CHAPTER - 7

RISK ASSESSMENT & DISASTER MANAGEMENT PLAN

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

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

7.1 RISK ASSESSMENT

7.1.1 INTRODUCTION

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

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

7.1.2 APPROACH TO THE STUDY

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

- Identification of potential hazard area;
- Identification of representative failure cases;
- Visualization of the resulting scenarios in terms of fire and explosion;
- Assess the overall damage potential of the identified hazardous events and the impact zones form the accidental scenarios;

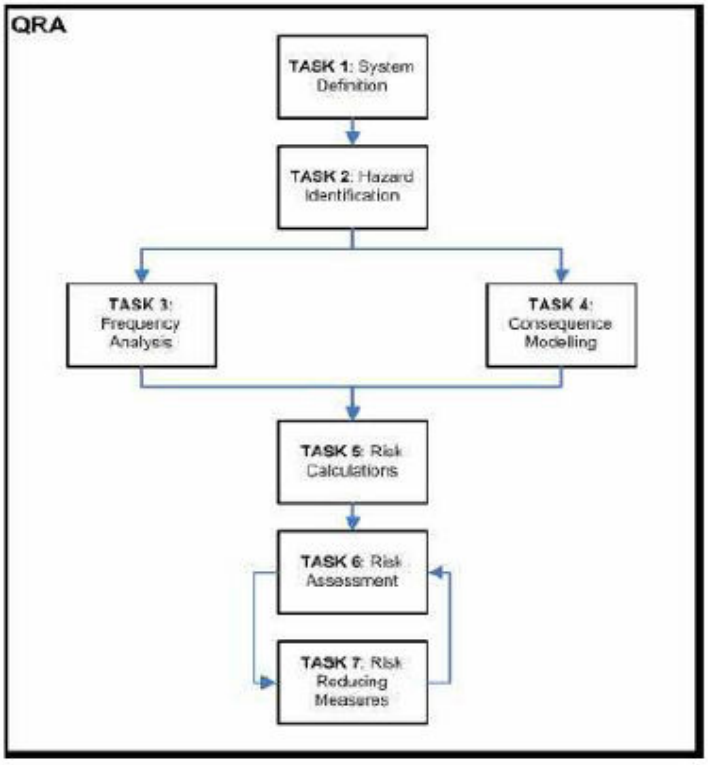
- Furnish the recommendations on the minimization of the worst accident possibilities
- Preparation of Disaster Management Plan;
- Emergency Plan, which includes Occupational and Health Safety Plan;

7.1.3 METHODOLOGY

Quantitative risk assessment (QRA) is a means of making a systematic assessment of the risks from hazardous activities, and forming a rational evaluation of their significance, in order to provide input to a decision-making process. The term 'quantitative risk assessment' is widely used, but strictly this refers to the purely numerical assessment of risks without any evaluation of their significance. The study has been conducted based on the premises of a traditional Quantitative Risk Assessment. The key components of a QRA are explained below, and illustrated in Figure-7.1 and Figure-7.2.

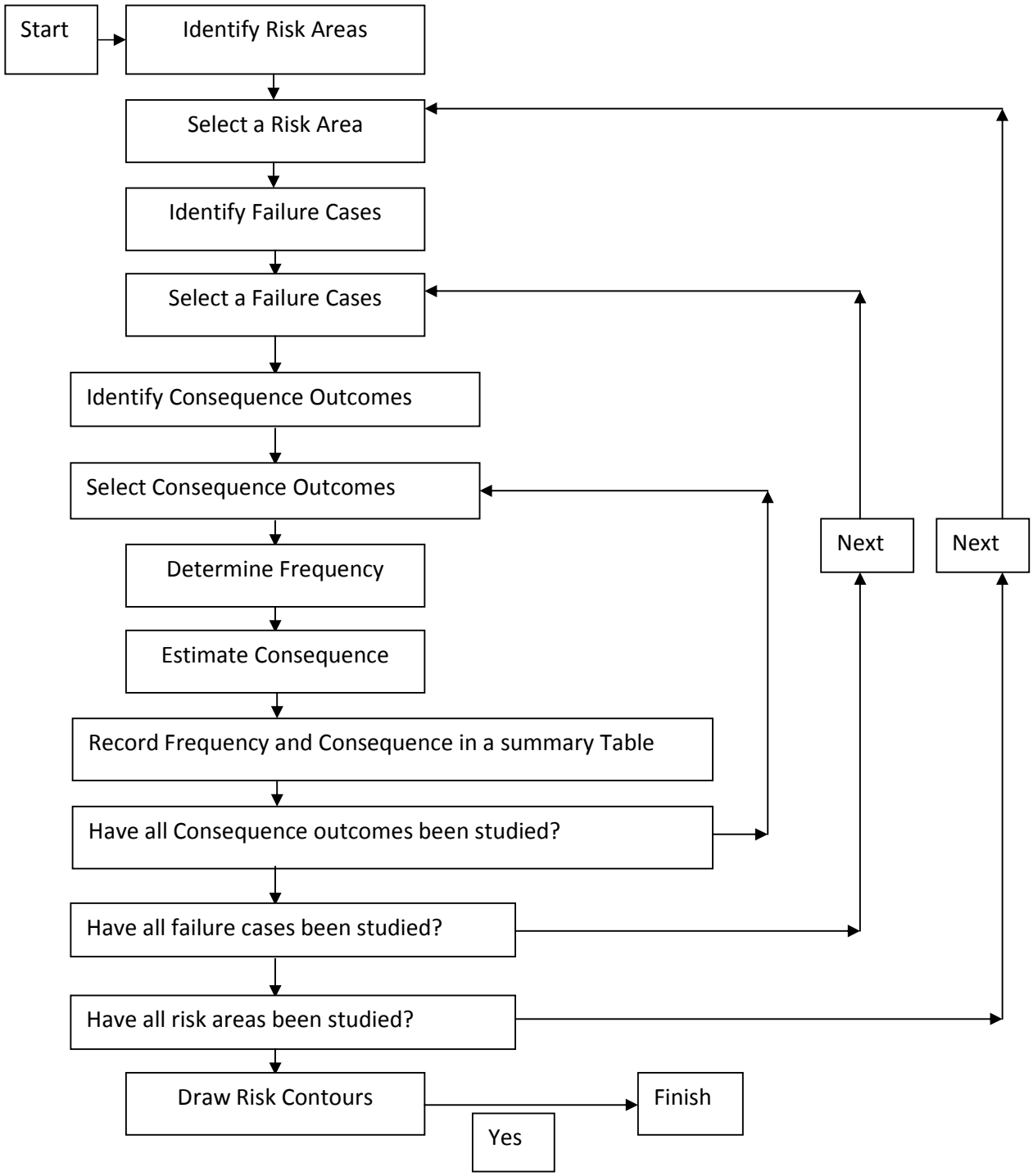
FIGURE – 7.1

QRA METHODOLOGY



FIGURE–7.2

FLOW CHART FOR QUANTITATIVE RISK ASSESSMENT



7.1.4 HAZARD IDENTIFICATION

Identification of hazards in the proposed project activity is of primary significance of the analysis, and quantification. Hazard states the characteristics of system/plant/process that presents potential for an accident. All the components of a system/plant/process need to be thoroughly examined to assess their potential for initiating or propagating an unplanned event/sequence of events, which can be termed as an accident.

7.1.4.1 IDENTIFICATION OF HAZARDOUS AREAS

The procedure for QRA starts with identification of major risk areas in the installation. Operation carried out in specialty and agrochemical Industries usually come under certain board, general categories. At M/s. Saga Chemie Pvt. Ltd., major risk areas are as follows:

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

7.1.4.2 IDENTIFICATION OF FAILURE CASES FOR HAZARDOUS AREAS

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

It is to be noted that for Quantitative Risk Assessment, worst case scenarios consider, though their frequency of occurrence is much lower than the cases of small leaks.

7.1.4.3 MAJOR HAZARDOUS AREAS

The hazardous chemical storage area is shown in Figure-7.3. The major Hazardous chemicals to be stored, transported, handled and utilized within the plot area are summarized in the Table-7.1. Other hazards and control measures are summarized in Table-7.2. Facilities/System for process safety, transportation, fire fighting system and emergency capabilities to be adopted are stated below.

