CHAPTER 7. RISK ASSESSMENT

7.1. Introduction

Pesticides plants deal with materials, which are generally hazardous in nature by virtue of their intrinsic chemical properties or their operating temperatures or pressures or a combination of these. Fire, explosion, toxic release or combinations of these are the hazards associated with industrial plants using hazardous chemicals. More comprehensive, systematic and sophisticated methods of Safety Engineering, such as, Hazard Analysis and Quantitative Risk Assessment have now been developed to improve upon the integrity, reliability and safety of industrial plants.

The primary emphasis in safety engineering is to reduce risk to human life, property and environment. Some of the more important methods used to achieve this are:

- **Quantitative Risk Analysis:** Provides a relative measure of the likelihood and severity of various possible hazardous events by critically examining the plant process and design.
- **Work Safety Analysis:** The technique discerns whether the plant layout and operating procedures in practice have any inherent infirmities.
- **Safety Audit:** Takes a careful look at plant operating conditions, work practices and work environments to detect unsafe conditions.

Together, these three broad tools attempt to minimize the chances of accidents occurring. Yet, there always exists, no matter how remote, probability of occurrence of a major accident. If the accident involves highly hazardous chemicals in sufficiently large quantities, the consequences may be serious to the plant, to surrounding areas and the populations residing therein.

7.2. Risk Assessment

A three 'levels' risk assessment approach has been adopted for the CCIPL facilities. The risk assessment levels are generally consistent with the practices encountered through various assignments for medium and large chemical complexes. The brief outline of the three tier approach is given below:

**7.2.1. Level 1 – Risk Screening**

This is top-down review of worst-case potential hazards/risks, aimed primarily at identifying plant sites or areas within plant, which pose the highest risk. Various screening factors considered include:

- Inventory of hazardous materials;
- Hazardous Materials properties;
- Storage conditions (e.g. temperature and pressure);
- Location sensitivity (distance to residential areas / populace).

The data / information are obtained from plant. The results provide a relative indication of the extent of hazards and potential for risk exposure.

**7.2.2. Level 2 – Major Risk Survey (Semi - Quantitative)**

The survey approach combines the site inspection with established risk assessment techniques applied both qualitative as well quantitative mode. The primary objective is to identify and select major risks at a specific location in the plant considering possible soft spots / weak links during operation / maintenance. Aspects covered in the risk usually include:

- Process Hazards;
- Process Safety Management Systems;
- Fire Protection and Emergency response equipments and programs.
- Security Vulnerability;
- Impact of hazards consequences (equipment damage, business interruption, injury, fatalities);
- Qualitative risk identification of scenarios involving hazardous materials;
- Risk reduction measures.

Selection of critical scenarios and their potential of damage provide means of prioritising mitigative measures and allocate the resources to the areas with highest risks.

**7.2.3. Level 3 – Quantitative Risk Assessment (Deterministic)**

This is the stage of assessment of risks associated with all credible hazards (scenarios) with potential to cause an undesirable outcome such as human injury, fatality or destruction of property. The four basic elements include:

- Hazards identification utilising formal approach (Level 2, HAZOP etc.);
- Frequency Analysis. Based on past safety data (incidents / accidents); Identifying likely pathway of failures and quantifying the toxic / inflammable material release;
- Hazards analysis to quantify the consequences of various hazards scenarios (fire, explosion, BLEVE, toxic vapour release etc.). Establish minimum value for damage (e.g. IDLH, over pressure, radiation flux) to assess the impact on environment.
- Risk Quantification: Quantitative techniques are used considering effect / impact due to weather data, population data, and frequency of occurrences and likely hood of ignition / toxic release. Data are analysed considering likely damage (in terms of injury / fatality, property damage) each scenarios is likely to cause.
QRA provides a means to determine the relative significance of each of a number of undesired events, allowing analyst and the team to focus their risk reduction efforts where they will be beneficial most.

7.3. Hazardous Chemicals handled in CCIPL Proposed Project

Hazardous materials have been defined under MSIHC Rules (1989) - 2 (e) which means.

(i) Any chemical which satisfies any of the criteria laid down in Part I of Schedule I and is listed in Column 2 of Part II of this Schedule;

**Toxic Chemicals:** Chemicals having the following values of acute toxicity and which owing to their physical and chemical properties are capable of producing major accident hazards:

**Flammable chemicals:**

i. Flammable gases; 20°C and at standard pressure of 101.3 KPa are:
   - Ignitable when in a mixture of 13% or less by volume with air, or;
   - Have a flammable range with air of at least 12% points regardless of the lower flammable limits.

ii. Extremely flammable liquids: chemicals which have a flash point lower than or equal to 23°C and the boiling point less than 35°C;

iii. Very Highly flammable liquids: chemicals which have a flash point lower than or equal to 23°C and the boiling point higher than 35°C;

iv. Highly Flammable Liquid: Chemicals which have a flash point lower than or equal to 60°C but higher than 23°C.

v. Flammable Liquids: chemicals which have a flash point higher than 60°C but lower than 90°C.

**Explosives:** Explosive means a solid or liquid or pyrotechnich substance (or a mixture of substances) or an article.

i. Which is in itself capable by chemical reaction of producing gas at such a temperature and pressure and at such a speed as to cause damage to surroundings;

ii. Which is designed to produce an effect by heat, light, sound, gas or smoke or a combination of these as the result of non-detonative self sustaining exothermic chemical reaction?
   a. any chemical listed in Column 2 of Schedule 2;
   b. any chemical listed in Column 2 of Schedule 3; Considering these aspects hazardous chemicals handled in CCIPL project are as given below:
Table 7.1: Hazardous Chemicals

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Product / Formula / [Active Ingredient (AG) % + Others%] / CAS / UN No</th>
<th>Properties</th>
<th>Toxicity Potential</th>
<th>Remarks / Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Clodinofop Propergyl C&lt;sub&gt;17&lt;/sub&gt;H&lt;sub&gt;13&lt;/sub&gt;CIFNO&lt;sub&gt;4&lt;/sub&gt; AG-22.3 % CAS No:105512-06-9</td>
<td>Light to dark brown liquid. With aromatic odour. Dangerous products Flash Point: 143.5°F of decomposition at high temperature – Toxic gases Nitrogen oxides (NOx)</td>
<td>DT-4000; OT-2276 IT-3.5; [T] (Rats) NFPA- H-2;F-2;I-0</td>
<td>Causes eye, skin and respiratory passage irritation. May cause sensitisation of skin. Exposure to high vapour level may cause dizziness, headache or affect nervous system.</td>
</tr>
</tbody>
</table>

(Source: EQMS)

