</td>
<td>Liquid</td>
<td>Flammable</td>
<td>Chilling Water Circulation shall be provided.</td>
</tr>
<tr>
<td>4</td>
<td>Dimethylamine</td>
<td>200L</td>
<td>Drums Liquid</td>
<td>Liquid</td>
<td>Flammable</td>
<td>Specialist to be consulted, if required..</td>
</tr>
<tr>
<td>5</td>
<td>Ammonia</td>
<td>100Kg</td>
<td>Cylinder Gas</td>
<td>Gas</td>
<td>Toxic</td>
<td>PPEs shall be used.</td>
</tr>
<tr>
<td>6</td>
<td>Thionyl Chloride</td>
<td>200L</td>
<td>Drums Liquid</td>
<td>Liquid</td>
<td>Toxic</td>
<td>Self contained breathing apparatus shall be used</td>
</tr>
<tr>
<td>7</td>
<td>Chlorine</td>
<td>900Kg</td>
<td>Tonner Gas</td>
<td>Gas</td>
<td>Toxic</td>
<td>PPEs like Splash goggles, Full suit, Vapor respirator or self-contained breathing apparatus, Gloves etc., shall be used while handling this chemical.</td>
</tr>
</tbody>
</table>

### NOTES:

1. The size of the biggest storage tank is 10 KL and Dyke of sufficient capacity (i.e. 10% extra than tank capacity) shall be provided for all the chemicals stored in tanks.
2. The unit shall be classified as Non Major Accident Hazard (NMAH) unit based on the quantity of Hazardous Chemicals stored at site, as the quantity of these chemicals being stored within the factory premises are well within the threshold storage quantity as per schedules of Manufacture, Storage & Import of Hazardous Chemicals (MSIHC) Rules of major hazardous chemicals.
TABLE 6.2
PROPERTIES OF HAZARDOUS CHEMICALS

<table>
<thead>
<tr>
<th>Sr. no</th>
<th>Chemical</th>
<th>Physical State</th>
<th>FP °C</th>
<th>BP °C</th>
<th>SP. GR @ 20°C</th>
<th>Vap. Den. @ 20°C</th>
<th>Vap. Pr. @ 20°C</th>
<th>LEL %</th>
<th>UEL %</th>
<th>LD₅₀ ORAL mg/kg</th>
<th>LD₅₀ DERMAL mg/kg</th>
<th>LC₅₀ mg/L</th>
<th>IDLH Value by ACGIH/NIOSH</th>
<th>STEL by OSHA (PPM)</th>
<th>TLV-TWA by OSHA (PPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Toluene</td>
<td>Liq</td>
<td>4.4</td>
<td>110</td>
<td>0.87</td>
<td>3.2</td>
<td>3.8 KPa</td>
<td>1.3</td>
<td>7</td>
<td>636</td>
<td>14100</td>
<td>440</td>
<td>-</td>
<td>150</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>Methanol</td>
<td>Liq</td>
<td>12</td>
<td>64.5</td>
<td>0.79</td>
<td>1.1</td>
<td>12.26 kPa</td>
<td>6</td>
<td>36</td>
<td>5628 mg/kg [Rat]</td>
<td>20 mg/kg (Rabbit)</td>
<td>64000 ppm (Rat)</td>
<td>200</td>
<td>310</td>
<td>200 ppm</td>
</tr>
<tr>
<td>3</td>
<td>N-Hexane</td>
<td>Liq</td>
<td>-23</td>
<td>69</td>
<td>0.66</td>
<td>2.97</td>
<td>151 mm Hg @ 25°C</td>
<td>1.2</td>
<td>7.5</td>
<td>25 gm/Kg (Rat)</td>
<td>-</td>
<td>48000 ppm (Rat)</td>
<td>1,100 ppm</td>
<td>-</td>
<td>50 ppm</td>
</tr>
<tr>
<td>4</td>
<td>Dimethylamine</td>
<td>Liq</td>
<td>6.7</td>
<td>6.9</td>
<td>0.66</td>
<td>1.59</td>
<td>170 kPa</td>
<td>2.8</td>
<td>14.4</td>
<td>698 mg/kg (Rat)</td>
<td>-</td>
<td>4700 ppm (rat, 4 hr)</td>
<td>500 ppm</td>
<td>15 ppm</td>
<td>10 ppm</td>
</tr>
<tr>
<td>5</td>
<td>Ammonia</td>
<td>Gas</td>
<td>NA</td>
<td>-33</td>
<td>0.6</td>
<td>0.6</td>
<td>860 kpa</td>
<td>16</td>
<td>25</td>
<td>NA</td>
<td>NA</td>
<td>2000 ppm (rat, 4 hours)</td>
<td>300</td>
<td>ACGIH TLV-STEL: 35</td>
<td>ACGIH :25</td>
</tr>
<tr>
<td>6</td>
<td>Thionyl Chloride</td>
<td>Liq.</td>
<td>N.A</td>
<td>78.8</td>
<td>1.63</td>
<td>4.1</td>
<td>13.3 kPa</td>
<td>N. A</td>
<td>N. A</td>
<td>-</td>
<td>-</td>
<td>500 ppm 1 Hrs [Rat]</td>
<td>25 ppm</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>Chlorine</td>
<td>Gas</td>
<td>N.A</td>
<td>-34</td>
<td>2.47</td>
<td>2.5</td>
<td>5168</td>
<td>N. A</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>293 ppm</td>
<td>10 ppm</td>
<td>1 ppm</td>
<td>0.5 ppm</td>
</tr>
</tbody>
</table>
6.3 **RISK ASSESSMENT**

Identification of hazards in the proposed project activity is of primary significance. Hazard states the characteristics of system/plant/process that presents potential for an accident. All the components of a system/plant/process are 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.

**IDENTIFICATION OF HAZARDOUS AREAS**

At M/s Om Shiv Industries, major risks have been identified for the following areas:

- Tank Farm area,
- Chlorine Shed,
- Ammonia Cylinder Storage Area,
- Warehouse.

As a conservative approach, we have analyzed the risk qualitatively and quantitatively both.

In this study, we have considered the following:

- Storage & Handling of hazardous chemicals like Toluene, Methanol, N-Hexane, Dimethyl amine, Ammonia, Thionyl Chloride and Chlorine have been considered for Consequence Analysis. Their storage location has been shown in Figure-6.2. Hazardous (physical & chemical) properties of these chemicals have been summarized in Table 6.2 B.
- Storage & Handling of Solid Chemicals, Caustic soda lye & Acids have been considered for Qualitative Risk Assessment.

6.3.1 **QUALITATIVE RISK ASSESSMENT**

Many a times Risk involved in various processes / process equipments cannot be addressed completely by Consequence Analysis. As a conservative approach, these risks have been considered separately under this topic. The approach is to identify hazards associated in operation of equipments as well as in processes, assessing its impacts, ranking the risk posed by it and finally to propose remedial actions/mitigation measures such that the risk is minimized to tolerable level.

The Risk Matrix presented below should be referred in evaluating this assessment.
In **Qualitative Risk Assessment**, risk has been analyzed using methodology called HIRA-Hazards Identification & Risk Assessment. In HIRA, major manual activities carried out by plant personnel as well as contract labours have been considered.

Qualitative Risk Assessment has been carried out for the following areas:
1. Storage and Handling of Solid Chemicals.
2. Storage and Handling of Caustic Lye.
3. Storage and Handling of Acids.

**TABLE: 6.3**

**RISK MATRIX FOR QUALITATIVE RISK ASSESSMENT**

<table>
<thead>
<tr>
<th>LIKEHOOD/PROBABILITY</th>
<th>SEVERITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Catastrophic (Death/System Loss)</td>
</tr>
<tr>
<td>Almost Certain</td>
<td>5</td>
</tr>
<tr>
<td>Likely</td>
<td>4</td>
</tr>
<tr>
<td>Possible</td>
<td>3</td>
</tr>
<tr>
<td>Unlikely</td>
<td>2</td>
</tr>
<tr>
<td>Impossible</td>
<td>1</td>
</tr>
</tbody>
</table>

**TABLE: 6.4**

**RISK RANGE & ACCEPTABILITY CRITERIA**

<table>
<thead>
<tr>
<th>Risk Range</th>
<th>Risk Acceptability Criteria</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>Medium</td>
<td>Generally Minor Impact. Acceptable with Management’s Review. Specific monitoring or SOP to be followed.</td>
</tr>
<tr>
<td>L</td>
<td>Low</td>
<td>Acceptable without Review. Manage through Routine Procedure.</td>
</tr>
</tbody>
</table>
## 6.3.1.1 STORAGE AND HANDLING OF SOLID CHEMICALS

### TABLE: 6.5

**RISKS AND RECOMMENDATIONS**

<table>
<thead>
<tr>
<th>SR No</th>
<th>PROCESS OR ACTIVITY</th>
<th>ASSOCIATED HAZARDS</th>
<th>HEALTH &amp; SAFETY IMPACT (RISK)</th>
<th>INITIAL RISK</th>
<th>EXISTING MEASURES</th>
<th>RESIDUAL RISK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SEVERITY</td>
<td>LIKELIHOOD</td>
<td>OBJ</td>
</tr>
<tr>
<td>1.</td>
<td>Handling Chemical bags</td>
<td>• Chemical Exposure.</td>
<td>• Skin/Eye irritation.</td>
<td>4</td>
<td>3</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Dusting.</td>
<td>• Ingestion &amp; Inhalation of dust powder.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>2</td>
<td>L</td>
</tr>
</tbody>
</table>

**ADDITIONAL RECOMMENDATIONS**

1. Operators/Workers to be trained for Safe Work Practices.
2. Chemical handling bags & dusty area to be labeled properly for each chemicals.
2. Cleaning of Chemical Spillage.