FIGURE-7.3

HAZARDOUS CHEMICAL STORAGE AREA

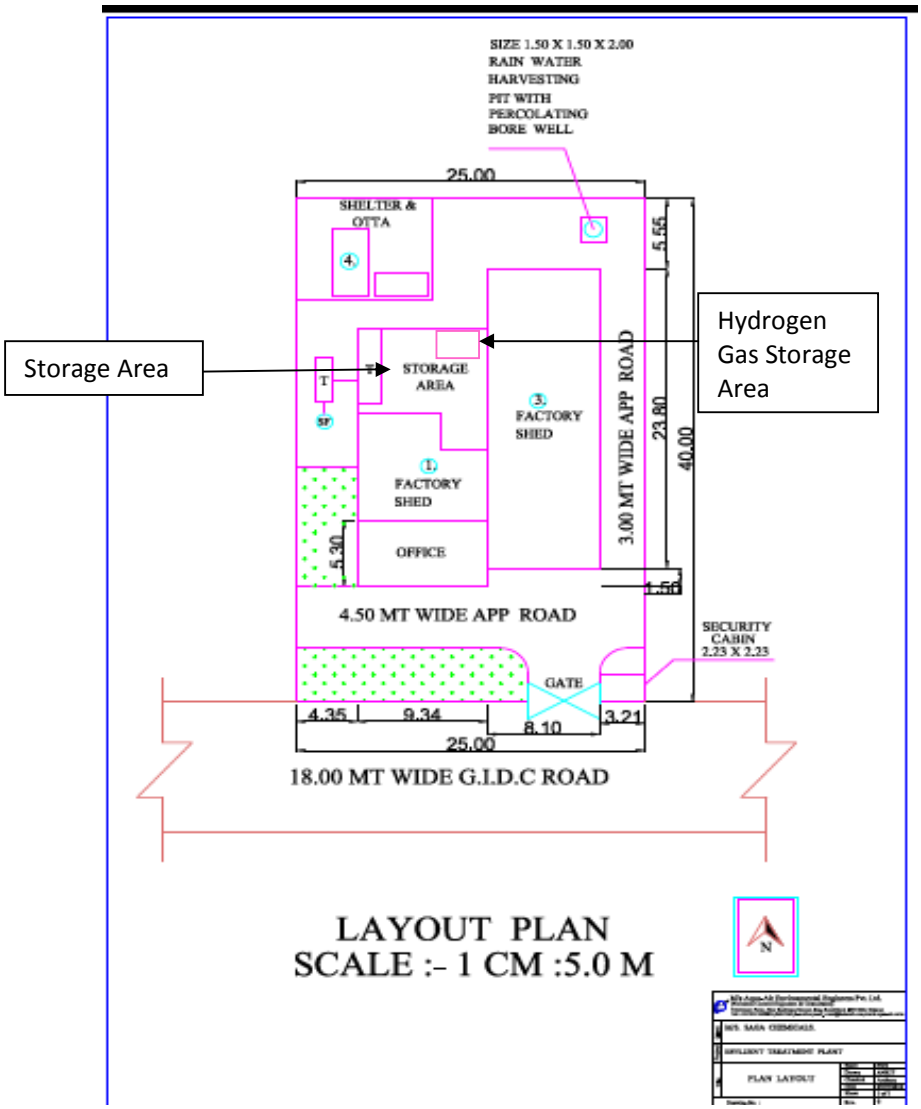


TABLE-7.1

STORAGE AND HANDLING DETAILS OF HAZARDOUS CHEMICALS

Sr. No.	Name of the Hazardous Substance	Maximum Storage	Mode of Storage	Actual Storage	State & Operating pressure & temperature	Possible type of Hazards
1	HCl	3 MT	Drum	200 Liter x 15	NTP	Flammable/ Toxic
2	Phenol	5 MT	Drum	200 Liter x 25	NTP	Flammable/ Toxic
3	Dimethyl Sulphate	1 MT	Drum	200 Liter x 5	NTP	Flammable/ Toxic
4	Ethylene Dichloride	2 MT	Drum	200 Liter x 10	NTP	Flammable
5	Chloro Sulphonic Acid	1 MT	Drum	200 Liter x 5	NTP	Flammable/ Toxic
6	Try Ethyl Amine	2 MT	Drum	200 Liter x 10	NTP	Flammable
7	Ammonia	1 MT	Drum	200 Liter x 5	NTP	Flammable/ Toxic
8	Sulphuric Acid	3 MT	Drum	250 Liter x 12	NTP	Corrosive
9	TBA	1 MT	Drum	200 Liter x 5	NTP	Toxic
10	Sodium Isocynate	1 MT	Bag	50 Kg x 20	NTP	Toxic
11	Hydrogen	1 Cylinder	Cylinder	7 Nm3	Pressurized & ambient Tem.	Explosive

TABLE 7.2

OTHER HAZARDS AND CONTROL

SR. NO.	NAME OF THE POSSIBLE HAZARD OR EMERGENCY	ITS SOURCES & REASONS	ITS EFFECTS ON PERSONS, PROPERTY & ENVIRONMENT	PLACE OF ITS EFFECT	CONTROL MEASURES PROVIDED
1	**BOILER** (1) Burning (2) Physical injury (3) Explosion	Over pressure in the boiler if safety valve not working. Water level indicator not working. Low water level indicator fail. High temp. System fails.	Minor/Major Injury Loss of human life Loss of property (Loss of Main/Machine Material)	Boiler House and surrounding places	Lower & Upper Level Indication System provision. Safety valves for pressure control fixed temp. & pressure indicator provided. Blow down & blowing system provided for cleaning tube and shell. Soft water used. Inter locking provided on pumps, FD fan, ID fan. Periodical checking & inspection maintenance done. Yearly inspection done by Boiler Inspector
2	**ELECTRICITY** (1) Burning (2) Fire (3) Shock	Loose Contacts, Weak earthling Short Circuit Improper Insulation	Burning, Shock, Death	Surrounding the accident area	Proper Earthing, Periodical Checking of joints, proper insulations of Equipments, etc. Flame proof fitting in solvent storage area, bounding and jumpers to all solvent barrier lines provided.
3	**HOUSE KEEPING** (1) Physical (2) Burning (3) Fire (4) Chemical Exposure	Bad House keeping	Physical/Chemical Thermal Burn Injury (Major/Minor)	In all surrounding areas i.e. Storage, Plants	Proper Handling, regular cleaning, Proper placement of material **(RIGHT THING AT THE RIGHT PLACE)**
4	**PIPE LINE LEAKAGES Spillages etc**. (1) Corrosion (2) Toxic gas release	Leaking of pipe line due to corrosion, Loose contact etc.	Physical/Chemical Thermal Burn Injury (Major / Minor)	Plant area	Proper maintenance, Proper Selection of Material for pipe lines, Immediate attention, Earthing provided, flame proof fitting, NO SMOKING Boards displayed.
5	**Structural Failure**	Inside the factory (Corrosion)	Injury/Death to persons, damage to property	Within the factory	Automatic operation Periodic Testing of safety valves Regular Inspection and Maintenance
6	**Toxic Release from outside**	Outside the factory	Injury/Death	Within & outside the unit	Alarm, Evacuation rescue & shelter/ Welfare
7	**Natural Calamity**	Nature	Injury/Death to persons, damage to property	Within & outside the unit	Alarm, Evacuation rescue & shelter/ Welfare

PRECAUTIONS DURING STORAGE AND TRANSPORTATION OF HAZARDOUS CHEMICALS

- **LIQUID FROM**

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

- **SOLID FORM**

- Vendor will be asked to provide MSDS to Truck Driver.
- Driver to have concerned Safety Officer's contact details to contact him in case of emergency.
- Provide muffler on exhaust while entering truck within premises.

- SOP to cover routine checking of Bags & Containers for checking any damage.
- Containers to be tested for safe racking & transportation.
- Proper PPE to be used while handling the material & concerned persons to be trained for usage of the same.
- Concerned persons will be trained properly to use spill kit in case of observing any spillage inside warehouse.

The major hazards in the M/s. Saga Chemie Pvt. Ltd. are described below.

- Toxic hazard due to leakage of hazardous chemicals Bromine, EDC
- Corrosive hazard due to leakage of chemicals like HNO_3, HCl, H_2SO_4 from storage tank or Carboys.
- Fire hazard due to leakage of hazardous chemicals Toluene, Methanol, Hexane etc.
- Explosive Hazard to leakage of hazardous Gas like Hydrogen
- Electrical hazards due to the electrical major equipment/machinery, operations, welding, motors, and heavy lift devices, cabling, human intervention (short circuit possibility), maintenance work (due to machinery breakdown etc.), plant lighting related electrical hazards.
- Possibility of human injury due to working with mechanical machines, manual handling etc.
- Possibility of injury during chemicals handled, during operations and due to intoxication.
- Major dropped objects hazard due to large number of physical handling steps/operations involved with crane/overhead lifting/ hoisting equipment.
- Fires in any part of the plant working areas – there is a possibility of rapid escalation if it is not brought under control quickly.
- Possibilities of fire hazards at transformers, switchgear and other electrical equipment etc.