Table 7.2: Raw Materials

<table>
<thead>
<tr>
<th>S. No</th>
<th>Material</th>
<th>S. No &amp; Threshold Quantity (TQ in Kg) as per MSHIC Rules</th>
<th>Chemicals Hazards Potential</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n-Hexane</td>
<td>CAS No:110-54-3 UN No:1208 Clear colorless liquids with a petroleum-like odor. Flash points -9°F</td>
<td>Highly flammable; Vapours may explode; Health Hazards: Inhalation causes irritation of respiratory tract, cough, mild depression, cardiac arrhythmias. Aspiration causes severe lung irritation,</td>
<td>TEEL-1: 400 ppm TEEL-2: 3300 ppm TEEL-3: 8600 ppm IDLH 1100 ppm</td>
</tr>
<tr>
<td>S. No</td>
<td>Material</td>
<td>S. No &amp; Threshold Quantity (TQ in Kg) as per MSHIC Rules</td>
<td>Chemical Hazards Potential</td>
<td>Remarks</td>
</tr>
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<td>-------</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Schedule-1, Part-II Schedule-2, Part-I Schedule-3, Part-I</td>
<td>Hazards</td>
<td>Toxic</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>coughing, pulmonary edema; excitement followed by depression. Ingestion causes nausea, vomiting, swelling of abdomen, headache, depression.</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Acetonitrile CAS No:75-05-8 UN No:1648 A colorless limpid liquid with an aromatic odor. Flash point 42°F</td>
<td>334</td>
<td>Highly flammable; toxic vapours (HCN /NOX ) are generated when heated; Vapor heavier than air and may travel a considerable distance to a source of ignition and flash back. Health Hazards: Exposure to 160 ppm for 4 hours causes flushing of the face and a feeling of constriction in the chest; 500 ppm for brief periods is irritating to the nose and throat.</td>
<td>TEEL-1: 13 ppm TEEL-2: 320 ppm TEEL-3: 670 ppm IDLH 500 ppm</td>
</tr>
<tr>
<td></td>
<td>Isopropyl Alcohols (Solvent)</td>
<td></td>
<td>Flash Pt.: 55.00 F Method Used: TCC</td>
<td></td>
</tr>
<tr>
<td>S. No</td>
<td>Material</td>
<td>S. No &amp; Threshold Quantity (TQ in Kg) as per MSHIC Rules</td>
<td>Chemicals Hazards Potential</td>
<td>Remarks</td>
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</tr>
<tr>
<td></td>
<td>CAS No: 67-63-0</td>
<td>Schedule-1, Part-II Schedule-2, Part-I Schedule-3, Part-I</td>
<td>Explosive Limits: LEL: 2.5% UEL: 12.1% LD 50: dermal Rabbit 1300 mg/kg; LC50: Rat (8 hours) 12000 ppm.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C-9 [naphtha] FP-62°C; LEL-0.6%; UEL-7%</td>
<td>-- 30</td>
<td>TWA-100mg/m³ Health Hazard Irritation of eyes, skin and nose. May cause nausea.</td>
<td>Flammable/ vapours can explode</td>
</tr>
<tr>
<td></td>
<td>Propargyl Chloride CAS No:</td>
<td></td>
<td>Emergency overview Danger: flammable. Corrosive liquid. Corrosive to the skin, eyes and respiratory system. Harmful if swallowed. Harmful if inhaled. Harmful in contact with skin. Has a narcotic</td>
<td></td>
</tr>
</tbody>
</table>
### S. No | Material | S. No & Threshold Quantity (TQ in Kg) as per MSHIC Rules | Chemicals Hazards Potential | Remarks
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Schedule-1, Part-II</td>
<td>Schedule-2, Part-I</td>
<td>Schedule-3, Part-I</td>
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</tr>
<tr>
<td></td>
<td>DMF Dimethyl formamide</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CAS No:68-12-2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>UN No: 2265</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>A water-white liquid with a faint fishy odour. Flash point 136°F. Slightly less dense than water</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Source: EQMS)

The material stored in bulk is given in Table 2.6.

#### 7.3.2. Model Used for Consequence Analysis

The Quantitative Risk Assessment study involves a large number of calculations for which established computing aids are essential. Areal Locations of Hazardous Atmospheres (ALOHA) model has been used in the present study for quantification of the hazards associated with the proposed project.

#### 7.3.3. Scenarios for Consequence Analysis

The plant is dealing with many hazardous substances. Most of hazardous chemicals are flammable in nature and will not create major threat to life and property in the event of spillage as dykes have been provided for full containment. Subsequently, their
consequence will be confined within short distances in the form of thermal radiation. In the event of release of toxic gases consequence may be off site. For selection of maximum credible accident scenarios following methodology have been adopted:

7.3.4. **Methodology for Selection of Accident Scenarios**

In this study, the following steps were followed for scenario selection for risk analysis study:

- The hazardous materials handled at the plant and the associated hazards materials (coming under MSIHC Rules, 1989) were identified and assessed.
- Operating and storage conditions of handling and storage of hazardous materials were studied.
- An assessment was made of what inventories can get released accidentally.

7.3.5. **Worst Case Scenarios**

Worst case scenarios selected for consequence analysis as a result of accidental releases of hazardous materials are given in Table 7.3.

<table>
<thead>
<tr>
<th>Sl.</th>
<th>Type of Release</th>
<th>Outcome Cases Considered</th>
</tr>
</thead>
<tbody>
<tr>
<td>RM-1.</td>
<td>Leakage in 15 KL Hexane Tank</td>
<td>Flash Fire/BLEVE</td>
</tr>
<tr>
<td>RM-2.</td>
<td>Leakage in 30 MT Acetonitrile/dimethylformamide</td>
<td>Flash Fire</td>
</tr>
<tr>
<td>RM-3.</td>
<td>Leakage in 15 MT Isopropyl Tank</td>
<td>Flash Fire</td>
</tr>
<tr>
<td>RM-4</td>
<td>Heavy Leakage in C-IXTank &amp; pool fire</td>
<td>Pool Fire / vapour Cloud Explosion</td>
</tr>
<tr>
<td>RM-5</td>
<td>Leakage in 15 MT Dimethyleformamide</td>
<td>Flash Fire</td>
</tr>
</tbody>
</table>

7.4. **Consequence Analysis**

Consequence analysis has been carried for the selected accident scenarios to estimate the vulnerable zones. When the vulnerable zones are identified for failure cases, mitigation measures can be taken for risk mitigation measures and to eliminate/avoid damage to the plant and injury to personal.
### Table 7.4: Scenarios Selected for Consequence Analysis

<table>
<thead>
<tr>
<th>Scenario No.</th>
<th>Scenario Raw Material</th>
<th>Impact Zone (m)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>RM-1</td>
<td>Leakage in Acetonitrile/dimethylformamide Tank &amp; Fire</td>
<td>1st degree burn -- 14</td>
<td></td>
</tr>
<tr>
<td>RM-2</td>
<td>Leakage in Hexane Tank &amp; Fire BLEVE</td>
<td>1st degree burn -- 13, 1st degree burn -- 488</td>
<td>From Fire Ball</td>
</tr>
<tr>
<td>RM-3</td>
<td>Leakage in Isopropyl Alcohol &amp; Fire</td>
<td>1st degree burn -- 13</td>
<td></td>
</tr>
<tr>
<td>RM-4</td>
<td>Heavy Leakage in C-9 Tank &amp; Pool fire Vapour Cloud Explosion</td>
<td>1st degree burn -- 15, 0.1 bar -- 103</td>
<td>Distance from centre of cloud</td>
</tr>
</tbody>
</table>
Figure 7.1: Intensity Radial for Thermal Radiation from Leaking RM-1 (Acetonitrile/dimethylformamide Tank)