- Fumes Inhalation.
- Dust Exposure.
- Severe irritation to eyes, skin.
- Inhalation.

3 3 M

- Certified Dust respirator shall be used.
- PPEs shall be used.
- Chemicals will be stored in isolated storage rooms having provision for natural & forced ventilation.
- Spillage shall be cleaned or neutralized with suitable media.
- Fire fighting facilities shall be made available near storage locations, if required.
6.3.1.2 STORAGE AND HANDLING OF CAUSTIC LYE

TABLE: 6.6

RISKS AND RECOMMENDATIONS

<table>
<thead>
<tr>
<th>SR No</th>
<th>PROCESS OR ACTIVITY</th>
<th>-associated Hazards</th>
<th>HEALTH &amp; SAFETY IMPACT (RISK)</th>
<th>INITIAL RISK</th>
<th>EXISTING MEASURES</th>
<th>RESIDUAL RISK</th>
<th>ADDITIONAL RECOMMENDATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NaOH handling /Loading &amp; Unloading</td>
<td>• Exposure due to leakage from joints, corroded lines failure etc.</td>
<td>• Skin burn. • Eye irritation and respiratory disorder.</td>
<td>4 3 M</td>
<td>• Dyke shall be made available. • NaOH shall be stored in well ventilated area. • Eye wash station to be made available nearby. • Maintenance to be carried as per schedule. • Appropriate PPEs to be used.</td>
<td>4 2 L</td>
<td>3. Proper trainings to be provided to the operators/workers. 4. SOPs to be prepared and followed the same. 5. Corroded lines to be painted/replaced.</td>
</tr>
<tr>
<td>2</td>
<td>Working in Storage Area</td>
<td>• Exposure due to spillage</td>
<td>• Severe irritation to eyes, skin etc. • Internal body burns.</td>
<td>4 3 M</td>
<td>• Neutralization media to be kept available. • PPEs like face mask, gloves etc. shall be worn by concerned person. • Eye wash station to be made available nearby.</td>
<td>4 2 L</td>
<td></td>
</tr>
</tbody>
</table>
6.3.1.3 STORAGE AND HANDLING OF ACIDS

TABLE: 6.7

RISKS AND RECOMMENDATIONS

<table>
<thead>
<tr>
<th>SR No</th>
<th>PROCESS OR ACTIVITY</th>
<th>ASSOCIATED HAZARDS</th>
<th>HEALTH &amp; SAFETY IMPACT (RISK)</th>
<th>INITIAL RISK</th>
<th>EXISTING MEASURES</th>
<th>RESIDUAL RISK</th>
<th>ADDITIONAL RECOMMENDATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Loading &amp; Unloading of Acids Drums.</td>
<td>• Exposure to Acid fumes due to leakage in pipe/container/valves etc. • Spillage of liq. Acid.</td>
<td>• Skin/Eye irritation. • Toxic Vapor inhalation etc.</td>
<td>4 3 M</td>
<td>• Loading &amp; Unloading activity shall be carried out in well ventilated area. • Neutralization media shall be made available in areas where acid is stored/handled/used. • PPEs will be used.</td>
<td>4 2 L</td>
<td></td>
</tr>
</tbody>
</table>

3. Tank overflow
   • Chemical Exposure
   • Eyes and Skin irritation.

4. Level indicator to be made available and the same shall be checked for proper operation.
   • Dyke wall shall be made to contain the spill.
2. Working in Storage Area.
   - Exposure to acid fumes.
   - Severe irritation to eyes, skin.
   - Body burns.

   4 3 M
   - Storage area shall be well ventilated.
   - Neutralization shall be done immediately with soda ash/lime or spill shall be absorbed in sand or by suitable adsorbent.
   - PPEs like face mask, gloves etc. shall be worn by concerned person.
   - Floors shall be made of acid proof tiles.

3. Tank overflow/leakage from joints etc.
   - Exposure to acid fumes.
   - Severe irritation to eyes, skin.

   3 3 M
   - Same as Above.

7. Work Instruction for checking tank level to be prepared and followed.
6.3.2 QUANTITATIVE RISK ASSESSMENT

Quantitative Risk Assessment (QRA) is a structured approach to identifying and understanding the hazards & risks associated with Storage and Handling of flammable/toxic chemicals. The assessment starts by taking into account an inventory of hazardous chemicals stored, likelihood of leakage/spillage associated with it and selecting the worst case scenario for consequence estimation.

Finally, suggesting the measures to minimize or mitigate risks to meet appropriate acceptability criteria. The planning for emergency evacuation shall be borne in mind whilst interpreting the results.

❖ CONSEQUENCE ANALYSIS

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

❖ DAMAGE CRITERIA

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 as per the Guidelines for QRA – Phast (Micro) Software (DNV) & Purple Book for QRA released by Centre for Chemical Process Safety (CCPS).

Heat Radiation

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

- The radiation energy onto the human body [kW/m²];
- The exposure duration [sec];
- The protection of the skin tissue (clothed or naked body).
In this report following damage criteria has been considered for the effects due to Fire/Explosion.

**TABLE: 6.8**

**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>37.5</td>
<td>Immediate ignition of wood (without flame Contact). 100 % fatal.</td>
</tr>
<tr>
<td>25</td>
<td>Minimum Energy required for igniting wood (Without flame contact). 100 % fatal in 1 min. Significant injury in 10 sec.</td>
</tr>
<tr>
<td>12.5</td>
<td>Minimum heat required to ignite wood (With flame contact). 1 % fatal in 1 min. First degree burn in 10 sec.</td>
</tr>
<tr>
<td>4</td>
<td>Pain after 20 sec. Blistering unlikely.</td>
</tr>
<tr>
<td>2</td>
<td>No discomfort for long exposure.</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.

The following damage criteria may be distinguished with respect to the peak overpressures resulting from a blast wave:
TABLE: 6.9

DAMAGE DUE TO OVERPRESSURE

<table>
<thead>
<tr>
<th>Peak Overpressure</th>
<th>Damage Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.40 bar</td>
<td>Ear Drum Rupture to humans</td>
</tr>
<tr>
<td></td>
<td>50% probability of fatality inside</td>
</tr>
<tr>
<td></td>
<td>15% probability of fatality in open</td>
</tr>
<tr>
<td>0.21 bar</td>
<td>Structural Damage to buildings</td>
</tr>
<tr>
<td></td>
<td>20% probability of fatality to personnel inside</td>
</tr>
<tr>
<td></td>
<td>0% probability of fatality in the open</td>
</tr>
<tr>
<td>0.13 bar</td>
<td>Minor Structural Damage to nearby structures</td>
</tr>
<tr>
<td></td>
<td>10% probability of fatality to personnel inside</td>
</tr>
<tr>
<td></td>
<td>0% probability of fatality in the open</td>
</tr>
<tr>
<td>0.02 bar</td>
<td>Glass Damage</td>
</tr>
<tr>
<td>0.01 bar</td>
<td>Minor Damage</td>
</tr>
</tbody>
</table>

**Intoxication**

In this report, IDLH & LC50 Concentrations have been considered for Consequence Analysis.

**Assumptions for consequence Analysis**

For Consequence Analysis, assumptions regarding Meteorological, Pasquil Stability Classes, Wind velocity, Ambient Temperature, Relative Humidity, Inventory, Ground Roughness, Model used etc. are very important. In this report, the following assumptions have been considered.

**i. Meteorological Data**

- Atmospheric Conditions: No Inversion
- Ambient Temperature: 30 °C has been considered as MCA approach.
- Relative Humidity: As the site is not in rainy zone RH of 50% has been considered.

**ii. Pasquil Stability Classes**

- Pasquil Stability category D/F is considered as conservative approach.

**iii. Other assumptions:**

- Ground Roughness: Ground Roughness has been considered as 0.3 M.
- Dispersion model of both Heavy Model and also Gaussian distribution have been used as applicable/appropriate.
- Inventory: Release of 100% of the inventory has been considered. For this, failure of the container has been considered from the bottom.
Storage conditions: Storage conditions have been considered as they are practically stored at site.

Following Weather data has been used for the study:

<table>
<thead>
<tr>
<th>WIND SPEED (M/S)</th>
<th>PASQUILL STABILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>F</td>
</tr>
<tr>
<td>1.5</td>
<td>D</td>
</tr>
<tr>
<td>5</td>
<td>D</td>
</tr>
</tbody>
</table>

**SOFTWARE USED FOR CALCULATIONS**
1. PHAST MICRO
2. ALOHA

**SCENARIOS CONSIDERED FOR CONSEQUENCE ANALYSIS**
1. In this study, the scenarios for consequence analysis have been selected considering:
   - The physical and chemical properties of hazardous materials.
   - Storage conditions & Modes of Storage (Above ground Drums).
   - Hazards ranking by NFPA.
   - Guidelines by OSHA (29 CFR).
   - Operating and storage conditions of handling and storage of hazardous chemical.

2. This report considers the worst case scenario which is possible during any set of operation variable and production methodologies. 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.

In this regard, the failure cases which may lead to release of hazardous chemicals are as under, out of which maximum worst case shall be considered:

- Possible Release/Leakage from Barrel.
- Release due to tilting of drum having open barrel.
• Failure of leakage from 25mm hole size in case of unloading line.

3. The scenarios of flammable solvent storage tanks (if it is stored in tanks) have been considered assuming unavailability of bunds. Practically a bund shall be provided as per OISD guidelines.

4. In this study, results of consequence analysis shall be used for;
   a. Emergency Planning,
   b. Deciding Evacuation Routes,
   c. Deciding Location of Assembly Points and ECC,
   d. Resource Allocation for mitigation.