7.1.4.4 TRANSPORTATION, UNLOADIND, HANDLING PROCEDURE AND SAFETY MEASURES FOR HAZARDOUS CHEMICALS

- **Transportation, Unloading and Handling Procedure for Benzene, Toluene, EDC etc.**

SR. NO.	ACTIVITY	TYPE OF POSSIBLE HAZARD	MITIGATION MEASURES
1	Transportation of Solvents like Toluene, EDC, Methanol etc. by road tanker	Leakage& Spillage	• Check the source of leakage point. • Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. • Stop leak if you can do it without risk.
		Fire,& explosion	• Use water spray to reduce vapors; do not put water directly on leak, spill area or inside container. • Keep combustibles (wood, paper, oil, etc.) away from spilled material.
		Toxic release	• Isolate the area • Isolate the container • Training will be provided to driver and cleaner regarding the safe driving, hazard of Flammable chemicals, emergency handling. • TREM card will kept with TL. • Fire extinguishers will be kept with TL. • Flame arrestor will be provided to TL exhaust. • Instructions will be given not to stop road tanker in populated area. • Clear Hazard Identification symbol and emergency telephone number will be displayed as per HAZCHEM CODE. • Appropriate PPEs will be kept with TL.
2	Toluene, EDC, Methanol Road tanker unloading at project site.	Leakage& Spillage	• Check the source of leakage point. • Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. • Stop leak if you can do it without risk.
		Fire,& explosion	• Use water spray to reduce vapors; do not put water directly on leak, spill area or inside container. • Keep combustibles (wood, paper, oil, etc.) away from spilled material.
		Toxic release	• Isolate the area • Isolate the container • Check the source of leakage point • Isolate the area • Isolate the container • Spray the water on leakage • Priority will be given to tanker to immediately enter the storage premises at site and will not be kept waiting near the gate or on the main road. • Security person will check License, TREM CARD, Fire extinguisher condition; Antidote Kit, required PPEs as per SOP laid down. • Store officer will take sample as per sampling SOP from sampling point. • After approval of QC department unloading procedure will be allowed be started.

			Following precautions will be adopted during unloading • Wheel stopper will be provided to TL at unloading platform. • Static earthing will be provided to road tanker. • Tanker unloading procedure will be followed according to check list and implemented. • Flexible SS hose connection will be done at TL outlet line. • The quantity remaining in the hose pipeline will be drained to a small underground storage tank, which will be subsequently transferred by nitrogen pressure to the main storage tank thus ensuring complete closed conditions for transfer from road tanker. • All TL valves will be closed in TL. • Finally earthing connection and wheel stopper will be removed. • Only day time unloading will be permitted.
3	Toluene, EDC, Methanol Storage tank safety	Leakage& Spillage	• Check the source of leakage point. • Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. • Stop leak if you can do it without risk.
		Fire, Explosion	• Use water spray to reduce vapors; do not put water directly on leak, spill area or inside container. • Keep combustibles (wood, paper, oil, etc.) away from spilled material.
		Toxic release.	• Isolate the area • Isolate the container • Check the source of leakage point. • Isolate the area • Isolate the container • Spray the water on leakage • SS storage tank will be provided as per IS code. • Dyke wall will be provided to storage tank. • Level transmitter will be provided with low level high level auto cut-off provision. • Vent will be connected to water trap and vent of water trap will be provided with flame arrestor. • Water sprinkler system will be provided to storage tank. • Fire hydrant monitor with foam attachment facility will be provided. • Dumping/Drain vessel/alternate vessel will be provided to collect dyke wall spillage material. • FLP type pump will be provided. • Nitrogen blanketing will be provided to storage tank. • Double static earthing will be provided to storage tank. • Double Jumper clip will be provided to all Solvent handling pipeline flanges.
4	Toluene, Benzene, EDC & other Solvents transfer from storage tank to Day tank	Leakage& Spillage due to Line rupture, Flange Gasket failure, Fire, Explosion, Toxic release.	• Double mechanical seal type FLP type pump will be provided. • Double on/off switch will provided at tank farm and process area near day tank. Pump auto cut off with day tank high level will be provided. • Flame arrestor will be provided on day tank vent.

			• Over flow will be provided for additional safety and it will be connected to main storage tank. • NRV will be provided on pump discharge line. • Double Jumper clip will be provided to all solvent handling pipeline. • Double static earthing will be provided to day tank.
5	Toluene, EDC, Methanol transfer from Day tank to reactor.	Leakage, Spillage due to Line rupture, Flange Gasket failure, Fire, Explosion, Toxic release.	• Gravity transfer. • Total quantity of day tank material will be charged in to reactor at a time. • NRV will be provided on day tank outlet line. • Static earthing will be provided to storage tank. • Double Jumpers will be provided to pipeline flanges.

- **Bromine Transportation, Unloading and Handling Procedure**

SR.NO.	ACTIVITY	TYPE OF POSSIBLE HAZARD	MITIGATION MEASURES
1	Transportation of Bromine by ISO container	Leakage, Spillage, Toxic release	• Leak check with ammonia torch and detect the leak point. • ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area). • Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. • Stop leak if you can do it without risk. • Prevent entry into waterways, sewers, basements or confined areas. • Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. • Do not get water inside containers. • GPS will be installed in all the trucks and ISO container vehicle. • Driver and assistant will be trained in using GPS. • Open space separated from public highway and public dwellings, where public does not normally pass. No passengers are allowed. • The crew shall know how to use fire-fighting appliances. • The driver or driver's assistant may not open a package containing bromine. • Bromine receptacles are not to be checked with open flames. • No smoking is permitted around the transport unit or in the vicinity of the vehicle during handling operations. • The engine is to be shut off during all handling operations unless required to drive pumps, hoist, etc. • Parking brakes are to be applied whenever parked. • If the vehicle is parked on a road at night or with poor visibility, warning signs are to be placed 10 meters ahead of and behind the vehicle. • TREM CARD provided to all transporters and trained for transportation Emergency of Hazardous chemicals. • Training will be provided to driver and cleaner regarding the safe driving, hazard of Bromine emergency handling, use of Self-contained breathing apparatus (SCBA) sets and neutralizing agent. • SCBA set will be kept with ISO container truck. • All the ISO container truck will be equipped with Global Positioning system (GPS) and route will be predefined. • Clear Hazard Identification symbol and emergency telephone number will be displayed as per HAZCHEM CODE. • Appropriate PPEs will be kept with Truck.

3	Bromine ISO container loading and handling at site	Leakage, Spillage, toxic release	• Leak check with ammonia torch and detect the leak point. • ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area). • Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. • Stop leak if you can do it without risk. • Prevent entry into waterways, sewers, basements or confined areas. • Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. • Do not get water inside containers. • Directly ISO container will be placed at storage area and connected with process tank. • Wear recommended personal protective equipment during connection of ISO container. • Make sure the absorber unit is working and capable of handling vented bromine fumes. • **BE SURE THAT DRY AIR (DEW POINT -40"C) OR DRY NITROGEN** is available in ample supply and its pressure is controlled below 3 atm. gauge. • Check that all the Iso-container valves are closed and blind flanges are in place. • Remove the blind flange above the red valve. • Connect your pressure release line to the red valve outlet. Use a new rubber gasket (use limit - 24 hours) to ensure tight connection. • Open the red valve slowly and then the depressurizing valve, to release any pressure which might have developed in the Iso-container. • Remove the blind flange above the yellow valve. • Connect your line to the yellow valve outlet. Use a new rubber gasket (use limit - 24 hours) to ensure tight connection. • Open the yellow valve and all the valves in your liquid unloading line. • Close the depressurizing valve. • Open the pressurizing valve, at first slowly (to check for bromine leaks), then fully, to start bromine unloading. Use only enough pressure to lift the bromine to the high point in the unloading system. • **NEVER EXCEED 3 ATM. PRESSURE** • When air/nitrogen blows through the unloading line into your storage tank, the Iso-container is empty. • Close the pressurizing valve. • Close the yellow valve and then all the other valves in your liquid unloading line. • Slowly open the depressurizing valve to release the air/nitrogen pressure on the Iso-container to your absorber unit. Wait 5 minutes. • Close the red valve and then the depressurizing valve. • Cautiously disconnect your liquid unloading line from the yellow valve of the Iso-container. Replace its blind flange, tightening all the bolts. Do not forget to reinstall the proper gasket. • Disconnect your pressure release line from the red valve of the Iso-container. Replace its blind flange, tightening all the bolts. Do not forget to reinstall the proper gasket.