- >= 10.0 kW/(sq m) = potentially lethal within 60 sec
- >= 4 kW/(sq m)
- >= 2.0 kW/(sq m) = pain within 60 sec
Figure 7.2: Leakage and Fire Analysis Hexane Tank

- $\geq 10.0 \text{ kW/(sq m)} = \text{potentially lethal within 60 sec}$
- $\geq 4 \text{ kW/(sq m)}$
- $\geq 2.0 \text{ kW/(sq m)} = \text{pain within 60 sec}$
Figure 7.3: Intensity Radius for Thermal Radiation from BLEVE (Hexane Tank)

- $>= 10.0 \text{ kW/(sq m)}$ = potentially lethal within 60 sec
- $>= 4 \text{ kW/(sq m)}$
- $>= 2.0 \text{ kW/(sq m)}$ = pain within 60 sec
7.4.2. Thermal Hazards

The impact zones for some of the hazards are shown in Figures 7.1 through 7.4.

Thermal and Explosion Hazards

Incidents involving thermal hazards are mainly due to raw material fire (in tank farms). The impact (1st degree burn) is limited to 15 m only (except in case of BLEVE when it extends to 488 m from fireball). However the consequences can go to worse if the incidents lead to domino effect in other tanks.

7.4.2.1 Toxic Hazards

Toxic hazards are mainly due to products leakage and their impacts are limited. Toxic impacts due to pesticides products are considered for liquid products mainly. The impacts due to these products are unlikely to cross the product storage godown and may reach other places in the plant depending upon wind direction.

Figure 7.4: Intensity Radii for Thermal Radiation from Leaky RM-3 (Isopropanol Tank)
7.4.2.2 Other Hazards

The other hazards in the plant include (but not limited to):

- Other toxic hazards due to acids / other toxic spillages (mainly limited to spillage area only.).
- Mechanical hazards due to machines / equipments.
- Hazards due to individual soft spots like walking casually and noticing a pit and falling or colliding/ stumbling or slipping (not noticing a wet place etc.).

7.4.2.3 Safety Inspections and Internal Audit

General safety inspections will be carried out regularly at the proposed plant. Internal safety audit will also be conducted frequently.

7.4.2.4 Safety Education And Training

Safety Training

There will be provision at the plant for induction training for new workers. The assessment of the trainee will be done to ensure the effectiveness of training.

Periodic Training / Reporting

The workers will be trained as per need of training.

Safety Communication / Motivation / Promotion

- The system for safety suggestion schemes will be implemented at the plant.
- There will be provision at the plant for the safety contests for motivation of safety at the plant.

7.4.2.5 First Aid

- First aid boxes will be available within various departments.
- The first-aid room will be available and trained first aid will be available in each shift at the plant.

7.4.2.6 Occupational Health

- The pre-employment and periodical medical check up will be carried out at regular interval for all employees.
- Emergency vehicle/ambulance for the event of an emergency will be available round the clock at the plant in each shift.

7.4.3 Risk Mitigation Measures Adopted at the Proposed Plant

7.4.3.1 Hazard Control Measures

- Procedures and actions will be well defined and known to all operating personnel's for safe shut down of plant incase of failure of any power, instrumentation, cooling water, air, etc.
• All the vessels and tanks will be provided with temperature indicator, pressure gauge and safety valves as depending upon the process and operating parameters.
• All the reactors which will not working at atmospheric temperature will be provided with glass wool lagging to contain the heat.
• All the motors and other rotating equipment machines will be provided with suitable safety guards.
• First Aid Fire extinguishers will also be installed in the plant area.
• Flame arrestors will be provided at all vent lines at solvent tanks.
• Suitable first aid fire extinguishers, such as, DCP, CO₂ & foam type will be kept in every plant area at easily approachable spots and in sufficient numbers.
• Fire hydrant points with sufficient length of hose reel will be provided at major emergency spots.
• Bound walls, bonded wire fencing, detached storage area will be kept away from probable ignition sources;
• Safety shower and eye washer will be installed at crucial places.
• Sufficient space will be provided for free movement in the plant area.
• Safe distances have been considered in designing of plant lay out.
• Regarding all components of the plant proper certificate will be taken. Also testing and inspection will not be compromised before deliveries.
• Certificate of structure stability will be taken from competent person.
• Insulation of piping will be provided as per requirement.
• All elevated structures will be provided with lightening arrestors.
• All exposed parts of moving machineries will be provided with suitable guards for personnel safety.
• All piping and equipment will be provided with earthing connection and it will be tested regularly.
• Safety valves & rupture disc will be provided to prevent over pressurization of vessels and reactors.
• SOP will be available of safe shut-down of plant during any emergency situation.

7.4.3.2 Operational Safety

• All operators & maintenance personnel's concerned with the plant will be given data sheets for hazardous chemicals and to be trained to combat any leakage spillage, etc.
• Detections and sensors for smoke, heat, ammonia, chlorine, etc. will be provided with alarm at strategic locations at the plant.
• Safety appliances like PVC suit, hand gloves, safety goggles, helmets etc. will be used during material handling.
• Emergency First Aid kits will be kept available in all departments.
• Preventive maintenance will be carrying out as per schedule to avoid failure.
7.4.3.3 Toxic Releases: Controls

Small quantities - say leakage from piping, valves, pin holes etc. will be easily controlled by isolating the equipment/piping etc. & using personal protective equipment like helmet, shoes, hand gloves, air line respirator, breathing apparatus (SCBA), apron, etc.

7.4.3.4 Spillages, Leakages: Controls

Depending on the leaking rate/source the following actions will be taken.

- Isolation/cutting of supply at the leaking point, transfer to some other vessel/equipment, and using protective appliances like hand gloves, helmets, PVC suits etc.
- Efforts will be made, to prevent the spread of spillage by neutralization/earth barriers.
- Outgoing effluents will have to be blocked and taken to effluent pit. It will be discharged after treatment only. Continuous neutralization will also be arranged.

7.4.3.5 Hazards in Transportation: Controls

Highly inflammable chemicals will be transported by road. Therefore, adequate safety precautions for transportation are followed.

The following safety precautions are suggested during transportation of toxic, inflammable and corrosive chemicals in tankers, while loading and unloading, transportation and meeting the emergencies arising out of leakages and spillages of hazardous materials:

- Park the vehicle at designated place.
- Stop the engine.
- Check up spark arrester.
- Provide earthing to tanker securely.
- Ensure that fireman is available near the place with proper equipment’s.
- Connect the piping properly.
- Before start unloading, check that, there should not be any leakage.
- In case of leakage, immediately attend the leakages & rectify it.
- After unloading is over, close the lid properly.
- Vehicle to be started only after removal of all pipelines connected with tanker.