5. SCENARIOS IDENTIFIED FOR CONSEQUENCE ANALYSIS

<table>
<thead>
<tr>
<th>TABLE: 6.11</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCENARIOS IDENTIFIED FOR CONSEQUENCE ANALYSIS</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>Description of Scenario</th>
<th>Storage Pressure &amp; Temp.</th>
<th>Scenarios considered</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FLAMMABLE/EXPLOSION SCENARIOS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Toluene</td>
<td>Ambient</td>
<td>Flash Fire, UVCE, Late Pool Fire</td>
</tr>
<tr>
<td>2</td>
<td>Methanol</td>
<td>Ambient</td>
<td>Flash Fire, UVCE, Late Pool Fire</td>
</tr>
<tr>
<td>3</td>
<td>N-Hexane</td>
<td>Ambient</td>
<td>Flash Fire, UVCE, Late Pool Fire</td>
</tr>
<tr>
<td><strong>BOTH TOXIC &amp; FLAMMABLE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Dimethylamine</td>
<td>Ambient</td>
<td>Flash Fire, UVCE, Late Pool Fire Dispersion</td>
</tr>
<tr>
<td><strong>TOXIC GAS RELEASE SCENARIOS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Ammonia</td>
<td>Ambient Temp. Pressure- 18Bar</td>
<td>Max. Concentration</td>
</tr>
<tr>
<td>6</td>
<td>Release of Thionyl Chloride</td>
<td>Ambient</td>
<td>Dispersion</td>
</tr>
<tr>
<td>7</td>
<td>Release of Chlorine</td>
<td>Ambient Temp. Pressure- 19 Bar</td>
<td>Dispersion</td>
</tr>
</tbody>
</table>
Considerations Made:

- In Case of Solvents (i.e. Toluene, Methanol & N-Hexane) we have considered the failure case of unloading line (1” i.e. 25 mm pipe dia.) for a period of 10 mins. As the solvents tankers are compartmentalized, the maximum release quantity equals the storage quantity of a single compartment.

- In Case of Benzene & Dimethylamine, we have considered the following scenarios:

  Considering LC₅₀ concentration – 4700 ppm & IDLH concentration – 500 ppm

  ✓ We have considered the maximum worst case scenario as Release of Inventory due to 2” leakage due to tilting of Drums.

- In Case of Thionyl Chloride, we have considered the following scenarios:

  Considering LC₅₀ concentration – 500 ppm & IDLH concentration – 25 ppm

  ✓ Leak from 2” leakage due to tilting of Drum.

- In Case of Ammonia, we have considered the maximum worst case scenario as Release of Inventory due to 2mm leakage from Cylinder.

  Considering LC₅₀ concentration – 2000 ppm & IDLH concentration – 300 ppm

- In Case of Chlorine, we have considered the maximum worst case scenario as Release of Inventory due to 2mm leakage from Tonner.

  Considering LC₅₀ concentration – 293 ppm & IDLH concentration – 10 ppm

Note: Release of above chemicals from process equipments like Reactor or any other equipment is not possible as these chemicals will be in diluted/intermediate form in all process equipments and not in pure form.
• Selection Criteria of Scenarios:
  o As per the relevant guidelines for consequence analysis, we have considered the **maximum credible scenarios** for all the above mentioned chemicals, which is the representative of all kinds of minor/major leakages for the respective chemicals.
  o Modeling has been carried out for dispersion up to IDLH concentration, in case of toxic chemicals. Evacuation should be carried out in less than 30 min from the areas covered under IDLH in case of relevant leakage scenario. The purpose is to avoid irreversible health effects to persons inside the area of IDLH concentration.
  o Based on the **above considerations** and the **input parameters considered for worst case scenarios & maximum credible scenarios**, the **risk contours are plotted on the plant layout map** clearly showing which of the facilities would be affected in case of an accident taking place. Based on the same the **safety measures/recommendations are proposed** and **On-Site & Off-Site Emergency Plan shall be prepared** as mentioned under the section 6.6.
  o The worst-case scenario has taken into account the maximum inventory of storage at site at any point of time.
TABLE: 6.12

SCENARIO # 1 – RELEASE OF TOLUENE

Basis: Possible Release/Leakage due Failure of leakage from 25mm hole size in case of unloading line

<table>
<thead>
<tr>
<th>Input Data</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Leak Duration</td>
<td>600 secs</td>
</tr>
<tr>
<td>Leak Size considered</td>
<td>25 mm</td>
</tr>
<tr>
<td>Release Rate</td>
<td>5012.85 gms/sec</td>
</tr>
<tr>
<td>Pressure</td>
<td>atm</td>
</tr>
<tr>
<td>Temperature</td>
<td>30°C</td>
</tr>
<tr>
<td>Weather Condition</td>
<td>1.5/F, 1.5/D, 5/D</td>
</tr>
<tr>
<td>LFL</td>
<td>12000 ppm</td>
</tr>
<tr>
<td>UFL</td>
<td>71000 ppm</td>
</tr>
</tbody>
</table>

**CASE:1 FLASH FIRE**

<table>
<thead>
<tr>
<th>Distance (m)</th>
<th>Category 1.5/F</th>
<th>Category 1.5/D</th>
<th>Category 5/D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Furthest Extent 6000 ppm</td>
<td>7.86712</td>
<td>6.44707</td>
<td>1.9225</td>
</tr>
<tr>
<td>Furthest Extent 12000 ppm</td>
<td>2.18713</td>
<td>1.91935</td>
<td>1.50754</td>
</tr>
</tbody>
</table>

**CASE:2 VAPOUR CLOUD EXPLOSION (OVERPRESSURE RESULTS)**

NOT REACHED

**CASE:3 LATE POOL FIRE (EFFECTS OF RADIATION LEVEL)**

<table>
<thead>
<tr>
<th>Radiation Level</th>
<th>Distance (m)</th>
<th>Category 1.5/F</th>
<th>Category 1.5/D</th>
<th>Category 5/D</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 kW/m²</td>
<td>15.0784</td>
<td>15.0847</td>
<td>15.3897</td>
<td></td>
</tr>
<tr>
<td>12.5 kW/m²</td>
<td>9.37422</td>
<td>9.8052</td>
<td>10.7496</td>
<td></td>
</tr>
<tr>
<td>25 kW/m²</td>
<td>6.75441</td>
<td>6.7672</td>
<td>8.46695</td>
<td></td>
</tr>
<tr>
<td>37.5 kW/m²</td>
<td>4.97958</td>
<td>4.96588</td>
<td>5.6568</td>
<td></td>
</tr>
</tbody>
</table>
FIGURE: 6.2
Risk Contour for Flash Fire:
FIGURE: 6.3
Risk Contours for Late Pool Fire:
TABLE: 6.13

SCENARIO # 2 – RELEASE OF METHANOL

Basis: Possible Release/Leakage due Failure of leakage from 25mm hole size in case of unloading line

<table>
<thead>
<tr>
<th>Input Data</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Leak Duration</td>
<td>600 secs</td>
</tr>
<tr>
<td>Leak Size considered</td>
<td>25 mm</td>
</tr>
<tr>
<td>Release Rate</td>
<td>4678.17gms/sec</td>
</tr>
<tr>
<td>Pressure</td>
<td>Atm</td>
</tr>
<tr>
<td>Temperature</td>
<td>30°C</td>
</tr>
<tr>
<td>Weather Condition</td>
<td>1.5/F, 1.5/D, 5/D</td>
</tr>
<tr>
<td>LFL</td>
<td>73000 ppm</td>
</tr>
<tr>
<td>UFL</td>
<td>360000 ppm</td>
</tr>
</tbody>
</table>

CASE:1 FLASH FIRE

<table>
<thead>
<tr>
<th>Distance (m)</th>
<th>Category 1.5/F</th>
<th>Category 1.5/D</th>
<th>Category 5/D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Furthest Extent</td>
<td>36500 ppm</td>
<td>2.32234</td>
<td>2.04271</td>
</tr>
<tr>
<td>Furthest Extent</td>
<td>72000 ppm</td>
<td>1.76911</td>
<td>1.768</td>
</tr>
</tbody>
</table>

CASE:2 VAPOUR CLOUD EXPLOSION (OVERPRESSURE RESULTS)

NOT REACHED

CASE:3 JET FIRE (EFFECTS OF RADIATION LEVEL)

<table>
<thead>
<tr>
<th>Radiation Level</th>
<th>4 kW/m²</th>
<th>12.5 kW/m²</th>
<th>25 kW/m²</th>
<th>37.5 kW/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Distance (m)</td>
<td>Category 1.5/F</td>
<td>Category 1.5/D</td>
<td>Category 5/D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9.88248</td>
<td>9.88791</td>
<td>9.34989</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6.90131</td>
<td>6.90675</td>
<td>6.30365</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.61356</td>
<td>5.61899</td>
<td>5.67445</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.77026</td>
<td>4.7757</td>
<td>5.11657</td>
</tr>
</tbody>
</table>
FIGURE: 6.4
Risk Contour For Flash Fire:
FIGURE 6.5
Risk Contour For Late Pool Fire:
**TABLE: 6.13**

**SCENARIO # 3 – RELEASE OF N-HEXANE**

Basis: Possible Release/Leakage due Failure of leakage from 25mm hole size in case of unloading line

<table>
<thead>
<tr>
<th>Input Data</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Leak Duration</td>
<td>600 secs</td>
</tr>
<tr>
<td>Leak Size considered</td>
<td>25 mm</td>
</tr>
<tr>
<td>Release Rate</td>
<td>8984.92gms/sec</td>
</tr>
<tr>
<td>Pressure</td>
<td>Atm</td>
</tr>
<tr>
<td>Temperature</td>
<td>30°C</td>
</tr>
<tr>
<td>Weather Condition</td>
<td>1.5/F, 1.5/D, 5/D</td>
</tr>
<tr>
<td>LFL</td>
<td>10500 ppm</td>
</tr>
<tr>
<td>UFL</td>
<td>76800 ppm</td>
</tr>
</tbody>
</table>