			• If there has been a bromine spillage, wash it off the Iso-container with plenty of water to prevent corrosion. Small bromine spills on the ground may be neutralized with a clear soda ash or a sodium thiosulphate solution. Then dispose of in a manner approved by the local authorities. • Close the cover dome and pin it securely. • Mark the Iso-container EMPTY (use erasable means). • Bromine Iso tanks should be stored no closer than 10 meters from human or animal consumable articles. Explosives and flammable materials should not be stored close to bromine. • There would be sufficient bromine storage tank capacity or an empty ISO tank to accommodate the transfer of bromine from a leaking container • Area where bromine will be used or stored will be enclosed so that unauthorized persons and animals are prevented from entering the area. Adequate lighting will be provided to allow sufficient night surveillance. Surveillance will be provided 24 hours a day. • Personnel escape routes will be clearly marked and it will be maintained without any obstructions including adequately sized doors and windows. • Facilities like offices, eating, showering and changing rooms, will be located in up wind direction and remote from the area where bromine is handled or stored. Provide an adequate supply of clean water for washing and showers. • Emergency siren, telephone will be provided in storage area for the reporting of accidents or emergency situations. The emergency telephone numbers will be displayed at prominent locations and it include the fire department, ambulance service, emergency response team, hospital and police. • A wind sock will be provided which will clearly visible from all points on the site and replaced as required. This is required for indicating wind strength and direction. • Emergency respirator equipment cabinets (Cupboard) will be installed not more than 30 meters or ten seconds walking distance from any location in the storage area. • Showers and eyewash fountains will be provided, clearly marked, well lit and with unobstructed access. • Signs will be posted prominently at the site entrance and throughout the installation with area maps showing access ways, hydrant locations, emergency showers, location of emergency equipment and emergency telephone numbers. • All management and operating personnel involved in the use or handling of bromine will undergo safety training, in addition to specific task training. • Only experienced well-trained operators will be allowed to receive and unload bromine receptacles. • The management will ensure that emergency response plans have been made and coordinated with the emergency response local authorities. • Safety permit for hazardous material loading unloading will be prepared and implemented. Fire hydrant system and water sprinkler system installed at tank farm area.

- **Chlorine Transportation, Unloading and handling Procedure:**

SR.NO.	ACTIVITY	TYPE OF POSSIBLE HAZARD	MITIGATION MEASURES
1	Transportation of Chlorine Tonners by road tanker	Leakage, Spillage, Toxic release	• Leak check with ammonia torch and detect the leak point. • ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area). • Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. • Stop leak if you can do it without risk. • Prevent entry into waterways, sewers, basements or confined areas. • Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. • Do not get water inside containers. • Training will be provided to driver and cleaner regarding the safe driving, hazard of Chlorine emergency handling, use of SCBA sets. • TREM card will kept with TL. • SCBA set will be kept with TL. • Instructions will be given not to stop Chlorine road truck in populated area. • Clear Hazard Identification symbol and emergency telephone number will be displayed as per HAZCHEM CODE. • Appropriate PPEs will be kept with TL.
2	Chlorine Tonners unloading at site	Leakage, Spillage, toxic release	• Leak check with ammonia torch and detect the leak point. • ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area). • Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. • Stop leak if you can do it without risk. • Prevent entry into waterways, sewers, basements or confined areas. • Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. • Do not get water inside containers. • Priority will be given to Tanker to immediately enter the storage premises at site and will not be kept waiting near the gate or the main road. • Security person will check License, TREM CARD, Fire extinguisher condition; SCBA set condition, required PPEs as per SOP laid down.
3	Chlorine Tonners storage shed	Leakage, Spillage, Toxic release.	• Leak check with ammonia torch and detect the leak point. • ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area). • Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. • Stop leak if you can do it without risk. • Prevent entry into waterways, sewers, basements or confined areas. • Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. • Do not get water inside containers. • SOP will be prepared for safe handling of Chlorine toners. • Chlorine Emergency Kit will be procured and kept ready at chlorine shed. • Chlorine Hood with blower will be provided with scrubbing

			arrangement. • Safety Shower and eye wash will be provided in Chlorine shed area. • Tonner handling EOT crane will be installed in Chlorine shed area for safe tonner handling. • Safety Valve will be provided on chlorine header line and it will be connected to caustic scrubber. • SCBA sets will be kept ready at chlorine handling area. • Safety valve will be provided on vaporizer header and outlet of safety valve connected to scrubber. • Flow and temperature controllers will be provided on process line.
4	Chlorine Tonners connected with header	Leakage, Spillage due to Line rupture, Toxic release.	• Leak check with ammonia torch and detect the leak point. • ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area). • Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. • Stop leak if you can do it without risk. • Prevent entry into waterways, sewers, basements or confined areas. • Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. • Do not get water inside containers. • Teflon or copper tube will be used for connection with header. Pressure gauge and safety valve will be provided on header line.

7.1.5 CONSEQUENCE ANALYSIS

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

Operating Parameters

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

Inventory

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

7.1.5.1 DAMAGE CRITERIA

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

a) Determination of the source strength parameters;
b) Determination of the consequential effects;
c) Determination of the damage or damage distances.

The basic physical effect models consist of the following.

Source strength parameters

* Calculation of the outflow of liquid, vapour or gas out of a vessel or a pipe, in case of rupture. Also two-phase outflow can be calculated.
* Calculation, in case of liquid outflow, of the instantaneous flash evaporation and of the dimensions of the remaining liquid pool.
* Calculation of the evaporation rate, as a function of volatility of the material, pool dimensions and wind velocity.
* Source strength equals pump capacities, etc. in some cases.

Consequential effects

* Dispersion of gaseous material in the atmosphere as a function of source strength, relative density of the gas, weather conditions and topographical situation of the surrounding area.
* Intensity of heat radiation [in kW/ m^2] due to a fire or a BLEVE, as a function of the distance to the source.
* Energy of vapour cloud explosions [in N/m^2], as a function of the distance to the distance of the exploding cloud.
* Concentration of gaseous material in the atmosphere, due to the dispersion of evaporated chemical. The latter can be either explosive or toxic.

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

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

Selection of Damage Criteria

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

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

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

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

Heat Radiation

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

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

Damages to Human Life Due to Heat Radiation

Exposure Duration	**Radiation for 1% lethality (kW/m^2)**	**Radiation for 2nd degree burns (kW/m^2)**	**Radiation for first degree burns (kW/m^2)**
10 Sec	21.2	16	12.5
30 Sec	9.3	7.0	4.0

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

Effects Due To Incident Radiation Intensity

INCIDENT RADIATION kW/m^2	TYPE OF DAMAGE
0.7	Equivalent to Solar Radiation
1.6	No discomfort for long exposure
4.0	Sufficient to cause pain within 20 sec. Blistering of skin (first degree burns are likely)
9.5	Pain threshold reached after 8 sec. second degree burns after 20 sec.
12.5	Minimum energy required for piloted ignition of wood, melting plastic tubing etc.

Explosion

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

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

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

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

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

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

Damage Due To Overpressures

Peak Overpressure	Damage Type
0.83 bar	Total Destruction
0.30 bar	Heavy Damage
0.10 bar	Moderate Damage
0.03 bar	Significant Damage
0.01 bar	Minor Damage

From this it may be concluded that p = 0.17 E+5 pa corresponds approximately with 1% lethality. Furthermore it is assumed that everyone inside an area in which the peak overpressure is greater than 0.17 E+ 5 pa will be wounded by mechanical damage. For the gas cloud explosion this will be inside a circle with the ignition source as its centre.

Intoxication

The consequences from inhalation of a toxic vapour/gas are determined by the toxic dose.

This dose D is basically determined by:

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

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

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

C = concentration of the toxic vapour, in [ppm] or [mg/m^3];

t = exposure duration, in [sec] or [min];

n = exponent, mostly > 1.0; this exponent takes into account the fact that a high concentration over a short period results in more serious injury than a low concentration over a relatively longer period of exposure. The value of n should be greater than zero but less than 5.

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

$D = \int C^n.dt$

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

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

Pr = probit number, being a representation of the percentage of people suffering a certain kind of damage, for instance lethality

Pr = 2.67 means 1% of the population;

Pr = 5.00 means 50% of the population;

a and b material dependent numbers;

$C^n.t$ = dose D, as explained above.

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

7.1.5.2 MAXIMUM CREDIBLE LOSS ACCIDENT SCENARIOS

A Maximum Credible Accident (MCA) can be characterised as the worst credible accident. In other words: an accident in an activity, resulting in the maximum consequence distance that is still believed to be possible. A MCA-analysis does not include a quantification of the probability of occurrence of the accident. Another aspect, in which the pessimistic approach of MCA studies appears, is the atmospheric condition that is used for dispersion calculations. As per the reference of the study, weather conditions having an average wind speed of 2.14 m/s have been chosen.