7.4.3.6 Safety Instructions For Transportation of Hazardous Materials

- The name of the chemical along with pictorial sign denoting the dangerous goods should be marked on the vehicle and the packing material.
- The name of the transporter, his address and telephone number should be clearly written on the road tanker and on the vehicle.
The important safety precautions should be mentioned on the tanker as a warning label.

- The tanker or vehicle should not be used to transport any material other than what is written on it.
- Only trained drivers and cleaners should transport hazardous chemicals.
- The transporter and the manufacturer must ensure the safe transportation of the material.

### 7.4.3.7 Tankers

- The tanker should be checked for its fitness and safe condition before loading.
- During loading and unloading, the tanker should be stopped and isolated against any movement, while loading/unloading, use safety appliances.
- The tanker should not be overloaded beyond the weight permitted by R.T.O.
- Check for leakages from the line connections before starting and stopping the filling operations.
- Drive the vehicles carefully, especially in crowded localities and on bumpy roads.
- Do not apply sudden break.
- The tanker should not be parked for long time on the way and especially in crowded places. Park the vehicle away from residential areas.

### 7.4.3.8 Other Hazards And Controls

In addition to the storage hazards, process hazards and vessel hazards, there are other hazards as given below:

- Boiler failure hazards.
- Non-Chemical vessels failure hazards
- Maintenance Hazards
- Hazards due to failure of electrical installations.
- Physical injuries.

### 7.4.3.9 Maintenance Hazards

- Safety permit system will be followed like hot work, cold work, confined space entry,
- Preventive maintenance will be carried out.
- Adequate inventory of spare parts will be maintained.
- Scaffoldings/Ladders will be used.
- Protective appliances will be utilized for protection against fall, hand injury, head injury etc.
- Positive insulations will be made.
- Maintenance procedures will be developed and followed.
- All physical hazards will be eliminated.
7.5. Risk Reduction Measures

Based on hazard identification, consequence analysis and safety measures to be adopted at the plant, following suggestions for improvement of safety at the plant are emerged.

7.5.1. Risk Mitigation/Reduction Measures

For risk mitigation/reduction, attempts should be made to either reduce inventories that could get released in the event of loss of containment or failure likelihood’s or both as feasible. Risk analysis identifies the major risk contributors, which enables prioritization of the plant that deserve special attention in terms of inspection and maintenance in particular and over all safety management as a whole.

For the risk reduction at the proposed plant, the following salient suggestions and recommendations are made:

- A written process safety information document may be compiled for general use.
- Personnel especially contractor workers at the plant should be made aware about the hazardous substance stored at the plant and risk associated with them.
- The process design information in the process safety information compilation must include P&IDs/PFDs; process chemistry; maximum intended inventory; acceptable upper and lower limits, pressures, flows and compositions and process design and energy balances.
- The document compilation should include an assessment of the hazards presented including (i) toxicity information (ii) permissible exposure limits. (iii) physical data (iv) thermal and chemical stability data (v) reactivity data (vi) corrosivity data (vii) information on process and mechanical design.
- The adequate numbers of heat, smoke, ammonia, chlorine detectors may be provided at strategic locations in the plant and indication of detectors/sensors should be provided in main control room.
- Predictive and preventive maintenance schedule should be prepared for equipment, piping, pumps, etc. and thickness survey should be done periodically as per standard practices.
- Safety measures in the form of DO and Don’t Do should be displayed at strategic locations especially in Gujarati and English language.
- Safe work practices should be developed to provide for the control of hazards during operation and maintenance.
- Personnel engaged in handling of hazardous chemicals should be trained to respond in an unlikely event of emergencies.
The plant should check and ensure that all instruments provided in the plant are in good condition and documented.

7.5.2. **Personal Protective Equipment**

Personal protective equipment (PPEs) is devices that are fitted and issued to each worker personally for his or her exclusive use. They are intended for temporary use and emergency response action only. If a worker must enter a contaminated area, he must wear adequate protective equipment. Employees should be taught when and how to use respiratory apparatus (SCBA) provided, and how to recognize defects in the equipment. Without SCBA entry into the contaminated area should not be attempted.

- Keep personal protective equipment where it can be accessed quickly, outside the hazardous material storage area and away from areas of likely contamination.
- Each employee should maintain his personal protective equipment in clean, working condition at all times.
- All equipment should be used and maintained in accordance with the manufacturer’s instructions.
- Equipment installed for body and eye wash should be checked properly for round the clock operation.

7.5.3. **Important Risk Mitigation Measures**

- Safe Operating Procedures will be made for all processes & operations and these are being operated according to Safe Operating Procedures. Staff is also trained for the same.
- Hazardous chemicals will be stored in separate storage along with all safety measures.
- Toxic Gas/vapours detectors will be installed and emergency gas leakage handling kits and scrubbing arrangements will be provided for handling emergency, at the chlorine station..
- Hazardous operations will be carried out by trained person & under supervision.
- Hazardous chemicals will be handling in close circuit.
- Enclosures will be provided with vent connected to scrubber.
- Nitrogen blanketing will be done for storage & process of highly flammable liquids.
- Safety fittings like Safety valve, Pressure reducing valve, vent, flame arrester, pressure / temperature indicators, level indicators, rupture discs etc. will be provided to the concern equipment.
- Periodical testing will be carried out by competent person for vessels and Lifting tackles.
- Preventive maintenance will be done periodically for all concern equipment.
- Calibration of all instruments in the plant will be carried out periodically.
Interlocks will be provided as & where required, in manufacturing processes.
Loading / Unloading will be ensured with earthing & bonding for flammable chemicals.
Flameproof fitting, Earthing & Bonding of equipments & pipelines will be provided.
Work permit system will be followed strictly.
Periodic on site emergency Mock drills will be arranged.
Work area monitoring will be done periodically.
Safety training’s will be given to the employees for handling of hazardous chemicals.
First aid treatment will be provided through well equipped first aid box & Occupational Health Center. Trained first aid persons will be available in each shift. Pre employment & periodic medical examination is done.
Monthly Cholinesterase enzyme test will be done for those employees who are working in manufacturing process.
Washing and Bathing facilities will be provided
Well-maintained SCBA set & Emergency Airline respirators will be installed at conspicuous places.
Protective clothing will be provided to all employees & casual workers and these are regularly washed properly.
Necessary PPE’s will be readily available. Jobs are accomplished using relevant PPEs
Deployment of competent supervisors for supervising hazardous activities.
Necessary cautionary placards will be displayed at conspicuous places in company.
Eating & Chewing will be prohibited in manufacturing area.
Vehicle and strangers movements will be regulated.

