Risk is an expression of chance, a function of the likelihood of an adverse impact and the magnitude of its consequences. Environmental Risk Assessment is the process of evaluating the likelihood of adverse effects in, or transmitted by, the natural environment from hazards that accompany human activities. Qualitative and Quantitative Risk assessment is discussed in subsequent sections.

Identification of Risk
The facility handles the following hazardous chemicals/materials, which pose a potential hazard to the environment, human health and safety.

Major Raw materials
1. Rock phosphate
2. Sulfuric Acid
In addition to the above materials, the following utilities and processes pose risks to the environment, health and safety which are inherent in any process plant.

Chemicals and Utilities
1. Emissions of dust during grinding process
2. Electricity

Identification of Hazard
The following is the brief on the various hazards associated with the handling and storage of above Chemicals/Material.

Sulfuric Acid:
Sulfuric acid is thick, oily, odorless liquid with marked acid taste. It is an inorganic compound with formula \( \text{H}_2\text{SO}_4 \). Sulfuric acid is very hazardous in case of skin contact (corrosive, irritant, permeate), of eye contact (irritant, corrosive), of ingestion, or inhalation.
**Phosphoric Acid:**
Phosphoric acid (also known as ortho-phosphoric acid or phosphoric (V) acid) is a mineral (inorganic) and weak acid having the chemical formula $\text{H}_3\text{PO}_4$. Orthophosphoric acid refers to phosphoric acid, which is the IUPAC name for this compound. Very hazardous in case of skin contact (corrosive, permeator), of eye contact (corrosive). Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

**Rock Phosphate:** Rock phosphate is odorless solid having grey to yellow color and it has a low order of toxicity. Rock phosphate is nonflammable and non-explosive material. The occupational exposure limit of phosphate dust is 10 mg/m$^3$ as an 8 hour TWA for inhalable dust and 3 mg/m$^3$ for respirable dust. Rock phosphate is non-corrosive and stable material.

**Radiation Hazard of Rock Phosphate**
Some phosphate ores contain high amounts of Uranium. Such mineral phosphates do pose radiation hazard in addition to the above hazard. So it is recommended to use rock phosphate with low uranium content.

**Construction phase**
The construction of the plant is expected to last for about 13-15 months. The hazards involved in various construction related activities like excavation, working at height, slip, trips, fall, collapse, Noise, Material handling, hand/arm vibration syndrome, electricity, vehicular movement have been considered.

**Diesel, lubricating oil and similar kind of material**
The diesel is required for D. G. Set operation in case of power outage by the electricity supply company. Generally the storage of diesel is 4 to 5 drums of 100 liters each. Furnace oil/ LDO will be stored in vertical cylindrical tank of 85 KL capacity. The lubricating oil is required for the gear boxes attached with various equipments (Reactors). The hazard involved in handling these materials is leakage spillage. Another hazard associated with lube oil is slippage of a person if the lube oil spills on the road, it can also create land contamination. The other significant hazard with these materials is fire as both liquids can catch fire being hydrocarbons. The used lubricating oils and sludge at the bottom of diesel tank is a hazardous waste and should be recycles to the authorized agents only. The hazards associated the production and handling of various utilities like electricity, compressed air, steam etc. are common in any process industry and the control of these hazards associated with them can be controlled in a normal way. Their hazard control methodology is well known.

**Qualitative Risk 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 labors have been considered. Qualitative Risk Assessment has been carried out for the following areas:
- Construction phase
- Storage and Handling of various Chemicals like Sulphuric acid, Rock phosphate, Diesel, lube oil and Furnace Oil

Risk involved in various processes / process equipment 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 equipment 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 in Table 1, is referred in evaluating the assessment. Risk acceptability criteria given in Table 2.

Table 1: Risk Matrix for Qualitative Risk Assessment

<table>
<thead>
<tr>
<th>LIKELIHOOD/PROBABILITY</th>
<th>LIKEHOOD/PROBABILITY</th>
<th>SEVERITY</th>
<th>LIKEHOOD/PROBABILITY</th>
<th>SEVERITY</th>
<th>LIKEHOOD/PROBABILITY</th>
<th>SEVERITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Catastrophic (Death/System Loss)</td>
<td>5</td>
<td>Major/ Critical (Serious injury/Illness)</td>
<td>4</td>
<td>Moderate (Less Serious Injury/Illness)</td>
<td>3</td>
</tr>
<tr>
<td>Almost Certain</td>
<td>E</td>
<td>H</td>
<td>H</td>
<td>M</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>Likely</td>
<td>D</td>
<td>H</td>
<td>H</td>
<td>M</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>Possible</td>
<td>C</td>
<td>H</td>
<td>M</td>
<td>M</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>Unlikely</td>
<td>B</td>
<td>M</td>
<td>M</td>
<td>L</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>Impossible</td>
<td>A</td>
<td>M</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Risk 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>
Table 3: Control measures for hazards involve during construction phase

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Process Or Activity</th>
<th>Associated Hazards</th>
<th>Health &amp; Safety Impact (Risk)</th>
<th>Initial Risk</th>
<th>Mitigation/ Control Measures</th>
<th>Residual Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Site Preparation and gardening</td>
<td>• Dust generation &amp; increase in SPM/ RSPM in air</td>
<td>• Health effect on workers and surrounding People • Air Pollution</td>
<td>2 C M</td>
<td>• Regular water spray on the roads to avoid dust generation. • Use of PPE like dust mask</td>
<td>1 B L</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Speed control of the vehicles on construction site.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Excavation</td>
<td>• Dust generation &amp; increase in SPM/ RSPM in air</td>
<td>• Health effect on workers and surrounding People • Air Pollution • Risk of injury to workers</td>
<td>3 C M</td>
<td>• Use of PPE • Water spray on the ground before excavation. • Work permit procedure to be followed • Shoring of the sides while manual digging the ground.</td>
<td>2 B L</td>
</tr>
<tr>
<td>3</td>
<td>Material Handling</td>
<td>• Back pain due to improper lifting</td>
<td>• Health effect</td>
<td>1 E M</td>
<td>• Training of the workers in Manual handling. • Lifting of material should be limited to max. 25 Kgs.</td>
<td>1 C L</td>
</tr>
<tr>
<td>4</td>
<td>Operation with construction equipments like mixer, dumper JCB etc.</td>
<td>• Noise generation, • Chances of accident</td>
<td>• Temporary Hearing loss due to noise • Injury to worker/ one who comes in contact.</td>
<td>2 E M</td>
<td>• Use of ear muffs and ear Plugs. Proper and regular maintenance of noise producing machinery to be done. • Barricading and no entry zone will be marked and confirmed.</td>
<td>1 C L</td>
</tr>
<tr>
<td>5</td>
<td>Movement of Material supply</td>
<td>• Chances of accident due to movement of trucks on the road • Noise generation</td>
<td>• Injury • Health effect</td>
<td>2 E M</td>
<td>• Use of trained driver with sufficient experience for operation of material handling equipments</td>
<td>1 C L</td>
</tr>
<tr>
<td>S. No.</td>
<td>Process Or Activity</td>
<td>Associated Hazards</td>
<td>Health &amp; Safety Impact (Risk)</td>
<td>Initial Risk</td>
<td>Mitigation/ Control Measures</td>
<td>Residual Risk</td>
</tr>
<tr>
<td>-------</td>
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</tr>
<tr>
<td>6</td>
<td>Structural work, welding, cutting</td>
<td>• Spark generation, and chances of accident during erection cutting</td>
<td>• Loss of vision, • Injury</td>
<td>3 C M</td>
<td>• Use of PPE (Welding Glasses) • Permit procedure to be followed. • Job safety analysis to be done for doing the work in confined space or on height.</td>
<td>1 B L</td>
</tr>
<tr>
<td>7</td>
<td>Construction work at height</td>
<td>• Chances of fall from height</td>
<td>• Injury</td>
<td>3 C M</td>
<td>• Use of PPE like safety Harness to be done. • Installation of scaffolding will be inspected and safety will be ensured.</td>
<td>1 B L</td>
</tr>
<tr>
<td>8</td>
<td>Disposal of construction debris</td>
<td>• Generation of dust</td>
<td>• Inhalation of dust and subsequent health effects</td>
<td>2 C M</td>
<td>• Debris to be transported in the covered trucks only. • Disposal of solid waste to be done at a demarked site only.</td>
<td>1 B L</td>
</tr>
<tr>
<td>9</td>
<td>Use of electrically operated machines and water pump</td>
<td>• Hazards due to electrical shock</td>
<td>• The electrical shock can result into serious injury or can be fatal</td>
<td>5 A M</td>
<td>• People to be trained in electrical safety and handling of electrical equipments • Use of EILCB and MCB to avoid shocks • No loose connections and open electrical connections, no loose or hanging wires. • Use of 24 volts lighting for confined space.</td>
<td>2 A L</td>
</tr>
<tr>
<td>10</td>
<td>Final clearing of the site disposal of solid and hazardous waste like packing material, used</td>
<td>• Exposure injury while handling solid and hazardous waste</td>
<td>• Health affect and minor injury • Land Pollution</td>
<td>3 C M</td>
<td>• The disposal of the debris to be done on the marked site only • People should be trained in handling such debris. • Material handling equipments to be</td>
<td>1 B L</td>
</tr>
<tr>
<td>S. No</td>
<td>Process Or Activity</td>
<td>Associated Hazards</td>
<td>Health &amp; Safety Impact (Risk)</td>
<td>Initial Risk</td>
<td>Mitigation/ Control Measures</td>
<td>Residual Risk</td>
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<tr>
<td></td>
<td>color drums</td>
<td></td>
<td></td>
<td></td>
<td>used for handling of such</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>construction debris disposal.</td>
<td></td>
</tr>
</tbody>
</table>