**CASE:1 FLASH FIRE**

<table>
<thead>
<tr>
<th>Distance (m)</th>
<th>Category 1.5/F</th>
<th>Category 1.5/D</th>
<th>Category 5/D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farthest Extent</td>
<td>5250 ppm</td>
<td>17.0941</td>
<td>18.0952</td>
</tr>
<tr>
<td>Farthest Extent</td>
<td>10500 ppm</td>
<td>11.7991</td>
<td>11.7459</td>
</tr>
</tbody>
</table>

**CASE:2 VAPOUR CLOUD EXPLOSION (OVERPRESSURE RESULTS)**

<table>
<thead>
<tr>
<th>Maximum Distance (m) at Overpressure Level</th>
<th>Category 1.5/F</th>
<th>Category 1.5/D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overpressure</td>
<td>0.02068 bar</td>
<td>32.1756</td>
</tr>
<tr>
<td>Overpressure</td>
<td>0.1379 bar</td>
<td>15.7418</td>
</tr>
<tr>
<td>Overpressure</td>
<td>0.2068 bar</td>
<td>14.4429</td>
</tr>
</tbody>
</table>

**CASE:3 LATE POOL FIRE (EFFECTS OF RADIATION LEVEL)**

<table>
<thead>
<tr>
<th>Distance (m)</th>
<th>Category 1.5/F</th>
<th>Category 1.5/D</th>
<th>Category 5/D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiation Level</td>
<td>4 kW/m2</td>
<td>12.6198</td>
<td>12.6388</td>
</tr>
<tr>
<td>Radiation Level</td>
<td>12.5 kW/m2</td>
<td>8.52939</td>
<td>8.53843</td>
</tr>
<tr>
<td>Radiation Level</td>
<td>25 kW/m2</td>
<td>6.45907</td>
<td>6.49811</td>
</tr>
<tr>
<td>Radiation Level</td>
<td>37.5 kW/m2</td>
<td>4.95122</td>
<td>4.97026</td>
</tr>
</tbody>
</table>
FIGURE: 6.6
Risk Contour For Flash Fire:
FIGURE: 6.7
Risk Contour For Overpressure:
FIGURE: 6.8
Risk Contour For Late Pool Fire:
### SCENARIO #4 – RELEASE OF DIMETHYLAMINE

**Basis:** Possible Release/Leakage due to Damage to drum & Tilting of Drum.

<table>
<thead>
<tr>
<th>Input Data</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Release Rate</td>
<td>8394.70 gms/sec</td>
</tr>
<tr>
<td>Leak Size considered</td>
<td>50 mm</td>
</tr>
<tr>
<td>Drum gets Empty in</td>
<td>0.98 secs</td>
</tr>
<tr>
<td>Pressure</td>
<td>Atm</td>
</tr>
<tr>
<td>Temperature</td>
<td>30°C</td>
</tr>
<tr>
<td>Weather Condition</td>
<td>1.5/F, 1.5/D, 5/D</td>
</tr>
<tr>
<td>LFL</td>
<td>28000 ppm</td>
</tr>
<tr>
<td>UFL</td>
<td>144000 ppm</td>
</tr>
</tbody>
</table>

**CASE: 1 FLASH FIRE**

<table>
<thead>
<tr>
<th>Furthest Extent</th>
<th>Distance (m)</th>
<th>Category 1.5/F</th>
<th>Category 1.5/D</th>
<th>Category 5/D</th>
</tr>
</thead>
<tbody>
<tr>
<td>14000 ppm</td>
<td>11.9739</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28000 ppm</td>
<td>6.19499</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**CASE: 2 VAPOUR CLOUD EXPLOSION (OVERPRESSURE RESULTS)**

<table>
<thead>
<tr>
<th>Overpressure</th>
<th>Maximum Distance (m) at Overpressure Level</th>
<th>Category 1.5/F</th>
<th>Category 1.5/D</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.02068 bar</td>
<td>22.9665</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.1279 bar</td>
<td>13.3573</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.2068 bar</td>
<td>12.5978</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**CASE: 3 FIRE BALL (EFFECTS OF RADIATION LEVEL)**

<table>
<thead>
<tr>
<th>Radiation Level</th>
<th>Distance (m)</th>
<th>Category 1.5/F</th>
<th>Category 1.5/D</th>
<th>Category 5/D</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 kW/m²</td>
<td>7.89074</td>
<td></td>
<td></td>
<td>7.89074</td>
</tr>
<tr>
<td>12.5 kW/m²</td>
<td>Not Reached</td>
<td></td>
<td></td>
<td>Not Reached</td>
</tr>
<tr>
<td>37.5 kW/m²</td>
<td>Not Reached</td>
<td></td>
<td></td>
<td>Not Reached</td>
</tr>
</tbody>
</table>
TABLE: 6.15

RESULTS:

<table>
<thead>
<tr>
<th>SR. No.</th>
<th>Concentration</th>
<th>Downwind Distance (meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Category 1.5/F</td>
</tr>
<tr>
<td>1</td>
<td>LC₅₀ (4700 ppm)</td>
<td>No Hazard</td>
</tr>
<tr>
<td>2</td>
<td>IDLH(500 ppm)</td>
<td>7.09</td>
</tr>
</tbody>
</table>

- 8 meters in downwind direction is considered as evacuation area.
FIGURE: 6.9
Risk Contour For Flash Fire:
FIGURE: 6.10
Risk Contour For Overpressure:
FIGURE: 6.12
Risk Contour For Fire ball:
FIGURE 6.13
Risk Contour For IDLH Concentration:
TABLE: 6.16

SCENARIO # 5– RELEASE OF AMMONIA

<table>
<thead>
<tr>
<th>Basis: Possible Release/Leakage due to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Ferrule Joint</td>
</tr>
<tr>
<td>• Flange Leakage</td>
</tr>
</tbody>
</table>

**Input Data**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leak Size considered</td>
<td>2 mm</td>
</tr>
<tr>
<td>Release Duration</td>
<td>100Secs (Cylinder gets 100% empty)</td>
</tr>
<tr>
<td>Pressure</td>
<td>18 bar</td>
</tr>
<tr>
<td>Temperature</td>
<td>35 deg C</td>
</tr>
<tr>
<td>Weather Condition</td>
<td>1.5/F, 1.5/D, 5/D</td>
</tr>
<tr>
<td>LC₅₀</td>
<td>2000 ppm</td>
</tr>
<tr>
<td>IDLH</td>
<td>300 ppm</td>
</tr>
</tbody>
</table>

TABLE: 6.17

**RESULTS:**

<table>
<thead>
<tr>
<th>SR. No.</th>
<th>Concentration</th>
<th>Downwind Distance (meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Category 1.5/F</td>
</tr>
<tr>
<td>1</td>
<td>LC₅₀ (2000 ppm)</td>
<td>No Hazard</td>
</tr>
<tr>
<td>2</td>
<td>IDLH (300 ppm)</td>
<td>35.15</td>
</tr>
</tbody>
</table>

- 36 meters in downwind direction is considered as evacuation area.
FIGURE: 6.14
Risk Contour For IDLH Concentration:
TABLE: 6.18

SCENARIO # 6 – RELEASE OF THIONYL CHLORIDE

Basis: Possible Release/Leakage from:
- Damage to Barrel (Pinhole leakage from 25 mm size)
- Tilting of barrel with top lid open

<table>
<thead>
<tr>
<th>Input Data</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Leak Size Considered</td>
<td>50 mm</td>
</tr>
<tr>
<td>Release Duration</td>
<td>1.66 Kg/ min</td>
</tr>
<tr>
<td>Temperature Considered</td>
<td>35 deg C</td>
</tr>
<tr>
<td>Pressure Considered</td>
<td>Atm.</td>
</tr>
<tr>
<td>Weather Condition</td>
<td>1.5/F</td>
</tr>
<tr>
<td>LC$_{50}$</td>
<td>500 ppm</td>
</tr>
<tr>
<td>IDLH</td>
<td>25 ppm</td>
</tr>
</tbody>
</table>

TABLE: 6.19

RESULTS:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Concentration</th>
<th>Down wind Direction (meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IDLH : 25 ppm (Red)</td>
<td>32.13</td>
</tr>
<tr>
<td>2</td>
<td>LC$_{50}$ : 500 ppm (Orange)</td>
<td>19.89</td>
</tr>
</tbody>
</table>

- 33 meters in downwind direction is considered as evacuation area
FIGURE: 6.15
Risk Contours for Dispersion of Thionyl Chloride:
### TABLE: 6.20

**SCENARIO # 7 – RELEASE OF CHLORINE**

<table>
<thead>
<tr>
<th>Basis: Release/Leakage of Chlorine from:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Filling line</td>
</tr>
<tr>
<td>• Flange/Ferrule Joint</td>
</tr>
</tbody>
</table>

**Input Parameters:**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leak Size Considered</td>
<td>2 mm</td>
</tr>
<tr>
<td>Release Duration</td>
<td>600 s</td>
</tr>
<tr>
<td>Temperature Considered</td>
<td>35 deg C</td>
</tr>
<tr>
<td>Pressure Considered</td>
<td>19 bar.</td>
</tr>
<tr>
<td>Weather Condition</td>
<td>5/D</td>
</tr>
<tr>
<td>LC₅₀</td>
<td>293 ppm</td>
</tr>
<tr>
<td>IDLH</td>
<td>10 ppm</td>
</tr>
</tbody>
</table>

### TABLE: 6.21

**Result:**

<table>
<thead>
<tr>
<th>SR. No.</th>
<th>Concentration</th>
<th>Downwind Distance (meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Category 5/D</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>LC₅₀ (293 ppm)</td>
<td>2.38</td>
</tr>
<tr>
<td>2</td>
<td>IDLH(10 ppm)</td>
<td>40.23</td>
</tr>
</tbody>
</table>