7.5.3.1 Spill Control

For all plants spill control procedures will be displayed. Spillage shall be controlled as per concerned spill control procedure.
Unprotected personnel up wind will be kept up wind.
Like any spilled materials to contain. Absorb spilled liquid by dry absorbent clay or sawdust.
Collect most of the contaminated absorbent with shovel for further disposal/incineration.
If spill of material directly on the ground, dig up and remove saturated soil for disposal/incineration.
Inactivate poisonous chemical with suitable method.
7.5.3.2 **Bulk Storage of Finished Product:**

- Stacking of formulated material in godown must be restricted to certain fixed height. Drums/plastic carboys/jars & other finished goods packing shall not be stacked at very high levels. This may cause accidents.
- Some space must be left while storing the product to easily identify lot numbers.
- It should be marked with Lot No. for easy stacking and removal.
- Material approved by Quality Control Department must be mentioned in the label or marked in the lot nos.
- Supervisor/Engineer must see that the plant personnel are wearing safety appliance while handling materials.
- The first aid box will be kept at Occupational Health Center, to be used during emergency.

7.5.4. **Handling of Hazardous Materials**

- Personal protective equipment used by the workers during handling of hazardous chemicals, should be replaced after certain time.
- If any spillage of hazardous chemicals, it should be cleaned and disposed as per standard practiced.
- Empty drums of hazardous chemicals should neutralize immediately.
- Workers engaged in handling of hazardous chemicals should be made aware of properties of hazardous chemicals.

7.5.5. **General Working Conditions at the Proposed Plant**

7.5.5.1 **House Keeping**

- All the passages, floors and stairways should be maintained in good conditions.
- The system should be available to deal with any spilling of dry or liquid chemical at the plant.
- Walkways should be always kept free from obstructions.
- In the plant, precaution, instructions and DO and Don’t Do should be displayed at strategic locations in Gujarati and English Languages.
- All pits, sumps should be properly covered or securely fenced.

7.5.5.2 **Ventilation**

- Adequate ventilation should be provided in the work floor environment.
- The work environment should be assessed and monitored regularly as local ventilation is most effective method for controlling dust and gaseous emissions at work floor.

7.5.5.3 **Safe Operating Procedures**

- Safe operating procedures will be available for mostly all materials, operations and equipment.
7.5.5.4 Work Permit System

- Work permit system will be followed at the plant during maintenance.

7.5.5.5 Fire Protection

- Well designed pressured hydrant system comprising with jockey pump, electrical & diesel pumps, hydrant, monitor, etc will be installed at the plant.
- The fire fighting system and equipment will be tested and maintained as per relevant standards.
- Heat and smoke detectors will be provided at the plant and shall be calibrated and maintained properly.

7.5.5.6 Static Electricity

- All equipment and storage tanks/containers of flammable chemicals shall be bounded and earthed properly.
- Electrical pits shall be maintained clean and covered.
- Electrical continuity for earthing circuits shall be maintained.
- Periodic inspections shall be done for earth pits and record shall be maintained.

7.5.5.7 Communication System

- Communication facilities shall be checked periodically for its proper functioning.

7.5.5.8 Safety Inspections

- The system shall be initiated for checklist based routine safety inspection and internal audit of the plant. Safety inspection team shall be formed from various disciplines and departments.

7.5.5.9 Safe Operating Procedures

- Safe operating procedures should be formulated and updated, specific to process & equipment and distributed to concerned plant personnel.
- Safety procedure near anhydrous Ammonia tanks and Ammonia Cylinders shall be prepared and displayed meticulously in Gujarati and English languages.

7.5.5.10 Predictive and Preventive Maintenance

- Predictive and preventive maintenance schedule shall be followed in religious manner.

7.5.6 Electrical Safety

- Insulation pad at HT panels shall be replaced at regular interval.
- Housekeeping in MCC room shall be kept proper for safe working conditions.
7.5.7. **Colour Coding System**

- Colour coding for piping and utility lines shall be followed in accordance with IS: 2379:1990.

7.6. **Disaster Management Plan**

Disaster Management Plan is essential for a pesticide and agro plant as the processes adopted for manufacturing are classified under Factory Act as Hazardous due to handling and storage of toxic, flammable and explosive hazardous materials. Over the years, the chemical process plant has created adequate infrastructure and adopted risk mitigation measures to tackle any emergency that may arise during the manufacturing process. The important aspect in emergency planning is to control an emergency by technical and organizational means, minimize accidents and consequent losses. Emergency planning also brings to light deficiencies, such as, lack of resources necessary for effective emergency response. It also demonstrates the organization’s commitment to safety of employees and physical property as well as increases the awareness among management and employees.

Disaster Management Plan for the plant is necessarily a combination of various actions which are to be taken in a very short time but in a pre-set sequence to deal effectively and efficiently with any disaster, emergency or major accident with an aim to keep the loss of men, material, plant/machinery etc. to the minimum.

A major emergency in a pesticide plant is one, which has the potential to cause serious injury or loss of life. It may cause extensive damage to property and serious disruption of both inside and outside the plant. Sometimes, it would require the assistance of outside emergency services to handle it effectively. Although the emergency at the plant may be caused by a number of different factors, e.g. leakage of toxic and flammable materials from piping/tanks, total/partial power failure, earthquake or sabotage, it will normally manifest itself in fire/toxic release.

Primarily, DMP is prepared to furnish details which may require at the time of the emergency, to delegate responsibility, to estimate the consequences in advance and to prepare ourselves to control any type of emergency. The plan explains basic requirements as follows:

- Definition,
- Objectives,
- Organization set up,
- Communication System,
- Action on site,
- Link with Off-site Emergency Plan,
Training rehearsal and record aspect. CCIPL has brought on-site emergency plan which is given Annexure 11. CCIPL also carrying mockdrill regularly. Brief outline about the emergency plan is given below:

### 7.6.1. Definitions

Various definitions on different analogy used on On-site & Off-site Emergency Plan are as follows:

**Accident:** An accident may be defined as “an undesirable and unplanned event with or without or major damage consequence of life and/or property.

**Major Accident:** It is a sudden, unexpected, unplanned event resulting from uncontrolled developments during an industrial activity, which causes or has the potential to cause, death or hospitalization to a number of people, damage to environment, evacuation of local population or any combination of above effects.

**Emergency:** This can be defined as any situation, which presents a threat to safety of person’s or/and property. It may require outside help also.

**Major Emergency:** Occurring at a work is one that may affect several departments within and/or may cause serious injuries, loss of life, extensive damage to properly or serious disruption outside the works. It will require the use of outside resources to handle it effectively.

**Disaster:** Disaster is a sudden calamitous event, bringing great damage, loss or destruction.

**Hazards:** Hazard may be defined as “the potential of an accident”. Hazard exists in man and the system of materials and machines.

**Chemical Hazards:** It is a hazard due to chemical(s) (including its storage, process, handling, etc.) and it is realized by fire, explosion, toxicity, corrosively, radiation, etc.

**Risk:** Risk may be defined as the combination of consequence and probability or likelihood of an accident being caused in a given man-material – machine system.

**On-Site Emergency plan:** It deals with measures to prevent and control emergencies within the factory and not affecting outside public or environment.

**Off-Site Emergency plan:** It deals with measures to prevent and control emergencies affecting public and the environment outside the premises.

### 7.6.2. Objective of the Disaster Management Plan

The primary purpose of this Disaster Management Plan is to equip the Plant with required resources and information for prompt implementation of the set of actions to be
undertaken in the event of an accident posing hazards to the people and community after commissioning of the plant.