**Table 4: Control measures for Storage and Handling of Sulfuric Acid**

<table>
<thead>
<tr>
<th>S. No</th>
<th>Process Or Activity</th>
<th>Associated Hazards</th>
<th>Health &amp; Safety Impact (Risk)</th>
<th>Initial Risk</th>
<th>Mitigation/ Control Measures</th>
<th>Residual Risk</th>
</tr>
</thead>
</table>
| 1     | Storage of sulfuric acid in the designated area | • Risk due to leakage and over pressurization. Safety valve gets operated  
• Exposure to sulfuric acid vapors and harm to workers/ employees  
• Air pollution | 3 | C | M | • The concentration of the acid to be marinated above 90% all the time as the dilute is corrosive to the ordinary Mild steel tank  
• Corrosion monitoring of the tank (Thickness testing) shall be done periodically.  
• Acid proof floorings shall be constructed.  
• In case of spillage, neutralization shall be done immediately with baking soda or spill shall be absorbed in sand or by suitable adsorbent.  
• Only trained personnel shall be allowed to work in this area.  
• Dyke wall shall be provided. | 1 | B | L |
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Process Or Activity</th>
<th>Associated Hazards</th>
<th>Health &amp; Safety Impact (Risk)</th>
<th>Initial Risk</th>
<th>Mitigation/ Control Measures</th>
<th>Residual Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Rupture of sulfuric acid line</td>
<td>• Heavy leakage of sulfuric acid</td>
<td>• Injury and Health effect on the employees/ workers and nearby surroundings</td>
<td>3</td>
<td>• Maintain acid concentration above 90% all the time. • The acid lines to inspect regularly. • Corrosion proof MOC should be selected e.g. HDPE pipe line instead of MS line.</td>
<td>1 B L</td>
</tr>
<tr>
<td>3</td>
<td>Cleaning of Chemical Spillage.</td>
<td>• Fumes Inhalation.</td>
<td>• Severe irritation to eyes, skin. • Inhalation.</td>
<td>2</td>
<td>• Spillage shall be cleaned or neutralized with suitable media. • Dust mask shall be used. • Suitable protective clothing, gloves, boots shall be used.</td>
<td>1 B L</td>
</tr>
<tr>
<td>S. No.</td>
<td>Process Or Activity</td>
<td>Associated Hazards</td>
<td>Health &amp; Safety Impact (Risk)</td>
<td>Initial Risk</td>
<td>Mitigation/ Control Measures</td>
<td>Residual Risk</td>
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<td></td>
</tr>
<tr>
<td>1</td>
<td>Storage of Phosphoric acid in the designated area</td>
<td>• Risk due to leakage and over pressurization, Safety valve gets operated</td>
<td>• Exposure to phosphoric acid vapors and harm to workers/employees • Air pollution</td>
<td>3</td>
<td>• Corrosion monitoring of the tank (Thickness testing) to be done periodically. • Acid proof floorings shall be constructed. • In case of spillage, neutralization shall be done immediately with dilute solution of sodium carbonate • Only trained personnel shall be allowed to work in this area. • Dyke wall shall be provided. • Respirators shall be used. • Eye wash stations &amp; Safety Shower shall be installed in near vicinity. • PPEs like chemical safety goggles or full face shield, Rubber or neoprene gloves and additional protection including impervious boots, apron shall be used. • Keep away from incompatibles such as oxidizing agents, combustible materials, metals, alkalis.</td>
<td>1 B L</td>
</tr>
<tr>
<td>2</td>
<td>Rupture of Phosphoric acid</td>
<td>• Heavy leakage of Phosphoric acid</td>
<td>• Injury and Health effect on the</td>
<td>3</td>
<td>• The acid lines to inspect regularly.</td>
<td>1 B L</td>
</tr>
<tr>
<td>S. No.</td>
<td>Process Or Activity</td>
<td>Associated Hazards</td>
<td>Health &amp; Safety Impact (Risk)</td>
<td>Initial Risk</td>
<td>Mitigation/ Control Measures</td>
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</tr>
<tr>
<td></td>
<td>Phosphoric acid line</td>
<td>employees/ workers and nearby surroundings</td>
<td></td>
<td></td>
<td>• Corrosion proof MOC should be selected e.g. HDPE pipe line instead of MS line.</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• A self contained breathing apparatus should be used to avoid inhalation.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Cleaning of Chemical Spillage.</td>
<td>• Fumes Inhalation.</td>
<td>• Severe irritation to eyes, skin.</td>
<td>2 C M</td>
<td>• Spillage shall be cleaned or neutralized with suitable media.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Inhalation.</td>
<td></td>
<td>• Dust mask shall be used.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Suitable protective clothing, gloves, boots shall be used.</td>
<td></td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>• A self contained breathing apparatus should be used to avoid inhalation.</td>
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</tbody>
</table>

Residual Risk

<table>
<thead>
<tr>
<th>Severity</th>
<th>Likelihood</th>
<th>Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>B</td>
<td>L</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>S. No.</th>
<th>Process Or Activity</th>
<th>Associated Hazards</th>
<th>Health &amp; Safety Impact (Risk)</th>
<th>Initial Risk</th>
<th>Mitigation/ Control Measures</th>
<th>Residual Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Unloading of rock phosphate from road carrier</td>
<td>• Spillage of rock phosphate during unloading&lt;br&gt;• Exposure to rock phosphate&lt;br&gt;• Rock phosphate can harm to workers/unloaders</td>
<td>2 D M</td>
<td>• The unloading operations can be mechanized.</td>
<td>1 B L</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Storage of rock phosphate in the designated area</td>
<td>• Dust generation&lt;br&gt;• Exposure to rock phosphate dust can harm to workers/employees&lt;br&gt;Air pollution</td>
<td>2 D M</td>
<td>• The rock phosphate to be stored in the covered shed to avoid dust generation due to wind.</td>
<td>1 B L</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Rock Phosphate to the acidulation reactor</td>
<td>• Leakage of rock Phosphate&lt;br&gt;• Exposure of workers employees to phosphate dust</td>
<td>2 D M</td>
<td>• The slurry to be transported in the closed pipeline&lt;br&gt;• The area to be well ventilated to avoid dust generation</td>
<td>1 B L</td>
<td></td>
</tr>
<tr>
<td>S. No.</td>
<td>Process Or Activity</td>
<td>Associated Hazards</td>
<td>Health &amp; Safety Impact (Risk)</td>
<td>Initial Risk</td>
<td>Mitigation/ Control Measures</td>
<td>Residual Risk</td>
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</tr>
</tbody>
</table>
| 1.    | Handling and storage of Diesel, lubricating oil and Furnace Oil                     | • Spillage leakage while transfer from the drum                                      | • Land pollution can lead to fire if excessive spillage of diesel/ Furnace oil is there.      | 2            | • Use a secondary container while storage and transfer of lubricating oil, Furnace oil and diesel.  
• Use of a spill kit in case of spillage of the material  
• Store the drums in the shed and on the concrete flour to avoid soil contamination  
• Ensure availability of Fire extinguisher in storage shed daily.                                                                                          | B             |