- 34 meters in downwind direction is considered as evacuation area.
FIGURE: 6.16
Risk Contours for Dispersion of Chlorine for IDLH Concentrations:
FIGURE: 6.17
Risk Contours for Dispersion of Chlorine for LC50 Concentrations:
### CONSEQUENCE ANALYSIS SUMMARY

#### TABLE: 6.22

<table>
<thead>
<tr>
<th>SR. No.</th>
<th>Scenario</th>
<th>Concentration (ppm)</th>
<th>Distance (meters)</th>
<th>Category 1.5/F</th>
<th>Category 1.5/D</th>
<th>Category 5/D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Release of Toluene</td>
<td>LFL Frac.6000</td>
<td>7.86</td>
<td>6.44</td>
<td>1.92</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>LFL. 12000</td>
<td>2.18</td>
<td>1.91</td>
<td>1.50</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Release of Methanol</td>
<td>LFL Frac.36500</td>
<td>2.32</td>
<td>2.04</td>
<td>1.67</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>LFL. 73000</td>
<td>1.76</td>
<td>1.76</td>
<td>1.36</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Release of N-Hexane</td>
<td>LFL Frac.5250</td>
<td>17.09</td>
<td>18.09</td>
<td>6.18</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>LFL. 10500</td>
<td>11.79</td>
<td>11.74</td>
<td>2.54</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Release of Dimethyl-amine</td>
<td>LFL Frac.14000</td>
<td>11.97</td>
<td>11.64</td>
<td>8.55</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>LFL. 28000</td>
<td>6.19</td>
<td>6.30</td>
<td>5.44</td>
<td></td>
</tr>
</tbody>
</table>

#### TABLE: 6.23

<table>
<thead>
<tr>
<th>SR. No.</th>
<th>Scenario</th>
<th>Overpressure (Bar)</th>
<th>Downwind Distance (meters)</th>
<th>Category 1.5/F</th>
<th>Category 1.5/D</th>
<th>Category 5/D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Release of Toluene</td>
<td>0.02068</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.1379</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.2068</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>2.</td>
<td>Release of Methanol</td>
<td>0.02068</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.1379</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.2068</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>3.</td>
<td>Release of N-Hexane</td>
<td>0.02068</td>
<td>32.17</td>
<td>27.65</td>
<td>NR</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.1379</td>
<td>15.74</td>
<td>14.57</td>
<td>NR</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.2068</td>
<td>14.44</td>
<td>13.53</td>
<td>NR</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Release of Dimethyl-Amine</td>
<td>0.02068</td>
<td>27.57</td>
<td>27.57</td>
<td>25.57</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.1379</td>
<td>7.13</td>
<td>7.13</td>
<td>7.13</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.2068</td>
<td>5.52</td>
<td>5.52</td>
<td>5.52</td>
<td></td>
</tr>
</tbody>
</table>
TABLE: 6.24

Late Pool Fire Scenarios:

<table>
<thead>
<tr>
<th>SR. No.</th>
<th>Scenario</th>
<th>Radiation Level (KW/m2)</th>
<th>Distance (meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Category 1.5/F</td>
</tr>
<tr>
<td>1</td>
<td>Release of Toluene</td>
<td>4</td>
<td>15.07</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12.5</td>
<td>9.87</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25</td>
<td>6.75</td>
</tr>
<tr>
<td></td>
<td></td>
<td>37.5</td>
<td>4.97</td>
</tr>
<tr>
<td>2</td>
<td>Release of Methanol</td>
<td>4</td>
<td>9.88</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12.5</td>
<td>6.90</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25</td>
<td>5.61</td>
</tr>
<tr>
<td></td>
<td></td>
<td>37.5</td>
<td>4.77</td>
</tr>
<tr>
<td>3</td>
<td>Release of N-Hexane</td>
<td>4</td>
<td>12.61</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12.5</td>
<td>8.52</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25</td>
<td>6.48</td>
</tr>
<tr>
<td></td>
<td></td>
<td>37.5</td>
<td>4.96</td>
</tr>
<tr>
<td>4</td>
<td>Release of Dimethyl-Amine (Fire Ball)</td>
<td>4</td>
<td>7.89</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12.5</td>
<td>NR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25</td>
<td>NR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>37.5</td>
<td>NR</td>
</tr>
</tbody>
</table>

TABLE: 6.24

Toxic Release Scenarios:

<table>
<thead>
<tr>
<th>Concentration</th>
<th>Downwind Distance (meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Category 1.5/F</td>
</tr>
<tr>
<td>Dimethyl Amine</td>
<td></td>
</tr>
<tr>
<td>LC50 (4700 ppm)</td>
<td>No Hazard</td>
</tr>
<tr>
<td>IDLH(500 ppm)</td>
<td>7.09</td>
</tr>
<tr>
<td>Ammonia</td>
<td></td>
</tr>
<tr>
<td>LC50 (2000 ppm)</td>
<td>No Hazard</td>
</tr>
<tr>
<td>IDLH(300 ppm)</td>
<td>35.15</td>
</tr>
<tr>
<td>Chlorine</td>
<td></td>
</tr>
<tr>
<td>LC50 (293 ppm)</td>
<td>-</td>
</tr>
<tr>
<td>IDLH(10 ppm)</td>
<td>-</td>
</tr>
<tr>
<td>Thionyl Chloride</td>
<td></td>
</tr>
<tr>
<td>IDLH : 25 ppm (Red)</td>
<td>22.13</td>
</tr>
<tr>
<td>LC50 : 500 ppm (Orange)</td>
<td>19.89</td>
</tr>
</tbody>
</table>
6.4 COMMENTS / RECOMMENDATIONS BASED ON CONSEQUENCE ANALYSIS

Flash Fire and UVCE Scenarios:
- In case of release of N-Hexane vapor travels to the farthest distance (18.09 m) in 1.5/D weather condition. If it gets a source of ignition within this radius, it will create UVCE (Unconfined vapor cloud explosion) and effects of overpressure (0.02068 bar) would be felt up to 32.17mt.
- Evacuation plan to be designed considering the worst case scenario of N-Hexane as mentioned above.

Late Pool Fire and Fire Ball Scenarios:
- In case of release of N-Hexane in 1.5/D weather condition for 4 KW/m2 radiation level of Jet fire is 12.62mt.

Toxic Release Scenarios:
- Dispersion of Chlorine covers more distance in case of IDLH concentration (10 ppm) that is 40.23mt.
- Evacuation plan to be designed considering the worst case scenario of the same.

Recommendations:
- Evacuation routes shall be planned such that alternate route is available from any corner in more than one direction.
- Extra precautions to be taken in unloading of flammable/toxic chemicals. The details of precautions during storage handling and transportation of chemicals have been given in separate paragraph.
- Fire fighting arrangements shall be provided as per the guidelines of OISD.
- In case of release of toxic chemicals, evacuation shall be done up to 40.23 meters.
6.5 OTHER SAFETY PRECAUTIONS / RECOMMENDATIONS

6.5.1 PROPOSED SAFETY/CONTROL MEASURES TO REDUCE THE RISK OF FIRE, EXPLOSION AND TOXIC RELEASE:

Following Mitigation Measures will be followed /practiced during transportation, unloading and handling of flammable & toxic chemicals, in order to ensure health & safety of workers involved in handling of hazardous chemicals and to avoid the human health impacts.

TABLE: 6.25

<table>
<thead>
<tr>
<th>Sr.</th>
<th>ACTIVITY</th>
<th>SAFETY PRECAUTIONS</th>
</tr>
</thead>
</table>
| 1   | Transportation of Chemicals, by Road Tanker or Truck. | • Training will be provided to driver and cleaner regarding the safe driving, hazards of Flammable chemicals, emergency handling, and use of SCBA sets.  
• TREM card & SCBA set will be 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 the truck in populated area.  
• Hazard Identification symbol and emergency telephone number will be displayed as per HAZCHEM CODE.  
• Appropriate PPEs will be kept with TL. |
|     | In case of leak or spill: | • Area & Container will be isolated.  
• Source of leakage will be checked.  
• Damaged containers or spilled material shall not be attended without wearing appropriate protective clothing.  
• Leakage will be stopped, if possible to do so without risk.  
• Water spray shall be used to reduce vapors (but do not put water directly on leak, spill area or inside container).  
• Combustibles (wood, paper, oil, etc.) shall be kept away from spilled material. |
| 2   | Unloading of Solvent Drums /Barrels from Truck. | • Priority will be given for truck 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; SCBA set condition, Antidote Kit, required PPEs as per SOP laid down.  
• QC check & other required checks shall be done & after the
Following precautions will be taken during unloading:

- Wheel stopper will be provided to TL at unloading platform.
- Unloading procedure will be followed according to check list.
- Only day time unloading will be permitted.

### Chemical Storage Area safety.

- All storage areas shall be isolated from all sources of open flame and well posted with “Hazardous Chemical Storage”, “No Smoking”, “Hot work Restricted” signs.
- Spark-resistant tools will be used.
- Pipes and equipment shall be inspected at regular intervals.
- Water spray shall be used to reduce vapors (by taking care that water is not directed straight away on leak, spill area or inside container).
- Combustibles (wood, paper, oil, etc.) shall be kept away from spilled material.
- MS or HDPE storage drums will be provided as per good engineering practices.
- Storage area will be provided with adequate fire fighting/extinguishing system, Fire hydrant monitor with foam attachment facility, etc. as mentioned under section: 6.5.3.
- Sand Buckets will be made available.
- Workers and Operators handling such materials shall be trained for the hazards (fire/explosion, health, chemical reactivity, etc.) & safety measures associated with them.
- Area shall be inspected on regular basis.
- NFPA label (hazard identification) along with capacity of chemical will be displayed on respective drums.
- Dumping /Drain vessel/alternate vessel will be provided to collect the spillage material. Spillage Kit shall be made available.
- FLP type pump & electric fittings will be provided, where applicable.
- Earthing will be provided to related drums and process vessels, as per the requirement.
- Double Jumper clip shall be provided to all solvent handling pipeline flanges, if applicable.