The objective of Disaster Management Plan (DMP), for the plant is to be in a state of perceptual readiness through training, development and mock drills, to immediately control and arrest any emergency situation so as to avert a full flegde disaster and the consequence of human and property damage and in the event of a disaster still occurring, to manage the same to that the risk of the damage consequences to life and property are minimized and thereafter, proper rehabilitation, review and revisions of the DMP to overcome the shortcomings noticed are undertaken.

The DMP document is prepared keeping in view and to conform the requirements of the provisions of The Factories Act 1948 under section 41 B (4), Guidelines issued by the Ministry of Environment and Forests, Govt. of India and Manufacture, Import and Storage of Hazardous Chemicals Rules, 1989 amended in 2000, Schedule 11 under Environmental Protection Act 1986.

Following are the main objectives of the plan to:

- Defined and assess emergencies, including hazards and risk
- Control and contain incidents.
- Safeguard employees and people in vicinity.
- Minimize damage to property and/or the environment.
- Minimization of risk and impact of event accident.
- Preparation of action plan to handle disasters and to contain damage.
- Inform employees, the general public and the authority about the hazards/risk assessed and to provide safeguard, and the role to be played by them in the event of emergency.
- Be ready for ‘mutual aid’ if need arises to help neighboring unit.
- Inform authorities and mutual aid centers to come for help.
- Effect rescue and treatment of casualties.
- Effective rehabilitation of the affected persons and prevention of damage to the property.
- Identify and list any fatalities.
- Inform and help relatives.
- Secure the safe rehabilitation of affected areas and to restore normalcy.
- Provide authoritative information to the news media.

7.7.   Emergency Organization

7.7.1. Incident Controller

Incident Controller’s role will be to control the emergency at the incident site
7.7.1.1 **Duties of Incident Controller**

- Incident Controller will proceed to the place of emergency after hearing siren/announcement. He will:
  - Assess the scale of emergency and decide if a major emergency exists or is likely, accordingly activate emergency procedure.
  - Immediately give his feedback to Emergency Control Centre (ECC) regarding emergency.
  - Direct all operations within the area with following priorities.
    - Secure the safety of personnel
    - Minimize damage to plant property and environment.
    - Minimize loss of material.
  - Direct rescue and fire fighting operations till the arrival of the outside Fire Brigade, he will relinquish control to Sr. Officer of Fire Brigade.
- Ensure that the affected area is searched for causalities.
- Ensure that all non-essential workers in the affected area evacuate to the appropriate assembly point.
- Set up communication point to establish Radio/Telephone/Messenger contact as with emergency control centre.
- Pending arrival of works site controller, assume the duties of the post in particular to:
  - Direct the shutting down and evacuation of plant and areas likely to be threatened by emergency.
  - Ensure that the outside emergency services have been called in.
- Ensure that the key personnel have been called in.
- Report all significant development to the Site Main Controller.
- Provide advice and information, as required to the Senior Officer of the Fire Brigade.
- Preserve evidence that would facilitate any subsequent inquiry into the cause and circumstances of emergency.

Dy. Incident Controller will carry out above said duties in absence of Incident Controller.

7.7.2. **Site Main Controller**

Site Main Controller will be overall in-charge of emergency organization:

7.7.2.1 **Duties of Site Main Controller:**

- Relieve the Incident Controller of responsibility of overall main control.
- Co-ordinate ECC or if required, security for raising evacuation siren and also all clear siren, in case emergency is over.
- Declaration of major emergency ensures that outside emergency services will be called and when required nearby firms will be informed.
- Ensure that key personnel will be called in.
Exercise direct operational control on parts of the works outside the affected area.
Maintain a speculative continuous review of possible development and assess these to determine most possible cause of events.
Direct the shutting down and evacuation of plants in consultation with key personnel.
Ensure causalities are receiving adequate attention; arrange for additional help if required. Ensure relatives are advised.
Liaison with Chief Officers of the Fire and Police services providing advise on
Ensure the accounting of personnel.
Control traffic movement within the work.
Arrange for a chronological record of the emergency to be maintained.
During prolonged emergency, arrange for the relief of the personnel and provision of catering facilities.
Contact the local office to receive early notification of impending changes in weather conditions, in case of prolonged emergency.
Issue authorized statements to the news media and informs H.O.
Ensure that proper consideration is given to the preservation of evidence.
Control rehabilitation of affected areas on cessation of the emergency.

7.7.3. **Other Key Personnel**

The key personnel required for taking decision about further action for shutting down the plant, evacuate the personnel, and carry out emergency engineering works in consultation with Site Main Controller in light of the information received.

HOD’s /Senior Managers/ Section Heads will be responsible for safety, security, fire, gas and pollution control, spillage control, communication system including telephone, wireless etc. Also medical services, transport, engineering, production, technical services, will form part of advising team.

7.7.3.1 **Emergency Response Team**

The role of Emergency Response Team members is to actually combat the emergency at the site and control the emergency situation and carry out rescue operations.

All team members will be thoroughly trained to deal with fires, explosions, chemical spills and atmospheric releases, first aid. As per priority list during emergency, the activities will be carried out as per emergency control plan.

7.7.3.2 **Emergency Personnel’s responsibilities Outside Normal Working Hours of the Factory.**

The duties of Shift In-charge & team members have been brought out in emergency control plan. All team members after evacuating the area shall report to ECC/ Incident Place. The non-essential workers shall be evacuated from the plants if need arises and
this will be determined with the forcible rate with which incident may escalate. Non-
essential workers shall assemble at the earmarked/specified point of assembly.

### 7.7.3.3 Assembly Points

At the proposed plan, at least 4 assembly points will be identified and marked properly.

### 7.7.4. Emergency Control Centre

It will be headed by Site Main Controller, HOD – PD, HOD- P&A and it is sited in Office of Site Main Controller in Admin Building & New security office (after office hours), which is readily accessible & with minimum risk, equipped with telephone facilities and other announcements extra communications facilities needed. It has enough means to receive and transmit information and directions from site main controller to incident controller and other areas. In emergency control center due to its safer location and advantage of easier accessibility, all necessary personnel protective equipment’s fire fighting extinguishers will be stocked in sufficient quantity.

**7.7.4.1 Role of Emergency Control Centre**

In case of mishap or accident like fire, toxic gas leakage, explosion in the factory, The Emergency Control Center will be Office of Head- Operations

- The plot plan indicating all the activities in the factory premises including that of storage’s utility services, production area, administration, will be kept for ready reference, showing the location of fire hydrant and fire fighting aids.
- Normal roll of employees, work permits, gate entries and documents for head count, employees blood group, other information and addresses will be available and the person, who will handle this operation will HOD P & A.
- Stationery required is available in the Control Center (ECC) and HOD (P & A) looks after it
- The requirement of personnel protective equipment and other material, like torches, have been worked out and the quantity required during emergency will be kept in the Control Room (ECC). The responsible person for maintaining the said requirement/inventory will be HOD- HSE.