The Maximum Credible Loss (MCL) scenarios have been developed for the Facility. The MCL cases considered, attempt to include the worst "Credible" incidents- what constitutes a credible incident is always subjective. Nevertheless, guidelines have evolved over the years and based on basic engineering judgement, the cases have been found to be credible and modelling for assessing vulnerability zones is prepared accordingly. Only catastrophic cases

have been considered and not partial or small failures (as is the case in Quantitative Risk Assessment where contributions from low frequency - high outcome effect as well as high frequency - low outcome events are distinguished). The objective of the study is emergency planning, hence only holistic & conservative assumptions are used for obvious reasons. Hence though the outcomes may look pessimistic, the planning for emergency concept should be borne in mind whilst interpreting the results.

7.1.5.2.1 CONSEQUENCE ANALYSIS CALCULATIONS

The Consequence Analysis has been done for selected scenarios. This has been done for weather conditions having wind speed 2.14 m/s. In Consequence Analysis, geographical location of the source of potential release plays an important role. Consideration of a large number of scenarios in the same geographical location serves little purpose if the dominant scenario has been identified and duly considered.

7.1.5.2.2 SOFTWARE USED FOR CALCULATIONS

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

TOXIC AND FLAMMABLE IMPACT

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

DISCHARGE

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

DISPERSION

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

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

FLAMMABLE EFFECTS

For releases of flammable material Phast calculates

- Radiation profiles and contours from a range of fire scenarios including pool fires, flash fires, jet fires and fire balls, including cross-wind effects on a jet fire

- Vapour Cloud Explosion modeling using industry standards models including the TNO Multi-energy, Baker Strehlow Tang and TNT Equivalence models
- Overpressure contours from Boiling Liquid Expanding Vapour Explosions

TOXIC EFFECTS

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

PHAST RISK

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

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

A key benefit of Phast Risk is the ability to identify major risk contributors and differentiate these from incidents with worst case consequences which might otherwise dominate the safety reviews. Whilst medium scale incidents have lesser consequences, they may have a higher frequency, which, when combined with their hazardous effects, generate a higher level of risk. Time and effort directed to mitigating high consequence but often low

frequency events may not be well spent. Phast Risk helps you direct this effort more effectively.

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

Benefits

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

7.1.5.2.3 SCENARIOS

Table 7.3

SCENARIOS

Scenario	MCL Scenario	Pressure & Temp.	Quantity
1	Release of Hydrogen	NTP	1 Cylinder
2	Drum Storage Area	NTP	5 MT

Scenario – 1 Release of Hydrogen

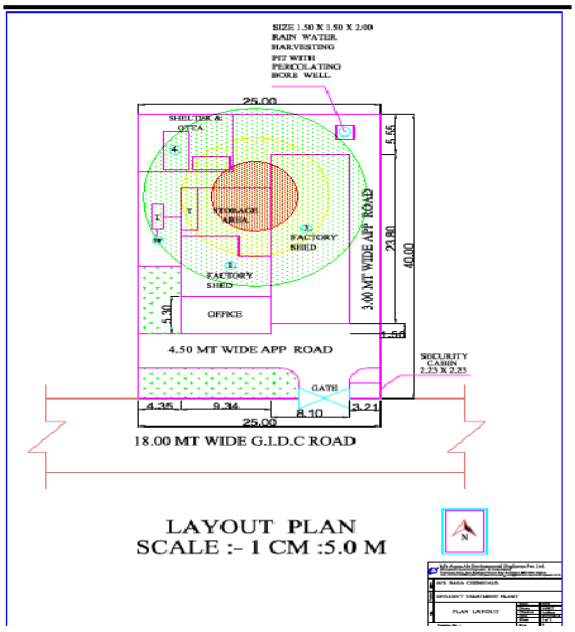
This scenario considers release of Hydrogen from Cylinder:

Results indicate:

Scenario: Diffusion Jet Fire Simulation for 1.0 cm copper connecting pipe to PRV station			
In put Data		**Results of Computations**	
Stored quantity	1 Cylinder	**Max. IHR at flame centre height**	52.49 Kw/m^2
Gas Jet diameter	1 (cm)	**Flame centre height**	63 meter
Gas velocity in the leakage hole/ pipe	143463 m/s	**Maximum Flame width**	12 meter
Wind speed	2.14 m/s	**Heat Flux**	8.5 KW/ m^2
Gas Density	0.067 kg/m^3	**Flame Surface Area**	3778 m^2

Incident Intensity of Heat Radiation (IHR) at ground level KW /m^2	**IHR- Isopleth Distance (Meters)**	**Effect if IHR at Height of Simulation**
37.5	16.8	Damage to process equipment. 100 % Fatal in 1 Min. 1 % fatal in 10 sec.
12.5	25.3	Min. to ignite wood (with flame contact). 1 % fatal in 1 min. 1st deg. burn in 10 sec.
4.0	37.8	Pain after 20 secs. Blistering unlikely.

Jet Fire



Red – 4 KW/m^2
Yellow – 12.5 KW/m^2
Green – 37.5 KW/m^2

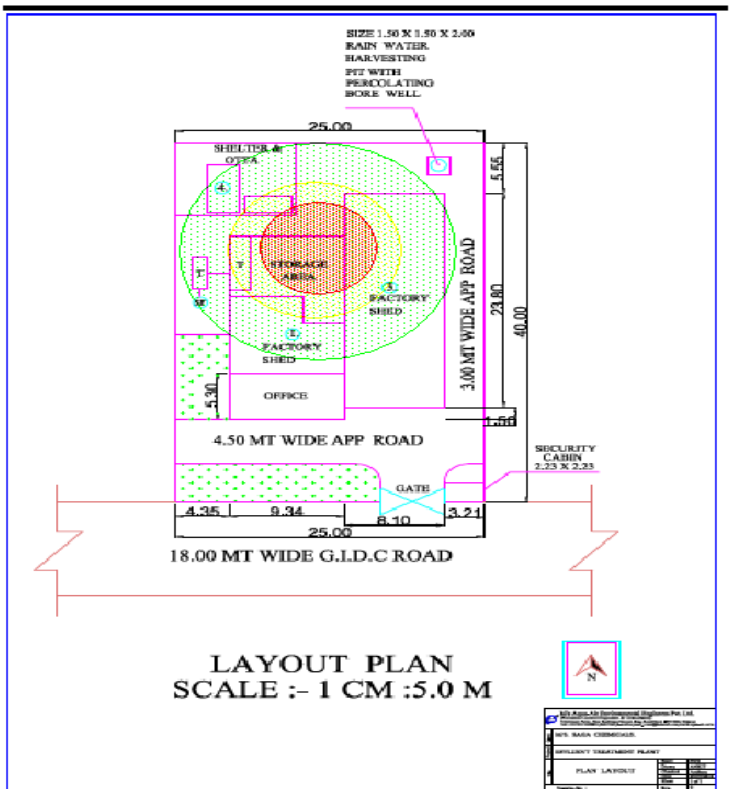
Over pressure / explosion for rupture of 1.0 cm copper pipe line of Hydrogen cylinder to PRV station

Results indicate:

In put Data		Results of Computations	
Stored quantity	1 cylinder	**Visible Flash Fire Height**	0.52 m
Mass of Gas	1 kgs	**Visible Flash Fire Width**	0.26 m
Heat of combustion	42267 KJ/Kg	**Duration of Flash-Fire in Sec.**	2 sec
Fuel-Air volume ratio in Flash fire cloud	0.600	**Radius of fuel-air cloud mixture**	4.19 m
Stochiometric Fuel-Air Mixture	00:29	**Total energy release**	283720 KJ
Wind speed	2.14 m/s	**Max. Heat Radiation from 1 m from Flash Fire**	750 KW/ m^2
Gas Density	0.067 kg/m^3	**Combustion efficiency**	0.5

Incident Intensity of Heat Radiation (IHR) at ground level KW / m^2	IHR- Isopleth Distance (Meters)	Effect if IHR at Height of Simulation
37.5	18	Damage to process equipment. 100 % Fatal in 1 Min. 1 % fatal in 10 sec.
12.5	31	Min. to ignite wood (with flame contact). 1 % fatal in 1 min. 1st deg. burn in 10 sec.
4.0	40	Pain after 20 secs. Blistering unlikely.