Table 7: Control Measures for Diesel, Lubricating Oil and Furnace Oil
Quantitative Risk Assessment
Quantitative Risk Assessment (QRA) is a structured approach to identifying and understanding the hazards and 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. Kisan Shakti Fertilizers & Pesticides Pvt. is proposing to install Chemical Fertilizer manufacturing plant i.e. Single Super Phosphate (SSP)(Granules and/or Powder), Triple Super Phosphate (TSP) (Granules and/or Powder) and Phosphoric Acid; which is Irritant. If they are not handled properly it will lead to respiratory disease, wounds and burns. Self-contained breathing apparatus will be available in the premises in the event of leakage in case of emergency. Employees will be trained in handling these self-contained breathing apparatus. Major identified hazardous chemicals identified in the project are Sulphuric acid and FO. Separate storage area will be provided for H₂SO₄ and will be handled with at most care following the safety norms for handling of hazardous chemicals. FO will be stored separately in the aboveground storage tank/drum.
### Table 8: Chemical storage details

<table>
<thead>
<tr>
<th>#</th>
<th>Equipments</th>
<th>Type</th>
<th>Tag No.</th>
<th>QTY</th>
<th>Capacity (m³)</th>
<th>Units</th>
<th>MOC</th>
<th>Operating Conditions</th>
<th>Design Conditions</th>
<th>DIMENSIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Temperature (°C)</td>
<td>Pressure Bar(A)</td>
<td>Length/Height</td>
</tr>
<tr>
<td>1</td>
<td>Sulphuric acid Storage Tank</td>
<td>Vertical cylindrical with Conical top &amp; Flat bottom</td>
<td>T-101 A/B</td>
<td>2</td>
<td>70</td>
<td>m³</td>
<td>CS</td>
<td>40</td>
<td>ATM</td>
<td>60</td>
</tr>
<tr>
<td>5</td>
<td>Sulphuric acid Storage Tank</td>
<td>Vertical cylindrical with Conical top &amp; Flat bottom</td>
<td>T-151</td>
<td>1</td>
<td>30</td>
<td>m³</td>
<td>CSRL</td>
<td>45</td>
<td>ATM</td>
<td>65</td>
</tr>
<tr>
<td>6</td>
<td>Weak Phosphoric Acid Tank</td>
<td>Vertical cylindrical top-flat &amp; bottom flat</td>
<td>T-111</td>
<td>1</td>
<td>50</td>
<td>m³</td>
<td>MSRL</td>
<td>45</td>
<td>ATM</td>
<td>65</td>
</tr>
<tr>
<td>4</td>
<td>Concentrated Phosphoric Acid Tank</td>
<td>Vertical cylindrical top-flat &amp; bottom flat</td>
<td>T-121</td>
<td>1</td>
<td>50</td>
<td>m³</td>
<td>MSRL</td>
<td>45</td>
<td>ATM</td>
<td>65</td>
</tr>
<tr>
<td>2</td>
<td>Phosphoric acid Storage Tank</td>
<td>Vertical cylindrical with Conical top &amp; Flat bottom</td>
<td>T-102 A/B</td>
<td>2</td>
<td>140</td>
<td>m³</td>
<td>CSRL</td>
<td>60</td>
<td>ATM</td>
<td>80</td>
</tr>
<tr>
<td>3</td>
<td>Furnace Oil/LDO tank</td>
<td>Vertical Cylindrical</td>
<td>T-104</td>
<td>1</td>
<td>85</td>
<td>m³</td>
<td>CS</td>
<td>40</td>
<td>ATM</td>
<td>60</td>
</tr>
</tbody>
</table>
Properties of materials
Properties of raw materials are mentioned as below:

1. Phosphoric acid
   - It is a colorless, odorless and non-flammable liquid (Syrupy liquid Viscous liquid.)
   - Specific gravity is 1.685 (water = 1)
   - Vapor Density is 3.4 (air = 1)
   - Easily soluble in hot water. Soluble in cold water.
   - Reactive with oxidizing agents, combustible materials, metals, alkalis.
   - Minor corrosive effect on bronze. Severe corrosive effect on brass. Corrosive to ferrous metals and alloys.

2. Sulphuric Acid:
   - It is a colorless and non-flammable liquid (Thick oily liquid.)
   - Sharp, choking odor
   - Highly corrosive in nature.
   - Specific gravity is 1.84 (water = 1)
   - Vapor Density is 3.4 (air = 1)
   - Easily soluble in cold water. Sulfuric is soluble in water with liberation of much heat. Soluble in ethyl alcohol.
   - Extremely corrosive in presence of aluminum, of copper, of stainless steel(316). Highly corrosive in presence of stainless steel(304). Non-corrosive in presence of glass.
   - Non-corrosive to lead and mild steel, but dilute acid attacks most metals. Attacks many metals releasing hydrogen. Minor corrosive effect on bronze. No corrosion data on brass or zinc.

3. High Speed Diesel:
   - It is flammable in nature.
   - Perceptible odour.
   - Flash point is 32°C.
   - LEL/ UEL (%) are 0.5 / 5.0 respectively
   - Specific gravity is 0.86-0.90 (water = 1)

4. Furnace Oil:
   - Flammable in presence of open flames, sparks and heat.
   - Mild petroleum oil like odour.
   - Flash point is >= 40 °C (104 °F)
   - LEL/ UEL (%) are 0.7 / 6.0 respectively
Personal Protective Equipments (PPE)
PPE for Process and storage areas is mentioned in table 9.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Material handling</th>
<th>PPE to be used</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Phosphoric acid</td>
<td>• Splash goggles.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Full suit.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Vapor respirator.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Boots.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Gloves.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• A self contained breathing apparatus should be used to avoid inhalation of the product</td>
</tr>
<tr>
<td>2</td>
<td>Sulphuric acid</td>
<td>• Splash goggles.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Full suit.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Vapor respirator.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Boots.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Gloves.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• A self contained breathing apparatus should be used to avoid inhalation of the product</td>
</tr>
</tbody>
</table>

Preliminary Hazard Analysis for Process and storage areas is mentioned in table 10.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Blocks/ Area</th>
<th>Hazard Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Flammable Chemical Storage (FO)</td>
<td>Fire, Spontaneous Combustion</td>
</tr>
<tr>
<td>2</td>
<td>D.G. Set</td>
<td>Fires in Cables galleries, Short Circuits in control rooms and switch gears</td>
</tr>
<tr>
<td>3</td>
<td>Power Transformers</td>
<td>Explosion and Fire</td>
</tr>
<tr>
<td>4</td>
<td>Switch – yard Control Room</td>
<td>Fire in cable galleries and Switchgear / Control Room</td>
</tr>
</tbody>
</table>

Since, only 4 to 5 drums of 100 liters each will be kept for storing HSD and Furnace oil will be stored in vertical cylindrical tank of 85 KL capacity which is very less quantity hence consequence assessments for the credible scenarios were not considered.