### Solvents transfer from storage area to Process Plant.

- Double mechanical seal type FLP type pump shall be provided.
- Double on / off switch shall be provided, if needed. Flame arrester shall be provided, wherever required.
- NRV shall be provided on pump discharge line.
- Double Jumper clip shall be provided to all solvent handling pipelines.
6.5.2 FIRE CONTROL PLAN

M/s. Om Shiv Industries has considered fire prevention measures at the project planning stage for its upcoming new facility to avoid any outbreak of fire. By 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, company has developed proposed, well-resourced and adequate fire protection system/firefighting network.

The company has planned to keep the different types of fire extinguishers at various conspicuous locations.

Other Firefighting Measures to be updated for the new facilities, if required, shall be:

- Fire load calculation will be carried out and accordingly fire fighting facilities comprising of main pump, stand by pump, jockey pump, diesel driven pump, Hydrant Network, Hose Box, Hose reels, Manual call points, Fire & Smoke detectors, fire alarms, fire buckets, etc will be provided as per the GFR and TAC guidelines.
- Also, flame detectors, smoke / temperature actuated heat detectors with alarms, automatic sprinkler system, shall be installed at conspicuous locations as per the requirements.
- Company shall have Fire Water Tank of adequate capacity to combat the emergency, if arise, GIDC water reservoir shall also be made available, if required.
- Working staff will be trained to operate DCP, CO2 and foam extinguishers.
- DG set shall be made available as a separate power backup for fire network, in case of emergency or power failure.
- Company will do tie up with GIDC Fire Brigade and nearby companies, for handling emergency situations.
- Electric driven Alarms & Sirens will be placed at the conspicuous locations. Hand Bell shall be used in case of power failure.
- Factory Layout shall be designed in such a way, that it will have a provision for separate entry and exist with adequate margin all around the periphery for unobstructed easy movement of the emergency vehicle / fire tenders without reversing back.
6.5.3 **DO’S & DON'TS**

Management has listed some of the Do's & Don'ts activities to strengthen the SAFETY AT WORK, which will be followed strictly:

**For Preventive Maintenance**

**Do's:**

- Inspection of Storage Area, Earthing & Bonding system.
- Inspection of all Fire Fighting Facilities / Check Alarms operation.
- Ensuring that operators/workers etc. follows the SOPs, Safety procedures & standards, work permit system etc.
- Checking the availability of Spill Containment Kit.
- Make sure existing fire extinguishers are fully charged and ready for action.
- Inspections of plant, machinery, tools, equipment, premises, work practices, processes, procedures and general environment must be carried out for the health and safety of plant, people and surrounding.
- On-site and Offsite Emergency Plans shall be reviewed and updated, as per the requirement.

**Don’ts:**

- Don't allow anyone who hasn't received specific safety and operational training to get indulge in any site activity.
- Don't perform your own maintenance.
- Don’t compromise on Design and Engineering part.
- Don't perform any activity without proper permit.
- Don't panic if you are in a risky situation.
- Don't allow spilled chemicals to drain to sewers/gutters etc.

**Strengthening of HSE (Applicable for Manufacturing Utility Staff)**

**Do's:**

- Follow instructions. Do not take chances. If you don’t know, ask.
- Correct or report unsafe conditions.
- Include a timeline for completion of each recommendation.
- Make recommendations that are measurable and track able.
• Ensure that each recommendation is assigned to an individual to oversee implementation.
• Help keep things clean & orderly. Keep gangways clear.
• Do not Horseplay. Do not run. Avoid distracting others. Avoid throwing things.
• Report all injuries. Get first aid promptly.
• Use, adjust and repair equipment only, when authorized.
• Use right tools & equipments for the job, use them safely.
• Do not smoke in restricted areas. Do not flick cigarette / beedi in company.
• Use prescribed protective equipment; keep them in good working conditions.
• Respect signs / warnings. Abide by rules laid down for your safety.

Don’ts:

1) No worker in a factory-

• Shall will fully interfere with or misuse any appliance, convenience or other thing provided in the factory for the purpose of securing the Health, Safety or Welfare of the workers therein:
• Shall will fully and without reasonable cause do anything likely to endanger himself
• or others; and
• Shall will fully neglect to make use of any appliance or other thing provided in the factory for the purposes of securing the Health or Safety of the workers therein.
• Do not make vague statements, do not overrule supervisor, and do not adopt shortcuts.

6.5.4 ANTIDOTES DETAILS:
Appropriate Antidotes, First Aid Measures & Medical treatment for major hazardous chemicals shall be kept available at site. Some of them are given as below:
TABLE: 6.21

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Antidote / Medical Treatment</th>
</tr>
</thead>
</table>
| Toluene          | • Wash affected skin with plenty of water.  
                  | • Administer Oxygen or shift to Fresh air.  
                  | • Don’t apply Epinefrin, Ifridin etc. Don’t apply milk, vegetable oil or alcohol.  
                  | • Give Diazepam 0.1 mg/kg (iv) slowly through injection, bed rest.  
                  | • Diazem – 1 mg/kg. (Intravenous), Epenephia, Efidrine                                    |
| Methanol         | • Ethanol (30% solution from inside, 5% solution from outside i.e. by intravenous injection), Epicake Syrup.  
                  | • In case of acidosis give Sodium bicarbonate.  
                  | • In case of delirium give Diazepam 10 mg. by intravenous injection.  
                  | • Folinic acid (Leucovorin), 1 mg/kg, iv, 4 hourly.                                       |
| Ammonia          | • If skin is affected then wash with plenty of water for 15 min. and then wash with dilute lactic acid and apply soframycin cream.  
                  | • If eye is affected, then wash by eye fountain with plenty of water for 15 min. Put one drop of 0.4% Benzocaine (Novocaine) solution in eye. Boric or lactic acid solution eye drops can also be given,  
                  | • If entered in throat, then give smell through cotton dipped in ethanol or ether through nose.  
                  | • Administer oxygen in case of breathing difficulty.                                      |
| Thionyl Chloride | • Milk of Magnesia, Soda Water, Castor Oil, Soframycine.                                     |
| Chlorine         | • Deriphylline Inj., Phenobarbitone Inj., Phenobarbitone Tab.                               |

6.5.5 WAYS TO MINIMIZE THE MANUAL HANDLING OF THE HAZARDOUS CHEMICALS:

1. Forklifts will be used for unloading chemical bags, bags movements within plant, drums etc.
2. Cranes, hoists, pallet trucks, conveyors, etc. shall be used as per the requirement, to eliminate manual handling.
3. Lifting tools & tackles will be used, wherever required.
4. SOPs, work instructions will be prepared and followed.
5. Trainings will be provided to relevant staff, operators, workers for the risk associated with manual handling of hazardous chemicals, ways to overcome those risk, etc.
6.6 ON-SITE / OFF-SITE DISASTER (NATURAL & MAN MADE) PREPAREDNESS AND EMERGENCY PLAN

M/s. Om Shiv Industries. shall prepare the Proposed On-Site / Off-Site Emergency Plan which shall be followed from the project construction & erection phase.

The purpose of this plan is to provide M/s. Om Shiv Industries, with the means to effectively utilize all the resources at its disposal for the protection of life, environment and property.

The details of the same are discussed in the following sections.

6.6.1 DEFINING THE NATURE/LEVEL OF EMERGENCY

THE LEVEL OF EMERGENCY CAN BE CLASSIFIED IN THREE CATEGORIES:

LEVEL - 1:
The leakage or emergency, which is confinable within the plant/area which may arise due to:

a) Small pipe/valve rupture or similar leakages that do not affect outside premises.

b) Release of toxic chemicals for short duration.

c) Small fire in the plant.

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

a) Leakage of toxic chemicals for long duration.

b) Medium scale explosion confined to the factory premises.

c) Medium scale fire inside the factory premises.

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

a) Heavy / Profuse leakage of toxic / flammable gases for a long duration.

b) Explosion of high magnitude affecting the adjacent area.

c) Major fire inside the factory premises.
6.6.2 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 neighbouring units.

6.6.3 STRUCTURE OF EMERGENCY MANAGEMENT SYSTEM

M/s. Om Shiv Industries shall develop an Emergency Management Team. The management structure shall include the following personnel’s:

- Site Main Controllers.
- Incident Controllers and Deputy Incident Controllers.
- Key Personnel’s.
- Essential Workers.
- The other elements of Emergency Plan shall be:
  - Assembly points.
  - Emergency control centre.
  - Fire control arrangements.
• Medical arrangements.
• Other arrangements.

❖ SITE MAIN CONTROLLER
Senior most Executives (i.e. Director & Supervisor) of the company shall be nominated as SMC. 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:

• Immediately on being informed of the emergency and its location, will arrive at the site, review the situation and control further actions.
• Direct all Emergency Operations within the approved area with the following priorities:
  a. Personnel Safety,
  b. Plant, Property and Environment Safety and
  c. Minimum loss of production.
• 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.
• Exercise direct operational control of the unaffected section of the plant.
• In consultation with the advisory team, expedite the shutting down of loading/unloading operations and if necessary, instruct the supervisor/security personnel to evacuate that area.
• 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.
• 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.
• Arrange for relief of personnel when emergency is prolonged.
• Issue authorized statement or press release to the news – media.
• Ensure preservation of evidence for enquiries to be conducted by statutory authorities.
• Authorize the sounding of “All Clear” and “Evacuation Siren”.

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• 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.

• Nominate a person from advisory team, to maintain chronological log of event during the entire period of emergency.