Flash Fire:



Red – 4 KW/m^2
Yellow – 12.5 KW/m^2
Green – 37.5 KW/m^2

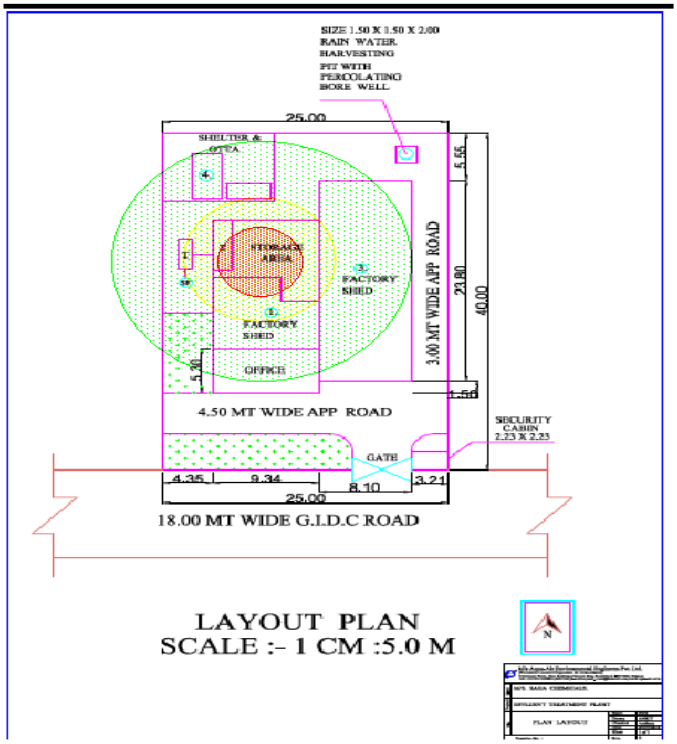
Scenario – 2 Unconfined Pool Fire Simulations for Drum Storage Area

Results indicate:

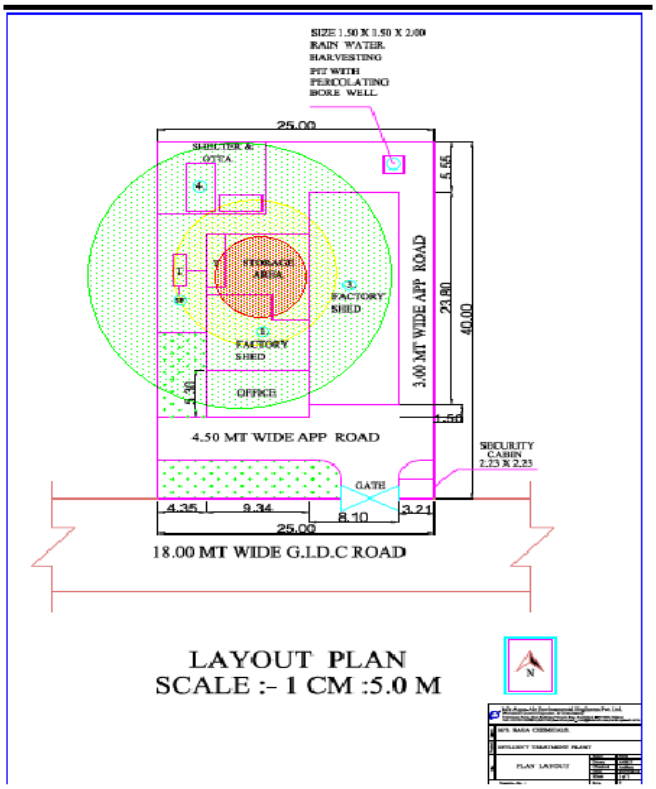
Catastrophic Rupture		
Input Data		
Stored quantity - 5 MT		
Wind speed - 2.14 m/s		
Density (Air) – 0.867 g/cm^3		
Results indicate		
Pool Fire Scenario		
Radiation Level (KW/m^2)	**Distance in meter**	**Effect if IHR at Height of simulation**
4	29.2	This level is sufficient to cause personnel if unable to reach cover within 20s; however blistering of the skin (second degree burn) is likely; 0: lethality
12.5	19.6	This level will cause extreme pain within 20 seconds and movement to a safer place is instinctive. This level indicates around 6% fatality for 20 seconds exposure
37.5	10.8	This level of radiation is assumed to give 100% fatality as outlined above

Fire Ball Scenario		
Radiation Level (KW/m^2)	**Distance in meter**	**Injury Type**
4	31.8	Pain after 20secs.
12.5	22.5	1st degree Burn
37.50	17.5	100% Fatal

Pool Fire:



Fire Ball:



Measures to be taken to prevent such accident:

- Priority will be given to Tanker to immediately enter the storage premises at site and will not be kept waiting near the gate or the main road.
- Security person will check License, TREM CARD, Fire extinguisher condition, Antidote Kit, required PPEs as per SOP laid down.
- Store officer will take sample as per sampling SOP from sampling point.
- After approval of QC department unloading procedure will be allowed be started.

Following precautions will be adopted during unloading

- Wheel stopper will be provided to TL at unloading platform.
- Static earthing will be provided to road tanker.
- Tanker unloading procedure will be followed according to check list and implemented.
- Flexible SS hose connection will be done at TL outlet line.
- The quantity remaining in the hose pipeline will be drained to a small underground storage tank, which will be subsequently transferred by nitrogen pressure to the main storage tank thus ensuring complete closed conditions for transfer from road tanker.
- All TL valves will be closed in TL.
- Finally earthing connection and wheel stopper will be removed.
- Only day time unloading will be permitted.

Following precautions will be adopted Storage of such chemicals

- Storage tank will be stored away from the process plant.
- Tanker unloading procedure will be prepared and implemented.
- Caution note and emergency handling procedure will be displayed at unloading area and trained all operators.
- NFPA label will be provided.
- Required PPEs like full body protection PVC apron, Hand gloves, gumboot, Respiratory mask etc. will be provided to operator.
- Neutralizing agent will be kept ready for tackle any emergency spillage.
- Safety shower, eye wash with quenching unit will be provided in acid storage area.
- Material will be handled in close condition in pipe line.
- Dyke wall will be provided to all storage tanks, collection pit with valve provision.
- Double drain valve will provided.
- Level gauge will be provided on all storage tanks.
- Safety permit for loading unloading of hazardous material will be prepared and implemented.
- TREM CARD will be provided to all transporters and will be trained for transportation Emergency of Hazardous chemicals.
- Fire hydrant system with jockey pump as per TAC norms will be installed.

For Storage tank farm area:

- Under N2 pressure storage.
- Safety valve provided and storage facility to ensure safe release of HC in case of over pressure.
- Dyke with separate fencing area is provided.
- SOP prepared
- Road tanker unloading procedure prepared
- Work permit followed
- PPEs used
- Safety shower, eye wash provided.
- NFPA labeling system adopted for storage tanks.
- Level indicator at local.
- Alarm for high level & high pressure.
- Automatic fire fighting indication provided for around the storage area
- Sprinkler system will be provided

7.1.6 RISK ASSESSMENT SUMMARY

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

7.1.6.1 PROCESS SAFETY

- Safety measures will be adopted from the design stage.
- Safety Valve and pressure gauge will be provided on reactor and its jacket (if jacket is provided).
- Utility like chilling, cooling, vacuum, steaming and its alternative will be provided to control reaction parameters in a safe manner.
- Free fall of any flammable material in the vessel will be avoided.
- Static earthing provision will be made at design stage to all solvent handling equipments, reactors, vessels & powder handling equipments.
- Any reaction upsets will be confined to the reaction vessel itself.
- All emergency valves and switches and emergency handling facilities will be easily assessable.
- Further all the vessels will be examined periodically by a recognized competent person under the Gujarat Factory Rules.
- All the vessels and equipments will be earthed appropriately and protected against static electricity. Also for draining in drums proper earthing facilities will be provided.
- Materials will be transferred by pumping through pipeline or by vacuum from drums.
- All solvents and flammable material storage tanks will be stored away from the process plant and required quantity of material will be charge in reactor by pump.
- Jumpers will be provided on all solvent handling pipeline flanges.

- Caution note, safety posters, stickers, periodic training & Updation in safety and emergency preparedness plan will be displayed and conducted.
- Flame proof light fittings will be installed in the plant.
- All the plant personnel will be provided with personal protection.
- Equipments to protect against any adverse health effect during operations, leakage, spillages or splash. PPE like Helmets, Safety Shoes, Safety
- Glasses, Acid-Alkali Proof Gloves etc. will be provided to the employees.
- All employees will be given and updated in Safety aspects through periodic training in safety.
- Material Safety Data Sheets of Raw Materials & Products will be readily available that the shop floor.