### 7.7.5. Fire & Toxicity Control Arrangements

The plant will be well equipped with suitable numbers of fire fighting and personnel protective equipment. The staff will be trained regularly to handle the various emergency situations.

### 7.7.6. Medical Arrangements

Availability of first aid facilities in sufficient quantity will be always ensured. In case of emergency arrangements will be made to avail outside medical help immediately. Emergency transport facility will be available.
7.7.7. **Transport & Evacuation, Mutual Aid Arrangements:**
Transport & Evacuation and Mutual Aid arrangements will be available in the factory.

7.8. **Communication System**

7.8.1. **Declaring the Emergency**

In case of any emergency in the plant, speedy and effective communication of the same to all concerned in least possible time is the most important aspect of any emergency-handling plan. An early communication increases the chances of control of emergency in the bud stage. Blowing siren will be adopted as method of communication of emergency, to all employees in the plant.

7.8.1.1 **Types of Sirens**

Three different types of sirens have been identified for communication of emergency.

**Alert Siren:** *Single Continuous Siren for One Minute.* This indicates that there is some accidental happening in the plant. All have to become alert. Incident controller will be rush to the site of emergency. Plant area people have to start safe shut down. Rescue team and other emergency control teams have to reach at the site of emergency.

**Siren for evacuation:** *Wailing & waning siren for three minutes.* This siren indicates that emergency is of serious proportion and everybody has to leave his work place. All people having their role in emergency control have to assume their assigned role. All non-essential workers have to proceed immediately to assembly area and wait for further instruction.

**All clear siren:** *Long continuous siren for two minutes.* This is a sign of return of normalcy. On hearing this siren everybody should go back to his or her respective workplace.

7.8.1.2 **Location of Siren**

Siren will be located in centre of the pant for wide coverage of the whole campus. Switch for siren will be provided at security gate. The switch at Security gate should be operated only as a general rule.

Emergency manual call bell will be installed which will be used in case of total failure of electricity. It is responsibility of HOD (HSE) to maintain the upkeep of electric call bell and HOD- Security and administration to maintain manual and Hand operated siren.

7.8.1.3 **Raising Alarm**

Any person noticing any emergency situation in the plant should immediately call security gate with following information:
- Identify oneself
- State briefly the type of emergency i.e. whether fire, explosion, toxic gas release etc.
- Give the location of the incident
- Estimated severity of the incident.

Security personnel after ensuring genuineness of the call shall raise the ALERT SIREN. At the same time he will also contact the incident controller and ECC in order and inform about the incident. He will keep the gate open and rush his two security personnel at the site of emergency.

ECC will be located at the office of Head- Operations on normal working hours and at Security gate after normal working hours (during night). ECC shall be immediately manned on hearing alert siren. If the authorized people to handle ECC are not available, any senior most people out of the available person nearby shall occupy ECC till authorized person comes.

Incident controller, on hearing alert siren or by any other way of information of the emergency, will immediately reach at the site of incident and assess the situation. He will immediately give his feed back to ECC. ECC shall direct security gate to raise evacuation siren, if the need arise.

SIREN FOR EVACUATION shall be raised on instruction from Site Main Controller or any Manager of the plant in the ECC.

Security gate person will be authorized to raise ALL CLEAR SIREN on instruction from Site Main Controller or ECC, after the emergency is over.

Incident controller shall assume the responsibility of site main controller in his absence

7.8.2. Internal Communication

It shall be responsibility of ECC to communicate to all employees in the plant. They may take help of telephone operator for such communication. However, telephone operator can directly communicate information about emergency to all internal departments, if such message comes from incident controller or site main controller. Telephone operator will continue to operate the switchboard advising the callers that staffs are not available and pass all calls connected with the incident to ECC.

7.8.2.1 Availability of Key Personnel outside Normal Working Hours

The details of key personnel availability after working hours will be made available at Security Gate, ECC, telephone operator as well as production units. Security personnel shall call required key personnel from their residence in case emergency occurs outside normal working hours. Availability of emergency vehicle / Ambulance will be
ensured to fetch the key personnel residing outside. It will be the responsibility of HOD (P & A) to maintain it.

7.8.2.2  To the Outside Emergency Services

Decision to call outside help to deal with emergency like fire brigade, ambulance, police, etc., shall be taken by Site Main Controller. However, in absence of Site Main Controller, if the incident controller realizes the situation going out of control, he may ask for immediate help from outside. ECC will be responsible for calling help from outside. A list of emergency services available in the area with their telephone numbers will be provided at ECC, at Security gate and with telephone operator. Facilities such as phones, emergency vehicle, and security personnel will be available to help calling outside emergency services and authorities.

7.8.3.  Communication to the Authorities

The emergency will be immediately communicated to the government officers and other authorities such as UPPCB, police, district emergency authority, Factory Inspectorate, hospital etc. by Emergency Control Centre.

7.8.3.1  To Neighboring Firms & the General Public

In case of emergency having its outside impact, public will be cautioned regarding the same. Co-ordination of police will be sought for speedy action. This is to be ensured by ECC.

7.9.  Pre-emergency activities

Internal Safety survey with regard to identification of hazards, availability of protective equipment’s, checking for proper installation of safety devices will be carried out periodically.

- Periodic pressure testing of equipment
- Periodic pressure testing of lines.
- Periodic safety/relief valve testing
- Periodic fire hydrant system testing.
- Mock drill to check up level of confidence, extent of preparedness of personnel to face emergency is being contemplated.
- Regular training is being imparted to all personnel to create awareness.
- Adequate safety equipment will be made available.
- Periodic check-up of emergency lights.
- Safer assembly points will be identified.
- Storage of adequate first aid treatment facilities.
- Statutory information is imparted to workers.
Post emergency activities:

Following post emergency actions will be carried out to study in detail and preventive measures to be taken.

- Collection of records.
- Inquiries
- Insurance claims
- Preparation of reports comprising suggestion and modification.
- Rehabilitation of affected personnel.
- Normalization of plant.

7.9.1. Evacuation and Transportation

In case of emergency, evacuation and transportation of non-essential workers will be carried out immediately. The affected personnel will be transported for medical aid.

7.9.2. Safe Close Down

During emergency plant shut down will be carried out if situation warrants. This will be as per the instruction of site main controller under guidance of incident controller.

7.9.3. Use of Mutual Aid

Mutual aid agreement with near by industries will ensure help to each other in the emergency.

7.9.4. Use of External Authorities

As and when necessary, statutory authorities, police, pollution control personnel, medical aid/ center, ambulance etc. will be contacted.

7.9.5. Medical Treatment

The affected personnel will be brought to safer place immediately to give them first aid. Immediate medical attention will be sought.

7.9.6. Accounting for Personnel

Proper accounting for personnel will be laid down in all the shifts. The number of persons present inside the plant premises, their duty etc. will be available with the P & A. This record will be regularly updated and will be made available.

7.9.7. Access to Records

The relatives of affected personnel will be informed. The details regarding all employees will be made available to Administration building.
7.9.8. Public Relations

In case of emergency, Manager P & A will be available for official release of information pertaining to the incident.