Disaster Management Plan
The Disaster Management Plan (DMP) is a guide, giving detailed organizational responsibilities, actions, reporting requirements and support resources available to ensure effective and timely management of emergencies likely to arise from planned operations. The DMP has been prepared for the Acid production plant on the basis of the Risk Assessment and related findings covered in the foregoing topics in this report.
Identification of Hazards
The following types of Major Hazards and emergency situations are identified at the facility to be operated by KSFPPL for manufacture of phosphoric acid and sulphuric acid.

- Fire in Electric Panels, lubricating & other storage, Furnace oil and Diesel storage
- Heavy spillage/leakage of sulfuric acid and phosphoric acid.

However, a team of trained persons will be kept in readiness all the time, who can deal not only with fire emergency but also other emergencies if arise inside factory or off-site emergency of any sort. Hence, to deal the above emergencies, the Emergency Plan is prepared.

Responsibility
The responsibility for establishing and maintaining DMP updated is of Head (Operations and Maintenance) who is also nominated as liaison officer. He is responsible for preparation of the DMP and for ensuring that the plan and the applicable implementing procedures are reviewed and revised periodically.

Head (P&A) is responsible for training of personnel to ensure that the adequate emergency response capabilities are maintained in accordance with the plan. He is further responsible for ensuring the adequacy of conducting mock drills outlined in Emergency Plan.

Head (Operations and Maintenance) is responsible for co-ordination jobs with various mangers and through him with the emergency team members for morale boosting and better co-ordination and liaison with district and Taluka level Government Officers for seeking as well as rendering services for ONSITE AND OFF-SITE EMERGENCY MANAGEMENT as may be required.

On-Site Emergency Planning

Table 11: On-site Emergency Planning

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Code of Practice</th>
<th>Objective</th>
<th>Line of Action</th>
</tr>
</thead>
</table>
| 1      | In Case of Fire at Factory or in diesel or FO storage tank | To deal with Fire efficiently and quickly at different locations in the factory including diesel storage tank and electrical Panel | • Any person notices any sign of fire shall start shouting FIRE, FIRE (Aag, Aag) to seek assistance and also immediately take steps to give warning by blowing the siren continuously and take steps to extinguish the fire by using fire extinguishers available near the site of fire  
• After giving information reach the spot, remove Man & Machinery and take steps to tackle the fire in accordance with the firefighting instructions. Inform at security office to get Ambulance if required. |
<p>| 2      | In case of Heavy Spillage Leakage of Sulfuric acid and | To deal with the incidence of sulfuric acid spillage or | • Any person who notices any leakage or spillage of sulfuric acid from storage tank, pipe line or from any equipment |</p>
<table>
<thead>
<tr>
<th>Phosphoric acid leakage efficiently and quickly</th>
<th>should try to warn the nearby persons and report to the shift supervisor without any delay.</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The Person should not go near the spill unless he is wearing a proper PPE and has been fully trained to handle the acid leaks</td>
<td></td>
</tr>
</tbody>
</table>

**Off Site Emergency Plan**

In the effects of the accident or disaster inside the plant is felt outside its premises, it calls for an off-site emergency plan, which would prepared and documented in advance in consultation with the district authorities.

The off-site emergency plan prepared herein will deal with those incidents identified under Level – 3 in the on-site plan, which have the potential to harm persons or the environment outside the boundary of the factory premises.

The most significant risk to outside areas is that associated with a large release of Furnace oil. Spread of its effected outside the works may require traffic control, evacuation, shelter arrangement.

Off-site emergency plan has been drawn up with a view to mobilize resources and integrate with district contingency plan for an effective system of command and control in combating the emergency.

Thus in brief the two main purpose of the off-site emergency plan are:

- To provide the local / district authorities, police, fire brigade, doctors, surrounding industries and the public, the basic information of risk and environment impact assessment and to appraise them of the consequences and the protection prevention measures and control plans and to seek their help to communicate with the public in case of major emergency
- To assist the district authorities for preparing the off-site emergency plan for the district or particulate area and to organize rehearsal from time to time and initial corrective action based on the lesson learnt.

**Structure of the off-site emergency plan:**

This off-site emergency plan will be integrated properly with the district contingency plan to tackle any kind of emergency. The site main controller will keep liaison for this purpose with the district authorities.

External telephone facilities from KSFPPL to Local Fire Station, Mutual Aid Members, and DPMC Bharuch will be established for quick communication.

The names of the key persons will be defined to establish contacts and Co-ordinate the activities with the help of the collectorate and disaster management center in case of major emergency.

An on-site emergency control room will be identified by KSFPPL, which can be activated / used for emergency control and manned round the clock.

As far as off-site emergencies are concerned, information shall be received first by the police control room, Bharuch on telephone next information to local fire brigade on telephone and to DPMC - Bharuch. The police / fire brigade control room shall in turn inform DSP, collector.
The safety department and individual plant has already the list of quantities of resources like breathing air sets, rescue masks, fire extinguishers, water resources etc. available with various industries in the vicinity which can be spread under Mutual Aid System to tackle such emergencies after receiving call from them.

The District Superintendent of Police, Bharuch District will be in overall charge of security, evacuation and rescue operations at the time of emergency.

**Arrangement made for off-site emergency:**
Considering distance from district Head Quarters, other nearby external emergency control organization. Following arrangements will be arranged in consultation with DY. DISH, district collectorate, SDM, mamlatdar.

Disclosure of information to neighboring organization and population:
KSFPPL will prepare booklet and circulate among neighboring organization and population containing hazardous operation and chemicals. First aid, emergency treatment, probable types of emergencies that can arise. Preventive steps will be taken to control emergency. Emergency warning siren code system, to make them aware in advance. KSFPPL will carry out group get together, acquaintance round, meeting with neighboring public, population to train, brief the and make them aware about our operation and preparedness.

The same groups along with external emergency control organization were invited during mock drill, rehearsals for training and acquaintance.

**Local crisis group:**
As per central government notification and DISH office for preparation of offsite emergency plan and KSFPPL will become member of local level crises group, will set up disaster management center of industrial area using existing available facility of industries in the area with facility and emergency contact phone numbers.

During emergency with in local group reach in and around industrial area any one can contact DMC – control room situated in both the factories and manned round the clock will initiate actions and arrange to organize resource mobilization and communication.

**Local crisis group consists of:**
- **Chairman:** Dy. Collector
- **Member Secretary:** Asst. Directorate – Industrial Safety & Health, Bharuch
- **Member:** Factory manager of all industries
- **Member:** Transport contractors
- **Member:** Safety Manager, KSFPPL
- **Member:** Medical officer, PHC, KSFPPL
- **Member:** Press reporter
- **Member:** Community leader, Sarpanch, nearby village
- **Member:** NGO, Lions club, nearby village
- **Member:** Local social worker, nearby village
- **Member:** Local social worker nearby village

Local crisis group will prepare local emergency response plan and will submit to Directorate – Industrial Safety & Health, Bharuch.
Rehearsal of local off-site emergency response plan will be carried out involving industries nearby as per mutual aid arrangements. Local crisis group will have to start emergency control action before arrival of and activation of district off site emergency plan and involvement of district crisis group. Any escalation need of further help will activate full district level off site control room. All type of emergencies like village fire, chemical accident, natural calamities and industrial accidents will be covered in the scope of local crisis group action plan.

**District level crisis group:**
Under chairmanship of collector district level crisis group will be formulated to aim at:
- Update off-site emergency plan regularly
- To organize, initiate action for mock drill
- To run central control room
- To coordinate for training need of all member government officials
- To maintain communication link among members through central control room.
- To monitor preparation of industrial organization and adequacy of on-site emergency plan.
Dy. Director – Industrial Safety & Health hold responsibility of member secretary for district level crisis group.