7.1.6.2 FOR HAZARDOUS STORAGE TANK FARM

- Tank farm will be constructed as per explosive department requirement and separation distance will be maintained.
- Tanks shall be located and marked in designated area of hazardous chemical storage.
- Static earthing provision will be made for road tanker as well as storage tank.
- Tanks of proper MOC will be selected.
- Flame arrestor with breather valve will be provided on vent line.
- Road tanker unloading procedure will be prepared and implemented.
- Fire load calculation will be done and as per fire load Hydrant System will be provided as per NFPA std. and Fire extinguishers will be provided as per fire load calculation.
- Spark arrestor will be provided to all vehicles in side premises.
- Flame proof type equipments and lighting will be provided.
- Lightening arrestor will be provided on the top of chimney.
- Trained and experience operator will be employed for tank farm area.
- NFPA label (hazard identification) capacity and content will be displayed on storage tank.
- Solvents will be transferred by pump only in plant area and day tank will be provided. Overflow line will be return to the storage tank or Pump On-Off switch will be provided near day tank in plant.
- Jumpers will be provided on solvent handling pipe line flanges.

- Flexible SS hose will be used for road tanker unloading purpose and other temperature connection.
- All tanks shall be uniformly tagged.
- Level indicator shall be provided in tanks.
- Dyke will be provided.
- Industrial type electric fittings shall be provided.
- Adequate fire fighting equipments will be provided.
- Anti corrosive paint shall be done.
- Safety instruction board will be displayed.

7.1.6.3 FOR DRUM/CARBOY STORAGE AREA

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

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

7.1.6.4 TRANSPORTATION

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

- NRV provision will be made on all pump discharge line.

7.1.7 OTHER RISK REDUCTION OPPORTUNITIES

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

- Buildings and plants structures shall be designed for cyclone floods and seismic events to prevent structural collapse and integrity of weather (water) proofing for storage of goods;
- Provision for adequate water capacity to supply fire protection systems and critical process water;
- Isolate people from load carrying/mechanical handling systems, vehicle traffic and storage and stacks locations;

7.1.8 RECOMMENDATIONS FOR ALARP

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

Raw Material Storage Area

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

Fire access for Tank Farm area and Ware Houses

- Fire access roads shall be provided to storage area. The storage tanks/area shall have suitable fire protection and fire fighting facility.

The following features are also important for the project by taking the layout into consideration:-

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

Electrical Safety for Whole Facility

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

7.1.9 FIRE FIGHTING SYSTEM

Company management will take into consideration fire prevention measures at the project planning and during plant commissioning stage to avoid any outbreak of fire. But looking to the hazardous nature of process and the chemicals that are handled and processed, the chances of outbreak of fire cannot be totally ignored. Hence to tackle such a situation a

good well laid fire protection system will be provided in the factory. Details of fire fighting are given in Table 7.4.

TABLE 7.4

PROPOSED FACILITIES TO BE MAINTAINED FOR FIRE FIGHTING:

Sr. No.	Type	Capacity	Total Quantity
1	Dry Chemical Powder	9 Kgs	3 Nos.
		6 Kgs.	6 Nos.
2	Carbon dioxide	4.5 kgs	1 Nos.
3	Form Type	Mechanical Foam 9 liters	2 Nos.

Other fire fighting facilities proposed to be installed at site:

- Fire load calculation will be carried out and Fire Extinguishers at different locations will be provided (as mentioned in above table) as per the TAC guidelines.
- Working staff will be given training to operate extinguishers.
- Fire Hydrant Network will be installed as per the calculated requirement for fire fighting.
- A main fire pump with a capacity of 50 m^3/Hr @ 10 Bar/cm^2 will be installed.
- A stand-by diesel pump with equal capacity (50 m^3/Hr @ 10 Bar/cm^2) will be installed. This pump will be used for fire fighting in case of power failure.
- A fire water reservoir with holding capacity of 300 m^3 of water shall be provided.
- First Aid Training will be imparted to employees by designated first aid trainers.

7.2 DISASTER MANAGEMENT PLAN

M/s. Saga Chemie Pvt. Ltd. shall develop the emergency management system to tackle the emergency situation, apart from its emergency management system. The detail of disaster management system is discussed in the following section.

7.2.1 DEFINING THE NATURE OF EMERGENCY

7.2.1.1 LEVEL OF EMERGENCY CAN BE CLASSIFIED IN THREE CATEGORIES.

LEVEL - 1:

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

a) Small fire in the plant

b) Low toxic gas release for short duration.

c) Collapsing of equipment that do not affect out side premises.

LEVEL - 2:

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

a) Major fire inside the factory premises.

b) Medium scale explosion confined to the factory premises.

c) Heavy toxic / flammable gas leakage for short duration.

LEVEL - 3:

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

a) Explosion of high magnitude affecting the adjacent area

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

7.2.2 OBJECTIVES OF EMERGENCY MANAGEMENT SYSTEM

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

- To identify and assess types of emergencies due to different types of hazards.
- To work out plan with all provisions to handle emergencies and safeguard employees and people in the vicinity of the factory.
- To provide for emergency preparedness and the periodical rehearsal of the plan.
- To plan mode of proper communication and actions to be followed in the event of emergency.
- To keep all necessary information with respect to hazard/accident control and emergency contacts in one document for easy and speedy reference.
- To inform employees, general public and the authorities about the hazards/risk if any and the role to be played by them in the event of emergency.
- To control and contain the accident.
- To effect rescue and treatment of casualties.
- To inform and help relatives of casualties.
- To secure rehabilitation of affected area and restore normalcy.
- To provide information to media and government agencies.

- To preserve record, equipment etc. for investigating cause of emergency.
- To be ready for "mutual aid" if need arises to help neighboring units.

7.2.3 STRUCTURE OF EMERGENCY MANAGEMENT SYSTEM

The management structure at M/s. Saga Chemie Pvt. Ltd. includes the following personnel's;

- Chief Emergency Controller
- Incident Controllers and Deputy Incident Controllers
- Site Main Controllers
- Key Personnel's
- Essential Workers
- Assembly points
- Emergency control center
- Fire control arrangements
- Medical arrangements
- Other arrangements

7.2.3.1 CHIEF EMERGENCY CONTROLLER (CEC)

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

1. Immediately on being informed of the emergency and its location, will arrive at the scene & handle the situation.
2. Relieve the Incident Controller from responsible of the Main Controller.
3. Co-ordinate to avail services from external agencies like fire brigade, hospitals etc., if called for, following the declaration of major emergency. If necessary, major installations in the vicinity may also be informed of the situation.
4. Exercise direct operational control of the unaffected section of the plant.
5. In consultation with the advisory team, expedite the shutting down of loading/unloading operations of tankers and if necessary, instruct the supervisor/security personnel to evacuate tankers.

6. Ensure that all employees are evacuated from the affected area and the casualties, if any, will be given necessary medical attention. Instruct P & A Assistant/Security for rushing casualties to hospitals if required.
7. Liaise with fire and police officials, pollution control board officials and other statutory bodies and advise them of all possible consequence effects outside the premises.
8. Arrange for relief of personnel when emergency is prolonged.
9. Issue authorized statement or press release to the news – media.
10. Ensure preservation of evidence for enquiries to be conducted by statutory authorities.
11. Authorize the sounding of "All Clear" and "Evacuation Siren".
12. Arrange for obtaining the head – count of all personnel within the premises and cross-checking with the data from records available for no. of persons within the premises.
13. Nominate a person from advisory team, to maintain chronological log of event during the entire period of emergency.

7.2.3.2 INCIDENT CONTROLLER (IC) AND DEPUTY INCIDENT CONTROLLER (DIC)

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

Responsibilities/Duties of Incident Controller (IC) and Deputy Incident Controller (DIC):

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

- Pressure evidences. This will be necessary for investigation for cause and concluding preventive measures.
- Send runners, if telephones are out of order.

7.2.3.3 SITE MAIN CONTROLLER (SMC)

SMC will have an overall responsibility for directing operations & calling outside help from Emergency Control Centers. SMC will be required to take decisions after consultation with the Senior Manager available at site.

The Shift Engineer (SE) of non-affected Plant will act as SMC till arrival of the designated SMC at Emergency Control Centre (ECC). Until the arrival of SMC, SE may have to execute following responsibilities.

- As soon as SE received the information or comes to know about the incident, SE shall proceed to Emergency Control Room (ECC) - Control Room and shall take charge of the incident. If Control Room gets affected due to unfavorable wind direction, Fire Control Room shall be used as alternate Emergency Control Room.
- SMC will has overall responsibility for directing emergency action, operation and calling outside help.
- SMC will ensure that all the Key Personnel are called.
- SMC will assess the gravity of situation with the help of Incident Controller (IC), Plant Manager and Key Personnel and after quickly assess the situation, shall find out the of emergency from Incident Controller (l C), and declare the emergency**.**
- Level-l: Emergency - may be handled within the plant premises.
- Level-2: Emergency - On Site Emergency plant shag be activated.
- Level-3: Emergency - Action to be taken to operate Off-Site Emergency Plan.
- SMC shall direct all emergency operations within the affected area with the following priorities.
- Personnel safety, including of surrounding community.
- Minimum damage to Plant, Property and Environment.
- Appropriate actions to minimize loss of Production and Material.
- SMC shall direct for evacuation of plant and areas likely to be affected by the emergency.