ROLE OF INCIDENT CONTROLLER AND DEPUTY INCIDENT CONTROLLER

His primary duties shall be 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 will take the charge of incident controller, if he is not available due to any reason. They will be always available in each shift and can take charge of the incident.

Responsibilities/Duties of Incident Controller and Deputy Incident Controller:

• Managers connected with Plants/the respective Plant-In-Charge from each shift have been designated as I.C.

• Two Production officers in each shift will be identified as Deputy Incident Controllers.

• He shall take charge at the scene of incident.

• He shall immediately assess the gravity of risk and alert panel and field operators to start controlling their respective section.

• He will work under the direction of the SMC, but till his arrival he may have to execute following responsibilities.

• He will 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.
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- Give information to the head of fire fighting and rescue team and other emergency services.
- Depending on the incident, instruct partial or total shutdown, isolations, depressurization, Nitrogen purging, fire fighting, rescue operations.
- Instruct upstream/downstream units to take emergency shutdown /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.
- Preserve evidences. This will be necessary for investigation for cause and concluding preventive measures.

**KEY PERSONNELS**

Senior officers of various departments like Fire, Security, Safety, Administration, Engineering, Project, Production, Transport, Pollution control, Technical Services and Stores shall be nominated as Key Personnel in their respective fields. As necessary, they shall 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 & neighbouring industries, action at assembly points, outside shelters and mutual aid centre under the direction of the SMC. All the key personnel and other called in so to assist, shall report to the ECC. They are available at any time on duty or on call or on holidays.

**ESSENTIAL WORKERS**

Essential Workers shall be those who shall be trained in Fire Fighting and First Aid. One Supervisor and two helpers from each shift will be Identified as E.W.’s & shall suppose to report at EMERGENCY SITE to take instructions from I.C. or Dy. I.C. Such work instructions will include:

- Fire fighting and spill control till a Fire Brigade takes the charge.
- To help the Fire Brigade and mutual aid teams, if it is so required.
- Shutting down plant and making it safe.
• 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.

• Provision of emergency power, water, lighting, instruments, equipments, materials, etc.

• Movement of equipment, special vehicle and transport to or from the scene of the accident.

• Search, evacuation, rescue and welfare.

• The injured will be given First Aid.

• Carrying out atmospheric test and pollution control.

• Manning of assembly points to record the arrival of evacuated personnel. Manning for outside shelters and welfare of evacuated persons there.

• Assistance at causalities reception areas to record details of causalities.

• Assistance at communication centres to handle outgoing and incoming calls and to act as messengers if necessary.

• 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.

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

• Any special help required.

OTHER ELEMENTS OF DMP:

❖ ASSEMBLY POINT

In affected & vulnerable plants, all nonessential workers (who are not assigned any emergency duty) will be evacuated from the area & they shall report to specified Assembly Points. Assembly Point will be marked at main security gate 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 number shall be marked at Assembly Points. Each Assembly Point shall be manned by a nominated person to record the names and dept. At each Assembly Point, duties of Assembly Point In-charge are 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., shall be issued & made available with workers.

✈ EMERGENCY CONTROL CENTER

The Emergency Control Center is the place or room from where the operations to handle the emergency are directed and coordinated. A safe room near security gate shall be earmarked /identified as the Emergency Control Room.

Telephone and other facilities required with necessary documents shall be displayed in ECC for ready reference. Designated trained personnel shall operate ECC. In case of Major Emergency, the Site Main Controller will operate from ECC.

The ECC center shall be equipped with the following facilities.

1. Internal and external telephone including STD facility
2. Telephone directory/ Telephone nos. of mutual aid centers
3. First Aid
4. Muster roll of Workers
5. Identity card register
6. Layout plan of the factory showing the location of hazardous materials, assembly point, first aid centers etc.
7. Map of surrounding area with Fire Extinguishers location
8. M.S.D.S
9. Copy of ON SITE OFF SITE PLAN
10. Stationeries like- note book, pen, pencils etc.
11. S.B. Apparatus
12. List of Government Agencies /Local press agencies with phone no.
13. Sand Buckets & Hydrant Network
14. Adequate numbers of PPE's

✈ FIRE CONTROL ARRANGEMENTS (FIRE FIGHTING, GAS LEAK CONTROL AND RESCUE OPERATION)

A) Role of Manager (Fire and Safety) / Shift In-Charge (Fire & Safety)

1. Incident Controller shall direct the fire fighting and Emergency operation. His duties include…
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, he shall immediately proceed to the help.
2. Decides his line of action in consultation with Incident controller and takes appropriate measures to handle the emergency.
3. Shall assess the severity of the incident & shall immediately report to emergency controller about the gravity of the situation.
4. He shall also assess the extra requirement required if any, from the neighbouring industry.

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

D) Emergency Squad Members
1. On hearing Emergency Siren, they shall immediately reports to site main controller, safety in charge or incident controller.
2. They shall combat the emergency situation as per the direction of site main controller, safety in charge or incident controller.
3. They will help for safe evacuation.

MEDICAL SERVICES
The roles of Medical officers are as follows;
(a) He will report 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.

- **ROLE OF SECURITY IN-CHARGE (SECURITY OFFICER)**
  - On hearing the emergency siren, he shall find out the location of the incident (fire / gas leak / spill / explosion) and inform the location of the same to the key personnel coming to the plant.
  - He will depute the security guards for managing gates and traffic control at the incident site & send remaining guards to the site of incident.
  - He will prevent unauthorized entry into the site
  - He will render assistance as demanded by the safety in-charge.
  - He will mobilize additional security force for help, if required.
  - He will direct ambulance(s) and emergency vehicle(s) to the scene of incident.
  - He will help evacuate persons within the scene of incident.
  - As directed by the site main controller, he may be required to address the public of surrounding villages for warning / evacuation.

- **ROLE OF MUTUAL-AID MEMBERS**
  - Company will have Mutual Aid with various nearby factories.
  - On receiving the call, they shall proceed immediately with fire squad & fire tenders.
  - They will be guided to the place of the incident by the main gate security guard.
  - The fire squad in-charge will report to the safety in-charge of the unit in which the incident has occurred.

- **OTHER ARRANGEMENTS**
  Other arrangements include external transport (transport centre), heavy vehicles, lift/cranes, generator sets to supply emergency power, environment monitoring equipment, special instruments/equipments, rescue items etc. shall be made available (if required) from near-by Industries /locations, when available resources do not meet the requirements.
STANDARD OPERATING PROCEDURE (SHALL BE FOLLOWED DURING 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 eg. 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.

6.6.4 COMMUNICATION SYSTEM

Communication System is a Crucial Factor while handling emergency. Company has quick & effective Communication System through which, any situation, which can lead to emergency, can be informed or known to…

i. All persons 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. Neighbouring facilities and public leaving in vicinity.
Each and every section, Plant & Department of the Factory will be connected by internal telephones with SMC, Supervisor or IC’s. External Phone at Office and Residence and Mobile shall also be made available with Key Personnel and top executive of the factory. The Communication System shall begins with raising the alarm declaring the emergency, Telephone messages and Procedure to communicate the emergency to other persons & General Public.

- **RAISING THE ALARM**
  As soon as incident takes place inside the factory and is noticed by someone, the first step shall be to raise the nearest manual emergency bell to alert the nearby people. Next, he/she shall inform the security persons to raise the emergency siren located at the factory gate. The security personnel sound the siren.
  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 shall takes charge of the scene.

- **DECLARING THE MAJOR EMERGENCY**
  Major emergency is declared after sufficient and thorough 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 shall nominate the persons (SMC: Director & Incident Controllers) who can declare the emergency; we have selected them on the basis of their knowledge & experience. These persons will be technically qualified and experienced. The decision about major emergency shall be taken as early as possible and without wasting time so that control action can be started immediately.

- **Telephone Messages**
  A Telephone operator who is precise, sharp, attentive and quick in receiving and noting the message and subsequently effective in further Communication, shall be appointed. A form to record emergency telephone calls will be available with telephone operator or Person available in Emergency Control Center, who shall 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 will also be given to authorities and external agencies to describe the type of emergency. All details of emergency will be collected/delivered according to this format, available with the telephone operator.

COMMUNICATION OF EMERGENCY & STATUTORY INFORMATION

COMMUNICATION OF EMERGENCY

An effective system to communicate emergency shall be made to communicate about the emergency situation as mentioned below:

• 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.

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 will be 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 will be given to outside emergency services and authorities, if required.

c) To neighbouring firms and the general public

Statutory information in the form of booklet will be given to neighbouring units and the general public of the villages in the vicinity of the unit, if required.

6.6.5 EMERGENCY TIME ACTIVITIES
The probable emergency situation that can arise in the unit and the corresponding control actions as described below shall be followed:

1. **FLAMMABLE RELEASES**

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

   Following Control actions shall be taken –
   
   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 are asked for help in the form of first-aid, transport etc.
   • If fire is growing, fire officer informs IC who alerts neighbouring 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 is likely to occur. 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
2. TOXIC RELEASES

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

Following Control Actions will be taken –

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

3. CHEMICAL SPILL

Most of the chemicals will be stored in Drums & drums shall be located in separate isolated storage area. Neutralizing material shall be kept available.
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Spill containment kit shall be kept available. For dilution, water connection will be provided on all sides of Storage Area. Sand buckets shall be available for covering spillage of flammable / corrosive materials. Fire fighting facilities shall be made available nearby.
6.7 OCCUPATIONAL HEALTH & SAFETY PROGRAMME

M/s. Om Shiv Industries, has prepared the Occupational Health Surveillance Program which shall be followed right from the project construction & erection phase and the same shall be updated for the upcoming new facility, if required.

The details of the same are described in the following sections.

6.7.1. 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.