7.9.9. Rehabilitation

The affected area will be cleared from emergency activities only after positive ascertaining of the system in all respects. The entry to affected area will have to be restricted until statutory authorities visit and inspect the spot of incident. Nothing should be disturbed from the area till their clearance. The site main controller will be in charge of the activities to be undertaken.

The plan will cover emergencies, which can be brought under control by the works with the help of emergency team/fire services. The DISASTER CONTROL PLAN for gas leak and fire will be prepared for entire factory.

7.10. Causes of Emergency:

7.10.1. Risk

7.10.1.1 Nature

In CCIPL plant, the nature of dangerous events could be of the following:

- **FIRE**: Chemical/Electrical
- **TOXIC RELEASE**: From chemicals & gases.
- **LEAKAGES**: Equipment, pipe lines, safety valves, etc.

Release of vapors like Acetonitrile/ dimethylformamide , Hexane or liquid pesticides/solvent mixed pesticides etc.

- Improper handling of products (raw materials/finished products)
- Large spillage to ground floors resulting in pollution & fire.
- Failures of Equipment / Instruments.
- Release of safety valves or ruptures of vessels due to excessive pressures.

7.10.1.2 Various Emergency Actions

a. Onsite

- Safe shut down of the plant and utilities.
- Emergency control measures.
- To attempt with the help of trained crew in fire fighting to contain the fire spread up/gas emission and limit within limited space.
- To cut off source of oxygen by use of fire fighting appliances/to cut off source of gas emission.
- Cut off fall sources of ignition like electrical gadgets.
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- To protect fire prone area from the fire.
- To remove material which can catch fire to the extent possible from fire prone area
- Evacuation of non-essential persons.

**b. Medical Facilities/Treatment**
- The Plant will have a Health centre which is manned with trained male nurse on continuous basis who can render medical first aid. Doctor will visit two times a week for two hour each time. The Plant is searching for a full time medical officer and will appoint as and when available.
- Depending on seriousness the injured person shall be shifted to any other hospital.
- Vehicle will be available round the clock for transportation. Ambulance will be also made available in the campus on regular basis.

**c. In the event of Fatal Accidents**
- The information shall be given to following authorities:
  - Inspector of Police
  - Inspector of Factories
  - Mamlatdar
  - Corporate Office
  - Regd. Office
  - Insurance the plant
  - Regional Officer, HSPCB

**d. Emergency Siren**
- Emergency siren shall be blown for announcing the emergency which shall have different sound for identification/differentiation than the normally used for commencement of factory working etc.
- Location of Siren: above Plant.
- Type of Siren: Industrial Siren
- Position of siren switch: Located at Main Gate

**e. Seeking Help From Neighbouring Industries / Sources For Fire Engine**

**f. Advise for vacation of other areas**
- Since the effect of fire/gas emission shall be contained within the area of the plant advice of vacation of other areas is not necessary.
7.10.1.3  **Response Time-Minutes**

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Fire Fighting</th>
<th>Police</th>
<th>Medical Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire &amp; Explosion</td>
<td>Immediate with whatever facilities available with the plant</td>
<td>10 minutes</td>
<td>10 minutes</td>
</tr>
<tr>
<td></td>
<td>External Help</td>
<td></td>
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<td></td>
<td>within 15 minutes</td>
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</tbody>
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7.11.  **Off-Site Emergency Plan**

7.11.1.  **Need of the Site Emergency Plan**

- Depending upon the wind direction and velocity of the effects of accident in factory may spread to outside its premises. To avert major disaster it is essential to seek guidance/assistance of statutory authorities, police and health department. The movement of traffic may have to be restricted.
- Required information will be given to the authority and consultation will be sought for remedial measures.
- A purpose of the off-site emergency plan is:
  - To provide the local/district authorities, police, fire, brigade, doctors, surrounding industries and public the basic information of risk and environmental impact assessment and appraise them of the consequences and the protection/prevention measures and to seek their help to communicate with public in case of major emergency.
  - To assist district authorities for preparing the off-site emergency plan for district or particular area and to organize rehearsals from time to time and initiate corrective actions on experience.

7.11.2.  **Structure of the Off-Site Emergency Plan**

Available with concerned authorities.

7.11.3.  **Role of the Factory Management**

The site main controller will provide a copy of action plan to the statutory authorities in order to facilitate preparedness of district/area off-site emergency plan.

7.11.4.  **Role of Emergency Co-ordination Office (ECO):**

He will be a senior police or fire officer co-ordination with site main controller. He will utilize emergency control center.
7.11.5. Role of Local Authority
Preparation of Off Site Plan lies with local authorities. An emergency-planning officer (EPO) works to obtain relevant information for preparing basis for the plan and ensures that all those organization involved in offsite emergency and to know their role and responsibilities.

7.11.6. Role of Fire Authorities:
The fire authorities will take over the site responsibility from incident controller after arrival. They will be familiarized with site of flammable materials, water and foam applies points, fire-fighting equipment.

7.11.7. Role of the Police and Evacuation Authorities:
 Senior Police Officer designed, as emergency co-ordination officer shall take over all control of an emergency. The duties include protection of life, property and control of traffic movement.
 Their functions include controlling standards, evacuating public and identifying dead and dealing with casualties and informing relatives of dead or injured.
 There may be separate authorities/agencies to carry out evacuation and transportation work.
 Evacuation depends upon the nature of accident, in case of fire only neighboring localities shall be alerted. Whole areas have to be evacuated in case of toxic release.

7.11.8. Role of Health Authorities
After assessing the extent of effect caused to a person the health authorities will treat them.

7.11.9. Role of Mutual Aid Agencies
Various types of mutual aid available from the surrounding factories and other agencies will be utilized.

7.11.10. Role of Factory Inspectorate
 In the event of an accident, the Factory Inspector will assist the District Emergency Authority for information and helping in getting Neighboring Industries/mutual aid from surrounding factories.
 In the aftermath, Factory Inspector may wish to ensure that the affected areas are rehabilitated safely.
7.12. Training Rehearsal and Records

7.12.1. Need of Rehearsal & Training

Regular training and rehearsal program of emergency procedures shall be conducted with elaborate discussions and testing of action plan with mock drill. If necessary, the co-operation/guidance of outside agencies will be sought.

7.12.2. Some Check Points

- The extent of realistic nature of incidents.
- Adequate assessment of consequences of various incidents.
- Availability of sufficient resources such as water, fire fighting aids, personnel.
- The assessment of time scales.
- Logical sequences of actions.
- The involvement of key personnel in the preparation of plan.
- At least 24 hour’s covers to take account of absences due to sickness and holiday, minimum shift manning.
- Satisfactory co-operation with local emergency services and district or regional emergency planning offices.
- Adequacy of Site.

7.12.3. Records and Updating the Plan

All records of various on-site and off-site emergency plans of the factory will be useful alone with those of the factors by which statutory authorities draw a detailed plan for the whole area/district. The records of the activity will be updated regularly.