**Communication and warning by Disaster Management Center:**
When a disaster occurs, the industry affected by the disaster will immediately inform the disaster management center with all available information, the DPMC will act as per the contingency plan and DPMC will also communicate immediately to district Collectorate. The integration of on – site plan with district contingency plan and various functions to be carried out are mentioned in chart OFF – SITE emergency plan as follow:
Figure 1. Off-Site Emergency Plan

- Emergency due to Natural Calamities

Types of natural calamities & its action plan:

a. Earthquake:

**During earthquake, if indoors:**
- Take cover under a piece of heavy furniture or against an inside wall and hold on.
- Stay inside.
- The most dangerous thing to do during the shaking of an earthquake is to try to leave the building because objects can fall on you.

**During earthquake, if outdoors:**
- Move into the open, away from buildings, street lights, and utility wires.
- Once in the open, stay there until the shaking stops.

**During earthquake, if in a moving vehicle:**
- Stop quickly and stay in the vehicle.
- Move to a clear area away from buildings, trees, overpasses, or utility wires.
- Once the shaking has stopped, proceed with caution. Avoid bridges or ramps that might have been damaged by the quake.

After earthquake
• Be prepared for aftershocks. Although smaller than the main shock, aftershocks cause additional damage and may bring weaken structures down. Aftershocks can occur in the first hours, days, weeks, or even months after the quake.
• Help injured or trapped persons.
• Give first aid where appropriate.
• Do not move seriously injured persons unless they are in immediate danger of further injury.
• Call for help.
• Listen to a battery-operated radio or television for the latest emergency information.
• Remember to help your neighbors who may require special assistance--infants, the elderly, and people with disabilities.
• Stay out of damaged buildings.
• Return home only when authorities say it is safe.
• Use the telephone only for emergency calls.
• Clean up spilled chemicals or other flammable liquids immediately. Leave the area if you smell gas or fumes.

b. Lighting & Thunderstorm:

Before
• Thunderstorm is invariably accompanied by lightning A single stroke of lightning has 125,000 volts of electricity. That’s enough power to light a 100-watt light bulb for more than 3 months, or enough to seriously hurt or to skill someone. Know what steps to take in the event of an oncoming thunder storm & lightning. Lightning is something you should not be careless about, so seek a safe shelter immediately! Be warned, lightning can and does strike just about any object in its path. When you see lightning, follow these safety rules.

Indoors
• Stay or go indoors If you hear thunder, don’t go outside unless absolutely necessary. Stand clear from windows, doors, and electrical appliances.
• Stay away from anything that could conduct electricity. This includes electric, lines, Electric Instruments, wires etc and phones Unplug appliances well before a storm strikes – never during.
• Don’t use any plug-in electrical instruments. If lightning strikes your building they can conduct the charge to you.
• Don’t use the telephone during the storm. Lightning may strike telephone lines outside. Use the telephone only for emergencies quickly. Avoid contact with piping including sinks, baths and faucets.

Outdoors
• When outdoors, seek shelter from lightning! Buildings are best for shelter, but if no buildings are available, you can find protection in a cave, ditch, or a campus. Trees are not good cover. Tall trees attract lightning. Never use a tree as a shelter.
• Stay in your vehicle if you are travelling, vehicles gives you excellent lightning protection. Get in a hard topped car.
• If you can’t find shelter avoid the tallest object in the area. If only isolated trees are nearly, your best protection is to crouch in the open, keeping twice as far away from isolated trees are high. Avoid areas that are higher than the surrounding landscape.
• Don’t use metal object outside. Keep away from metal objects including bikes, electric or telephone poles, fencing, machinery etc.
• Get out of the water. Immediately get out and away from pools, lakes, and other bodies of water.
• When you feel the electrical charge – if your hair stands on end or your skin tingles-lightning may be about to strike near you. Immediately crouch down and cover your ears. Do not lie down or place your hands on the ground.
• Victims of lightning shock are administered CPM (Cardio pulmonary resuscitation) i.e. artificial respiration, if necessary. Seek medical aid.

c. Heavy Rain:
• Stay out of the basement.
• Stop all jobs outside.
• Heavy rain many times accompanies high-speed wind. Stop all work at height.
• Disconnection power supply to all electrical Machines in open yards.
• Cover all JBs\DBs where chances of water coming to it are there.
• Keep Gumboot, Raincoat and umbrellas ready.
• Keep all dewatering pumps ready in working order.
• Move valuable objects upstairs only if safe to do so, without straining yourself
• Keep yourself indoors and away from rivers and creeks
• Stay away from low/lying areas
  Avoid walking through a waterlogged area on foot; you can get swept away easily.
• Assemble everyone inside shelters or buildings.
• Close windows and blinds.
• Evacuate rooms that might bear the full force of the wind
• Avoid enclosures that have long roof spans.
• Keep the office radio tuned to a local station for current advisory information

4.1.1 Objectives for Emergency Plan
Specific objectives of the Emergency Response Plan are listed with regards to the responses desired for successful management of the possible emergency situations. Suggested Objectives would include:

• To define and assess emergencies
• To control and contain incidents.
• To safeguard the employees.
• To minimize damage to the property and/or the environment.
• To inform the employees, the general public residing around the plant and the authority on the hazards/risks assessed.
• To safeguard provided residual risk, if any, and the role to be played by the employees in the event of emergency.
• To inform the state authorities like Police and Fire Departments, Mutual Aid Centers, Medical Centers to come up for help.
• To effectively rescue and to provide treatment of casualties and to count the injured.
• To identify and list fatal accidents, if any.
• To secure the safe rehabilitation of affected areas and to restore normally.
• To provide authoritative information to the news media for the incident.
• To preserve records, equipments, etc. and to organize investigation into the cause of the emergency and to suggest preventive measures to stop its recurrence.
• To ensure safety of staff and patients and resume work.
• To work out a plan with all provisions to handle emergencies and to provide for emergency.

**Structure of Emergency Management System**

KSFPPL shall develop an Emergency Management Team. The management structure shall include the following personnel’s;

- Main Incident Controllers
- Incident Controllers and Deputy Incident Controllers
- Key Personnel’s
- Essential Workers

The other elements of Emergency Plan shall be:

- Assembly points
- Emergency control center
- Fire control arrangements
- Medical arrangements
- Other arrangements
Roles and Responsibility of Emergency Management Team

Main Incident Controller (MC)

Senior most Executives (i.e. Supervisor & Unit head) of the company shall be nominated as MC. His task will be to co-ordinate all internal and external activities from the Emergency Control Centre (ECC), from where all operations will be directed. He shall:

1. Inform Emergency Control Center (Mutual Aid Scheme Office) under District Contingency Plan.
2. Appraise the Top Executives at HO about the incidence.
3. Decide about the nature of help required such as evacuation, traffic control, warning to the public, vehicles requirement etc. and inform Collector’s office, ADISH office, Civil Defense Control room and Police Commissioner accordingly.
4. Apprise the Chiefs of the neighboring industries about the situation and help, if any.
5. Decide the safe route of entry for external help depending upon the place of accident & wind direction.
6. Ensure that the key personnel are called in.
7. Consult with operating heads and decide about the operation of the complex.
8. Continuously review and assess developments to determine the most probable cause of events.
9. Direct safe shut down and evacuation of plant personnel in consultation with Incident Controller & key personnel. If necessary, arrange for evacuation of neighboring population.
10. Ensure that all additional teams like Medical Services team, Shift Security team, Utility & Environment control team, Administration team, PR & Adv. team, and Industrial Relation team, function properly.
11. Advise for chronological record of incident.
12. He will issue authorized statement to the news media.
13. Control rehabilitation of affected areas & victims on cessation of emergency. Do not restart the plant unless it is ensured safe to start and cleared by the authorities.