6.7.2. HOSPITAL FACILITIES / FACTORY MEDICAL OFFICER & OHC

Company will make formal agreements with nearby Hospital having facilities to attend fire and toxic effect cases, emergency cases, attending the affected persons in the emergency arising out of accidents, if any, etc.

A qualified doctor will be appointed as FMO on retainer shift basis. Apart from him, required medical facilities applicable as per Gujarat Factories Rules and Factories Act shall also be made available.

All types of first aid related accessories, Medicines & Antidotes as prescribed by FMO, etc shall be made available at conspicuous locations.

6.7.3. AMBULANCE VAN & FIRST AID BOX

An Emergency Vehicle shall be made available round the clock to be used as an Ambulance during emergency.

First Aid Boxes will be made available at the different location in the plant. Training shall be given to employees for First Aid.

6.7.4. PLAN FOR PERIODIC MEDICAL CHECKUP

Periodic Medical Examination shall be conducted as per the following schedule;

Workers employed will be examined by a Qualified Medical Practitioner/Factory Medical.
Officer, in the following manner:

a. Before employment, to ascertain physical fitness of the person;

b. During employment, every six months (blood & physical examination) as per Gujarat Factories Rules, to ascertain physical fitness of the person to do the particular job;

6.7.5. DETAILS OF OCCUPATIONAL HEALTH IMPACTS AND SAFETY HAZARDS

**Occupational Hazards Identification Occupational Health Impacts**

- Exposure to Toxic Chemicals.  
  - Toxification, Irritation,
- Exposure to Flammable Solvents.  
  - Fall Injury, Electrocution,
- Fire due to Static charge generation  
  - Body Injury, Burns, Skin sensitization,
- Slip/trip, fall, electric shock, etc.  
  - Severe irritation to eyes & skin,
- Spillage/leakage,  
  - Respiratory disorder,
- Overflow,  
  - Damage to nearby equipments,
- Body Injury, Burns, Skin sensitization,  
  - Fatality, etc
- Exposure to Corrosive Chemicals.

Mitigation measures/Safety Measures proposed to avoid the human health hazards are mentioned under section 6.5. In addition to these safety measures, personal protective equipment (IS approved) like safety Helmet, Safety shoes/ Gumboots Hand gloves, Gas Mask / Nose Mask, PVC apron, SCBA Set, PVC pressure suit, goggles, hood, etc. will also be provided to the required personnel.

6.7.6. DETAILS OF WORK PLACE AMBIENT AIR QUALITY MONITORING PLAN

Work zone monitoring will be carried out by independent competent third party every month. Records will be kept in Form No. 37 as per Gujarat Factories Rules. Location for samplings shall be identified. Ambient Air & Noise Monitoring shall be done every 3 months as per GPCB CCA requirements. Following information will be incorporated in the format for maintaining records of work zone monitoring:

Location/Operation monitored
- Identified contaminant
- Sampling instrument used
6.7.7. MONITORING OF THE OCCUPATIONAL INJURY & IT’S IMPACT ON WORKERS

Following action plan will be prepared & followed to monitor the occupational injury to workers:

• Each workplace will be evaluated for the existing work conditions.
• Unsafe Act & Unsafe Practices will be identified.
• Unsafe equipments, unsafe areas, etc., will be identified.
• Area will be checked for proper Ventilation and Illumination.
• Air-borne concentration of toxic chemicals will be measured and records will be kept.
• Evaluation of training & on the job work.

Impact of the above mentioned unsafe conditions on workers will be studied and remedial measures for the same will be adopted.
6.7.8. **PROVISION OF INDUSTRIAL HYGIENIST & HEALTH EVALUATION OF WORKERS**

1. It is proposed that management will devise 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. Complete medical examinations including PFT, Urine and Blood examination, Liver Function tests, chest X-ray, Audiometry, Spirometry Vision testing, ECG, etc. shall 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 also, 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. Again, 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, will be maintained.

6.7.9. **ARRANGEMENTS FOR ENSURING HEALTH AND SAFETY OF WORKERS ENGAGED IN HANDLING OF TOXIC MATERIALS**

As discussed in previous clauses, company shall make various plans & arrangements to ensure health and safety of workers engaged in handling of toxic materials. Summary of the same is as follows :

- Each workplace shall be evaluated for the existing work conditions.
- Unsafe Act & Unsafe Practices shall be identified.
- Unsafe equipments, unsafe areas, etc., shall be identified.
- Area shall be checked for proper Ventilation and Illumination.
- Air-borne concentration of toxic chemicals shall be measured, mitigation measures shall be followed to keep them under PEL and the same to be documented.
- Periodic Medical check up & Health evaluation shall be done.
- Adequate funds shall be allotted for the Safety Management System.
6.7.10. PLAN AND FUND ALLOCATION TO ENSURE THE OCCUPATIONAL HEALTH & SAFETY OF ALL CONTRACT AND CASUAL WORKERS

Company shall prepare Safety Plan and implementation for the new project activity. Also, management shall allot enough funds to ensure the occupational health & safety of all contract & causal workers. Details of the same are as follows:

- To allocate sufficient resources (like PPEs) 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;
- Daily briefing/ safety instructions shall be given by security at main gate ,
- Daily checking of helmet and shoes shall be done by security at gate,
- Tool Box Talk by plant personnel before start up of work, like informing employees about materials, equipment or processes to be used in their work which shall be 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 shall be 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 take 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.

6.7.11. HEALTH EVALUATION OF WORKERS (EXPOSURE SPECIFIC)
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. Complete medical examinations including PFT, Urine and Blood examination, Liver Function tests, chest X-ray, Audiometry, Spirometry Vision testing, ECG, etc. shall 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 also, 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. Again, the parameters and frequency of such examination will be decided in consultation with Factory Medical Officer and Industrial Hygienists. Monthly and yearly report of the health status of workers with special reference to Occupational Health and Safety, will be maintained.

6.7.12. MEASURES ADOPTED BY COMPANY TO KEEP AIR BORNE CONCENTRATION OF HAZARDOUS CHEMICALS BELOW PEL:
• Each workplace shall be evaluated. Air-borne concentration of toxic chemicals shall be measured and records to be maintained.
• For purpose of measuring worker exposure across a single shift, a reasonably accurate exposure measuring device (Alarms will be configured at TLV value) shall be placed within the worker’s breathing zone, and have it operates for the full shift. Company shall study the exposure data when the plant is operative.
• To avoid mixing of hazardous chemicals in air; leak surveys shall be conducted every 15 days. LDR (Leak Detection and Rectification) program shall be designed for early detection of leakages of hazardous chemicals and to rectify leakages.
• Flange/Ferrule joints, pipelines, transfer lines, etc. shall be checked on regular basis for maintenance purpose.
• Regular maintenance check up shall be carried out for pumps, equipment, instruments handling toxic and corrosive chemicals.
• PPEs like Air mask, Breathing canisters, SCBA sets, On-line breathing apparatus shall be kept available at the places where there is possibility of presence of toxic chemicals.

6.7.13. ACTION PLAN FOR SAFE HANDLING & SAFETY SYSTEM

Action Plan For Safe Handling of Hazardous Chemicals:

1. Manual Handling is eliminated or replaced by fork lifts, cranes, hoists, pallet trucks, etc.
2. Appropriate PPEs are used.
3. Lifting tools & tackles are used, wherever required.
4. Do’s and Don’ts for strengthening the safety system is being practiced.
5. SOPs, work instructions are followed.
6. Training is being provided to relevant staff, operators, workers for the risk associated with handling of hazardous chemicals, ways to overcome those risk, etc.

Action Plan For Safety System:

Following action plan for Safety System has to be implemented:

SAFETY ORGANIZATION/COMMITTEE

A qualified and experienced safety officers shall be appointed together constitute a safety committee and meetings to be held at least once in a quarter. The responsibilities of the committee shall 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.
Safety organization to be responsible to ensure compliance of Safety Rules/Statutory Provisions. Safety Organization organizes Safety contests like Safety Slogan, Quiz, Safety Poster, safety Speech by individual, Safety Exhibition, etc. to educate the staff, workers, operators on safety aspects. Employees, contractor employees and their representatives shall be properly informed of their rights and process hazard analyses.

**SAFETY CIRCLE**

In order to fully develop the capabilities of the employees in identification of hazardous processes and improving safety and health, safety circle can also be constituted. The circle shall consist of about three to four employees. The circle shall meet for about an hour every week.

**SAFETY TRAINING**

Company shall made a policy of identifying the Safety Training Needs at different positions/levels. Safety trainings shall be arranged by Safety department in consultation with the plant/area in-charge and the Occupier and sometimes external faculty deputed for the same. One day training on safety induction shall be arranged for each category of new employee.

In addition to regular employees, limited contract labours shall be allowed to attend safety training. To create safety awareness, safety films shall be shown to workers and leaflets to be distributed. Training programmes shall cover plant safety rules and hazard communication, safety aspects, BBS, etc. Bulletins on health awareness to be circulated through mails. Visits to safety institutes/organizations to be arranged. The man days and man-hours used in safety training shall be recorded. Safety training calendar to be devised for one year.

**6.7.14. SAFETY TRAININGS & MOCK DRILLS**

Safety trainings (on Safe Material Handling, First Aid, & all Safety Aspects) shall be provided every 15 days by the Safety Officers with the assistance of faculty members called from other Professional Safety Institutions and Universities. In addition to regular employees, limited contractor labours will also be given safety training. To create safety awareness, safety films shall be shown to workers and leaflets are distributed.
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MOCK DRILLS
To evaluate the effectiveness of emergency preparedness and to spread the awareness among employees mock drill will be carried out at the interval of every six months.
After completion of the mock drill, summary report shall be made and corrections will be done if any weakness has been observed.

FREQUENCY OF MOCK DRILLS:
• On-site emergency : Once every 6 months
• Off-site emergency : Once every year