**Incident Controller**

Incident controller’s primary duty is to rush to the emergency spot and assess the situation of emergency in consultation with Dy. Incident Controller & plant officials. He has to decide the type of emergency and declare it in consultation with Main Incident Controller. In the initial stage, he may be required to take decisions involving the operation of other plants or to stop or continue process and to take technical decisions to control the incident and after deputing Dy. Incident Controller on the emergency spot, he has to appraise Sr. Officials, ask for mutual aid and confirm with essential services department whether they have understood the type of emergency.

On hearing about the emergency, immediately he will rush to the emergency site and will:

1. Assess the scale of emergency with Dy. Incident Controller, the Manager of the respective plant & HoD (S&F) and decide if a major emergency exists or is likely.
2. After deputing Deputy Incident Controller on the emergency site for tackling the emergency, he will:
   - Direct the shutting down and evacuation of plant and areas likely to be affected by the emergency.
   - He will inform DAP Control Room ‘A’ and ‘B’ /SST Control Room to blow siren accordingly.
   - Inform other plants & alert them.
   - Inform Utility plant to monitor fire hydrant system.
   - Ensure that the outside emergency services including mutual aid, have been called in.
   - Inform Security Office to pass on instructions to Security Guard for diversion external agency coming for help.
   - Ensure that key personnel have been called in, if need be.
   - Post one person equipped with walkie-talkie at the emergency site for receiving information about the situation & passing instructions accordingly.
   - Brief the Main Incident Controller & keep them informed of developments.
   - Inform the Emergency Team leaders about the situation.

**Dy. Incident Controller**
KSFPPL having continuous process and shift-in-charge will be available round the clock in Utility & Plant. As shift-in-charge (SM/Mgr./Dy.Mgr./P.E.) is having the knowledge of his plant and has capability to take decisions, both for process and incident control, he will be Dy. Incident Controller till the arrival of Sr. Officials. The Dy. Incident Controller being at the scene of emergency will have the overall command of the emergency spot.

1. Direct all operations within the affected area with the following priorities:
   - Secure the safety of personnel.
   - Minimize damage to plant, property & environment.
   - Minimize loss of material. (All operations like — process control / emergency control, asking help from services department / essential workers, information, warning, communication, safety appliances etc.)
2. Decide whether On Site Emergency Action Plan is to be initiated depending upon process control and severity of the incident. Consult Fire Supervisor if necessary. Inform security control room accordingly.
3. Direct rescue & fire fighting operations with his plant personnel /fire crew.
4. Do not involve yourself in a single activity like fire fighting / closing the valve etc. but monitor the incident as a whole.
5. Search for the casualties.
6. Inform & warn neighboring plants / maintenance shed / elect. Substation etc.
7. Appraise the situation to a Senior Officer whoever reaches first at site. Handover the charge and act accordingly.
8. Evacuate non-essential technical persons to assembly points.
10. Preserve evidences that will be necessary for subsequent inquiry into the cause of emergency and concluding preventive measures.

Essential Workers (EW)
A task force of essential trained workers will be formed in three team i.e. Fire & Rescue Team, Security Team & Medical Services Team in which 35 persons from different departments will be nominated by the Management. These persons will be available round the clock.
They will trained to help firefighting, evacuation, first aid, and rescue. All the members will rush to the site with Appropriate Personal Protective Appliances. They will put shoulder badge of red, silver and green colour respectively and tie on shoulder for identification. Concerned Department Head will guide them.

Essential workers will do the following activities.
1. To help the fire brigade in firefighting, gas leak & spill control.
2. To help in shutting down the plant & making it safe, if need be.
3. To help in emergency engineering work e.g. isolating equipment, materials, process.
4. To help in diversion of traffic.
5. Search, evacuation, rescue & welfare.
7. Moving tankers or other vehicles from areas of risk.
8. Any special help required.

KSFPPL has proposed full-fledged Fire, Security, Medical, Administration (For Transport) department whose duties and responsibilities are mentioned in the respective teams.

**Medical Services Team**
1. The team shall consist of the head of Medical Officer and Male nurse.
2. After assessing the type of injuries and number of victims reached at Medical Centre, necessary arrangement shall be made to receive / to direct them properly.
3. Arrange for additional Oxygen sets/cylinder if required. Such arrangement with the supplier shall be made in advance.
4. Inform the nearby Hospital and nearby Industrial Medical Centres about the necessary help. The list of the addresses with telephone numbers shall be kept ready with Medical Officer.
5. Contact Head of P&A, if blood donors are required to follow the victims.
6. Ambulance shall not wait to receive call; it should rush to accident site on hearing the siren.

**Utilities and Environment Control Team**
1. The team shall be consisting of HoD (U/S) & HoD (QC Lab). It shall function from their offices.
2. On hearing siren or receiving the message, ensure that Fire Water Pumps are running and monitor their performance. Arrange for diesel driven fire pumps.
3. Monitor the firewater tank levels.
4. Arrange for holding the storm water flow or removing the restriction on the channels as required under the situation.
5. Arrange for isolation of the rest of the fire water system from the plant under emergency to conserve the water and to maintain consistency of water pressure.
6. Check the plant effluent coming to Effluent Plant and act accordingly.
7. Maintain min. 2 sets of portable pumps in good condition.
8. Make necessary arrangements to treat contaminated water / neutralized water to avoid any possibility of consuming the same either by animals or human beings.

**General Administration Team**
1. The team shall consist of Head of P&A, other Officers of P&A Dept., supervisor (GH & Canteen), Transport Supervisor. They will function from the office of Head of P&A.
2. Attend the external phones of the affected plant immediately for informing key personnel of Nature - I Emergency.
3. Keep on updating telephone numbers of key personnel as and when required.
4. Get ready with transportation arrangements such as Jeeps, Cars, and Buses (Both Private and Company) etc. near Admin. Building parking place.
5. Arrange for refreshment/food for the personnel engaged in the emergency action.
6. It shall be ensured that Telephone traffic is controlled and messages to the key personnel as per the list, for Nature - I and Nature -II emergency are communicated immediately.
7. Send one vehicle at Safety & Fire Deptt. to transfer additional emergency appliances to accident site.
8. Send the vehicles to Assembly points as per the instructions from Emergency Control Room.

**Public Relation & Advt. Team**
1. On receiving the message from E.C.R. about the emergency, arrange for photographer and rush to the control room.
2. Collect the data about the victims and their subsequent treatments.
3. Prepare the press release note in consultation with ‘Main Incident Controller’.

**Industrial Relation Team**
1. The team shall consist of Head of P&A, Mgr.(IR & Admin.), Time Office Staff and Union Representatives.
2. Get ready with the list of blood donors and arrange to send the donors as required by Medical Officer.
3. Get the relevant data of the victims and inform their relatives.
4. Inform Union Representatives to get any help required.
5. Arrange for financial help for the victims.
6. Inform the Contractors’ Supervisors suitably at Security Gate.

**Other Key Personnel**
Emergencies cannot be controlled single handedly. Co-operation of the following departments are very much essential to deal with an emergency.

- Safety & Fire
- Security
- Medical
- Utility & Environment Control
- Transport
- Engineering Workshop
- Technical Services
- Electrical
- Instrumentation
- Civil
- Inspection
- Stores
- Personnel
- Logistics

All such key personnel will assist the Main Incident Controller and the Incident Controller in all efforts to fight with an emergency.

**Other elements of EMP**
**Assembly Points**
In affected and vulnerable Dept., all non-essential technical workers (who are not assigned any emergency duty) shall evacuate the area & proceed to assembly points. The need to evacuate
non-essential technical workers will be determined by the severity of emergency and the foreseeable rate at which the incident may escalate. To ensure that workers will not have to approach the affected area to reach the assembly points, proper location and numbers will 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 will also be 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 Room (ECR)/ Emergency Control Center (ECC)**

The Emergency Control Room will be provided from which the operations to handle the emergency are directed and co-coordinated. It will be attended by the Main Incident Controller, Factory Inspectorate, District authorities and emergency services.

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

The ECR/ ECC center will be equipped with the following facilities.
1. External telephones facility. The latest telephone directory.
2. Internal telephones, walkie-talkies, Wireless communication set.
3. List of telephone nos. of MAS members & Key personnel.
4. Plans of the factory to show:
   - Location of the hazardous plants/areas.
   - Location of sirens
   - The firewater system and additional sources of water.
   - Assembly points and canteen.
   - Location of the factory with respect to the surrounding community.
   - Factory Medical Unit
   - First Aid
   - Muster roll of workers
   - Identity card register
   - M.S.D.S
   - Copy of ON SITE OFF SITE PLAN
   - Stationeries like- note book, pen, pencils etc.
   - S.B. Apparatus
   - List of Government Agencies /Local press agencies with phone no.
   - Sand Buckets & Hydrant Network
   - Adequate numbers of PPE’s

**Fire control Arrangements**

Fire is classified in following three classes. The appropriate fire extinguishers are used to extinguish the different class of fire.
5. **Class A**: General Fire - Cotton Waste, Paper, Rubbish and Scrap: water, ABC powder type
6. **Class B**: Liquid Fire - All solvents, Resin, Paints, LDO, HSD: Mechanical foam, ABC type
7. **Class C**: Gaseous /Electrical fire - Gaseous fire & panels etc.: CO₂, DCP/ABC

Sufficient number of fire hydrant valves and riser valves will be arranged to fulfill fire extinguishing need of the plant. Apart from this, fire extinguishers will be kept at various locations inside plant and those will be hydrostatically tested and refilled at intervals as specified by statutory body.

- Foam type - 15 Nos.
- Dry chemical powder type-25 Nos.
- CO₂ type- 15 Nos

Fire drill will be carried out by all the security guards apart from safety persons to keep them ready fortnightly. Sufficient amount of firefighting water will always be stored in storage tank for firefighting works. In case of power failure, diesel driven fire engine pump has arranged to generate the power for emergency lighting and to run water pump.

**Role of Manager (Fire and Safety)/Shift In-Charge (Fire & Safety)**
1. Incident Controller shall direct the firefighting 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.

**Role of EHS Representative**
1. On being notified about the location of fire/ gas leakage, he shall immediately proceeds 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 neighboring industry.

**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.

**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 Arrangements**
KSFPPL has proposed Medical Unit (First-Aid Centre) in the factory premises. Occupational Health Centre (OHC) is as per Factories Act/Rules. Trained Doctors, paramedical staff will be available round the clock at OHC. The information pertaining to Doctors of Jamnagar will available in OHC.
Medical Services team will function as follows:

1. On receiving the victims the necessary arrangements shall be made to treat them.
2. Arrange for additional oxygen sets / cylinders if required. Such arrangements with the supplier shall be made in advance.
3. Inform the nearby Hospital and nearby Industrial Medical Centre about the necessary help.
4. The list of addresses with telephone numbers shall be kept ready with medical officer.
5. Contact Industrial Relation (IR) Team if blood donors are required to follow the victim.
6. Ambulance shall not wait to receive call; it should rush to accident site on hearing the siren.

Facilities and Equipment at Medical Center
1. Examination Table
2. O₂ Cylinder
3. Artificial Respirator (Umbo Beg)
4. Autoclave sterilizes
5. Water jell.
6. BP Measuring Instrument
7. Male & Female ward with minimum two beds
8. Dressing room & Lab collection center

Communication System
Communication System is a Crucial Factor while handling emergency. Company will provide quick & effective Communication System through which, any situation, which can lead to emergency, can be informed or known to
1. All persons working inside the plant.
2. Key Personnel outside during normal working hours & during off-duty hours.
3. Outside emergency services, Statutory and Local Authorities,
4. Neighboring facilities and public leaving in vicinity.

Each and every section, Plant & Department of the Factory will be connected by internal telephones with Site Main Controller, 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 begin 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 plan 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 Message**
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 neighboring firms and the general public: Statutory information in the form of booklet will be given to neighboring units and the general public of the villages in the vicinity of the unit, if required.

**Post Emergency Activities**

**Medical check up**
Medical checkup of affected persons in the incident, if any, will be carried out, and suitable medical aid shall be provided to set right the problem.
Collection of Records
All possible evidences will be collected along with shift logs and personnel nearby or connected with the incident will be called for narrating the details so as to facilitate finding of the most probable and convincing cause of incident and emergency situation. The proposed procedure will help in suggesting the remedial measures for preventing recurrence.

Inquiry
Detailed inquiry for the incident will be carried out to find out the cause, which will be in the form of fact finding mission and recommendations made to the suitable authority.

Training
Regular training program for all the concerned personnel will be conducted to enable them to face any type of emergency situation, be it natural disaster, fire in equipment, building or any explosion in equipment.

Mock Drill
Full scale mock drill will be conducted at least once a year in coordination with Safety Department. Manager will declare the emergency for mock drill and all personnel concerned will perform various duties as per responsibilities assigned in this plan.

DMP Audit, Non Conformance and Corrective Action and Preventive Action
Since this DMP will be designed as a dynamic document, it is required that its performance be audited at regular intervals. Ideally, the persons auditing the DMP should be external auditors (i.e. not employed at the site being audited). The audit should result in a set of findings that are put before the site management for review. Audits will be periodic, at intervals that are decided by the Head Office. Audit reports will state the exact non-compliance with the particular clause of this DMP, and would include steps to be taken to attain the compliance, through corrective and preventive actions.

Review of Emergency Performance
The site/head office management will review the findings of the audit and the non-compliances. It will consider whether the DMP is providing adequate safety assurance to the management, delivering performance as desired, and whether it continues to be in the spirit of Environment, Health and Safety Policies and changing requirements. On the basis of these, the management will record its decisions and consider modifying the DMP, as deemed appropriate.

Safety Aspects of the Project
In this type of plant, the principle safety hazards will be due to normal burns, chemical burns, slips, falls, vehicle accidents, electrocution and shocks due to working on high voltage level equipment and system, injury due to machines during operation and maintenance, head injury due to object falling from height, boiler explosion due to flame out, seam burns due to sudden leakage from pipeline at high pressure, suffocation during working in confined space like tank, and so on.
Various measures listed hereunder will be implemented to maintain safety of the plant and personnel working there.
**General Safety Guidelines**

1. The responsibilities of the working personnel, supervisors, engineers and higher authorities will be clearly identified towards strict implementation of safety aspects and awareness.

2. All personnel irrespective of category, departmental or contractual, will have to use Personal Protective Equipment (PPE) while working in the plant areas. Use of safety shoes, safety helmet, ear plugs will be made mandatory for all the personnel when moving in the plant indoor and outdoor areas. Use of these PPE will also be mandatory for all the visitors.

3. When machines or system will present danger of potential eye injury from physical or chemical elements, the personnel working there will be provided an appropriate eye protection device like safety clear glasses or goggles face shields and welding helmets, which will be adequate and reasonably comfortable.

4. Vehicle speed for movements within the plant areas will be limited to 20 kmph so as to prevent road accidents. Instruction boards will be placed on the roads.

5. In road designing, proper curvature at the bends, cross-roads will be provided so as to facilitate turning of vehicle without any problem.

6. Good housekeeping will always be maintained in the entire plant area, which is one of the best contributors to the safety of the equipment and personnel. Combustible scrap and debris like wood, clearing/grubbing material will be removed from the site daily or will be securely stored in the covered containers.

7. No unauthorized personnel will be permitted to work, which will be required to be carried out by highly specialized and trained personnel, e.g. welding work in the boilers will have to be carried out by the welder possessing necessary valid recognition under the Indian Boiler Regulations (IBR approved), or only necessary Wireman/Supervisor permit holder will be deployed for working on electrical equipment and system.

8. All the exits points in the entire plant area will be kept free from obstructions so as to facilitate quick escape in the event of emergency. The buildings will have normal escape as well as safe emergency escape doors, staircases as required. Illuminated “EXIT” signs will be installed on all the escape doors.

9. Every floor, working place and passageway will be kept free from protruding nails, splinters, holes or loose boards.

10. A full-proof work permit system with clear identification of the responsibilities of the permit issuing authority and permit drawing agency/person will be developed to avoid unforeseen accidents.

11. All equipment and materials should be stored in designated storage areas that are labelled as such. The hazardous materials will have display of “Material Safety Data Sheet” nearer to the storage for knowledge of personnel handling them.

12. DC supply operated emergency lighting will be arranged in the plant for providing some illumination to facilitate safe movement of plant operating personnel during complete blackout conditions.

13. The belt drives, pulleys, extended shafts, gears and other moving parts will be provided with shield guards and guard railings for preventing accidental touch.

14. The steam pipelines and exposed hot surfaces will be provided thermal insulation to maintain the skin temperature as specified under the applicable standards to prevent burn injuries.
15. Visible signs and symbols will be provided during any construction/maintenance activity that will present a hazard, which will be removed immediately on completion of work.

16. “DANGER” signs will be posted at all immediate hazards, i.e. Danger: Open Hole and “CAUTION” signs will be posted at all potential hazards, i.e. Caution: Construction Area, Caution: Buried Cable.

17. Specific “Assembly Points” for gathering of personnel working in the plant in case of any eventuality will be decided and boards will be placed in the entire plant.

**Fall Protection**

1. It will be strictly ensured that the fall protection is provided by the contractor to the employees working at heights equal to or greater than 1.8 m. The fall protection will be in the form of perimeter protection such as guardrails and toe rails, personal protective equipment like safety belt. Activities that require personal fall protection systems include steel erection welding, bolting, riveting, fitting-up and plumbing-up, work over water and some deep excavation work.

2. On buildings and structures not adaptable to temporary floors, and where scaffolds are not used, safety nets will be installed and maintained, whenever the potential fall distance exceeds two stores.

3. If machines or system operations present the potential for foot injury, necessary foot protection will be provided, which will be of safe design and construction for the work to be performed.

4. The personnel working in the area with high noise level present will be provided with hearing protection devices like ear plugs and ear muffs.

5. The working surfaces will be kept clean and dry to prevent slips and falls. Spillage of chemicals such as lube-oils will be avoided and in case of spillage, necessary action for cleaning using appropriate cleansing materials will be immediately taken to avoid slips and falls.

6. During construction phase, the floor to be used as the erection floor will be solidly planked or decked over its entire surface except for access openings.

**Ladders and Stairs**

1. During construction stage, the temporary ladders/portable steps brought by the contractors will be inspected prior to use. Random checks on upkeep of all ladders and temporary/portable steps will be exercised to ensure that they are maintained in good and safe working condition.

2. All the ladders will be used only on stable and leveled surfaces unless secured to prevent accidental movement. The ladders will not be permitted for use on the slippery surfaces unless secured or provided with slip-resistant feet to prevent accidental movement.

3. During construction phase, it will be ensured that the contractor provides a ladder (or stairway) at all work points of access, where there is a break in elevation of 0.5 m or more.

4. When there is only one point of access between levels, it will be kept clear to permit free passage by the working personnel. If free passage becomes restricted, a second point of access will be provided and used. At all times, at least one point of access will be kept clear.
5. All elevated platforms, walkways, stairways and ramps will be provided handrails, toe-
guards and non-slip surfaces. The design of staircases will be maintaining required angle of
repose so that the personnel will climb safely and comfortably.

Scaffolds
1. If access to and between scaffold platforms will be more than 0.6 m above or below, the
point of access will be made by portable/attachable ladders or ramps.
2. No makeshift devices, such as boxes and barrels, will be permitted to use to increase the
scaffold platform working level height.

Trenching and Excavation
1. The area around the trench/excavation will be kept clear of surface encumbrances.
2. Water will not be allowed to accumulate in the excavation.
3. Adjacent structures will be shored in accordance with the design documents to prevent
collapse. The trench or excavation will be sloped to prevent cave-ins.
4. Guardrails or some other means of protecting people from falling into the trench/excavation
will be provided where work will supposed to go on for longer duration.
5. The trench or excavation will be shored or sloped to prevent cave-ins.
Prior to commencement of excavation during construction stage and during operation stage,
necessary permission from mechanical for underground pipelines, electrical for underground
cables and civil for foundations will have to be taken so as to protect existing equipment from
damage and for safety of workers taking up excavation. The drawing showing exact details of
such things will be always available with all these departments and Safety Officer and it will be
updated from time to time incorporating all details.

Mitigation Measures during construction phase:
The following needs to be implemented by the contractor while carrying out civil construction

Provision of Personal Protecting Equipments (PPE's)
Required PPE shall be provided to cover occupational foot, head, hearing, and eye protection

Occupational Health Hazards
In this type of plant, the principle occupational health hazards posing danger to the health of
personnel are acid handling area, oil & chemical storage areas. Working in these areas without
proper precautions and PPEs may cause skin diseases, chemical burns, respiratory diseases,
electric shock and electrocution leading to permanent disability.

1. Various measures listed hereunder will be implemented to encounter health hazards to
the personnel working there:
2. The plant areas will have good washing and sanitary facilities, which will be kept clean
and maintained.
3. In acid/alkali storage areas and laboratories prone to chemical burns, facility for
emergency eye wash baths will be provided at several locations to facilitate washing of
eyes, hands in the event of chemical burns.
4. The chemists working in the laboratory and handling acid/alkali will be provided chemical resistant aprons and hand gloves to protect against chemical burns.

5. Noise level around generators will be less than 75 dBA at 1.5 m from the machine. For operators working near the equipment will be seating in an insulated room in which noise level will be much lower than 75 dBA.

6. While operating high voltage and extra voltage electrical equipment, special shockproof insulated hand gloves will be worn by the personnel so as to avoid electrical shock or electrocution.

7. The personnel operating on the boiler floor may be exposed to higher temperatures and may experience heat stress on physique. To reduce this health hazard, operators will be given frequent breaks and the area will also have good general ventilation for air circulation.

**OCCUPATIONAL HEALTH & SAFETY PROGRAM**

KSFPPL has prepared the Occupational Health Surveillance Program which will 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.

**Occupational Health**

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

**Hospital Facilities /Factory Medical Officer & OHC**

- Company will make formal agreements with nearby hospitals 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 ship 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.

**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.

**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:

1. Before employment, to ascertain physical fitness of the person;
2. 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;

Details of Occupational Health Impacts and Safety Hazards

<table>
<thead>
<tr>
<th>Occupational Hazards Identification</th>
<th>Occupational Health Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposure to Corrosive Chemicals</td>
<td>Irritation and burns</td>
</tr>
<tr>
<td>Exposure to Chemical Dust, Spillage/leakage, Overflow</td>
<td>Severe irritation to eyes &amp; skin, Respiratory disorder, Fatality, etc.</td>
</tr>
<tr>
<td>Slip/trip, fall, electric shock, etc.</td>
<td>Body Injury, Burns, Skin sensitization, Fall Injury, Electrocution, Damage to nearby equipment’s, Fatality, etc.</td>
</tr>
</tbody>
</table>

Mitigation measures/ Safety Measures proposed to avoid the human health hazards are mentioned under previous section. 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.

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
- Number of Samples
- Range of contaminant concentration as measured in sample
- Average concentration
- TWA concentration of contaminant (As given in Second Schedule of Factories Act)
- Reference method used for analysis
- Number of workers exposed at the location being monitored
- Signature of the person taking samples
- Other relevant details

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 equipment’s, 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.
Provision of Industrial Hygienist & Health Evaluation of Workers
1. It is proposed that management will develop 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.

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 labors will also be given safety training. To create safety awareness, safety films shall be shown to workers and leaflets shall be distributed.

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

Budget for Occupational Health & Safety
A capital Budget of **Rs. 30.00 Lakhs** and **Rs. 1.00 Lakh per annum** as recurring cost will be allocated for Occupational Health and Safety.