- SMC shall continuously review and assess possible developments to determine most probable course of events and actions.
- SMC shall assess the situation and ensure that whatever resources needed is made available and utilized in a co-ordinate manner.
- SMC shall direct the safe shut down of plants in construction with incident controller and Key Personnel, if necessary.
- SMC shall check that all non-essential workers, visitors, contractors are evacuated to safe assembly points and head count is completed.
- SMC shall give instructions to the Incident controllers, Fire fighting and Rescue teams.
- SMC shall, if necessary, arrange for evacuation of neighboring population.
- SMC shall ensure that search for casualties, within the affected area has been carried out and arrange for hospitalization of victims and additional medical help, if required.
- SMC shall ensure that liaison will be made with outside agencies such as Police Services, Fire Services, Expert on Health and Safety, Meteorological Office, District Emergency Authorities, Collector and Senior Inspector of Factories. Provide advice on possible effects to areas outside the factory.
- SMC shall arrange for up to date records of emergencies.
- SMC shall advice not to re-start the plants unless it is declared safe to start by competent authorities.

7.2.3.4 KEY PERSONNELS

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

the key personnel and other called in so to assist shall report to the ECC. They shall be available at any time on duty or on call or on oil duty or holiday.

7.2.3.5 ESSENTIAL WORKERS

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

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

7.2.3.6 ASSEMABLY POINT

In affected & vulnerable plants, all nonessential workers (who are not assigned any emergency duty) are evacuating the area & report to a specified Assembly Points. Each assembly Point will be clearly marked by conspicuous notices & provided with identification numbers e.g. Assembly Point No. 1, 2 and so on. Assembly Points will be located at a safe place, well away from area of risk and least affected by the down wind direction. To ensure that workers will not have to approach the affected area to reach the Assembly Point proper location and numbers will be marked at Assembly Points. Each Assembly Point in manned by a nominated person to record the names and dept. Further telephone to communicated SMC will be provided at each assembly Points. 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 will require 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.

7.2.3.7 EMERGENCY CONTROL CENTER (ECC)

Emergency Control Center (ECC) is the place or room from where the operations to handle the emergency will be directed and coordinated. Main Control Room will be earmarked/identified as the Emergency Control Room. Fire Control Room shall be earmarked/identified as the alternative Emergency Control Room to be operated in case of unfavorable wind direction. Adequate Telecommunication System will be available in the Emergency Control Room i.e. Hot Lines, Intercom Walkie-Talkies & External Phones.

The ECC center shall be equipper with the following facilities.

1. Internal and external telephone including STD facility
2. Telephone directory
3. Telephone nos. of mutual aid centers
4. Factory layout plan
5. Map of the area
6. Employee blood group and their address
7. Messengers / Runners for sending messages
8. Adequate numbers of PPE'S

7.2.3.8 FIRE CONTROL ARRANGEMENTS

7.2.3.8.1 FIRE FIGHTING, GAS LEAK CONTROL AND RESCUE OPERATION

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

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

B) Role of EHS Representative:

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

C) Fire crew members

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

7.2.3.9 MEDICAL SERVICES

The role of Medical officer (MO) is as follows;

(a) Contact immediately to the SMC/IC.

(b) Render necessary treatment at Occupational Health Center (OHC).

(c) Arrange for Hospitalization and Treatment at outside hospitals, if required.

(d) Mobilize in getting the services of External medical agencies, other Para –medical services etc. and transportation services etc.

(e) Arrange for extra medical assistance/antidotes, from out, if required.

(f) Arrange for first-aid trained volunteers for necessary help.

(g) Liaise with the Government Health Authorities for treatment of the affected persons nearby.

7.2.3.10 OTHER ARRANGEMENTS

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

STANDARD OPERATING PROCEDURE (SOP) - (EMERGENCY)

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

7.3 COMMMUNICATION SYSTEM

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

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

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

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

7.3.1 RAISING THE ALARM

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

The alarm sound informs the IC and the SMC that an emergency has been created and emergency organization is to be activated. The IC rushes to the site and takes charge of the scene.

7.3.2 DECLARING THE MAJOR EMERGENCY

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

7.3.3 TELEPHONE MESSAGES

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

7.3.4 COMMUNICATION OF EMERGENCY & STATUTORY INFORMATION

7.3.4.1 COMMUNICATION OF EMERGENCY

An effective system to communicate emergency shall be available.

- Inside the factory i.e. workers including key personnel and essential workers, on duty & inside during normal working hours.
- To key personnel and essential workers not on duty and outside during normal working hours.

- To the outside emergency services and the Government authorities.
- To the neighboring factory & the General Public in the vicinity.

a) Information to Workers

All personnel inside the factory shall be informed by the sounding of the siren or in case of electricity by ringing the bell.

b) To key personnel outside during normal working hours

The key personnel outside the factory premises shall be informed as per the need by external telephones or runners.

c) To the outside Emergency Services and the Authorities

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

d) To neighboring factories and the General Public

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

7.3.4.2 STATUTORY INFORMATION

a) Information to Workers

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

b) To the outside emergency services and authorities

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

c) To neighboring firms and the general public

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

7.4 ACTION ON SITE

The activities related to emergency time activities shall be divided into two parts. These are

- Pre-emergency activities
- Post-emergency Activities

7.4.1 PRE-EMERGENCY ACTIVITIES

7.4.1.1 INTERNAL SAFETY SURVEY

A safety committee shall be constituted as per Factories Act. The nominated members of the committee shall be assigned the responsibility to conduct safety survey once in a month before safety meeting. The internal safety survey includes –

- Identify various hazards in the factory
- Check whether protective equipments are in sound working condition
- Check various safety installations located at various plants for proper working
- Check sprinklers, showers, etc. in all plants
- Suggest extra modifications/ requirements to make systems more reliable
- Check presence of toxic gases by the help of dragger tube

Frequency of Internal Safety Survey: Once in a month

7.4.1.2 THIRD PARTY SURVEY

A safety survey shall be carried out once in a year by an external agency. It shall include –

- Inspection of building, structures for strength and stability
- Identify and study the hazards inside individual plants and within the factory premises.
- Check safety system for its adequacy.
- Suggest modifications or additions in the operating practices and safety system, if necessary.

Frequency of Third Party Safety Survey: Once in a year

7.4.1.3 PRESSURE VESSEL TESTING/ EXAMINATION

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

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

7.4.1.4 NON-DESTRUCTIVE TESTING (NDT)

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

Frequency of Non-Destructive Testing : Once in a year

7.4.1.5 SAFETY RELIEF VALVES TESTING

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

Frequency : Twice in a year

7.4.1.6 FIRE SYSTEM TESTING

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

Frequency: Once in a month

7.4.1.7 MUTUAL AID SCHEME

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

7.4.1.8 MOCK-DRILLS

- To conduct minor mock drills to train employees about their role/duties during emergency
- To refresh training to the employees for fire fighting, spill control, use of personal protective equipments etc.

- To check whether various members of emergency control committee remember their role/duties properly and to find out the faults and points of improvement in their performance.
- To check whether the various equipment for emergency control are operating satisfactorily and find and rectify the draw-backs if any.
- To conduct major mock-drills with permission from the authorities

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

7.4.1.9 SAFETY TRAINING

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

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

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

Frequency: Once in a year

7.4.1.10 PERSONAL PROTECTIVE EQUIPMENT

- To procure adequate number of personal protective equipment (aprons, hand gloves, safety goggles, helmets, nose masks, safety belts, gas cartridges, self-breathing apparatus, safety shoes etc.) suitable for plant operations and maintain records of use.

- To have proper system for issuing the PPE and disposal of used PPE
- To train the workers about proper use of PPE.
- To check the fresh air blowers provided at confined spaces for fresh air to workers.

7.4.1.11 COMMUNICATION

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

7.4.1.12 EMERGENCY LIGHTS

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

7.4.1.13 EMERGENCY CONTROL ROOM

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

7.4.1.14 ASSEMBLY POINTS

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

7.4.1.15 LIAISON WITH STATE AUTHORITIES

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

7.4.1.16 HOSPITAL FACILITIES

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

7.4.1.17 OUTSIDE SHELTER

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

7.4.1.18 STATUTORY INFORMATION

Statutory Information about chemicals handled in the unit, manufacturing process, the hazards in the unit, methods of prevention and control, first aid measures etc. shall be given to

- Workers
- Public and Neighboring units
- Government authorities & outside emergency services

7.4.1.19 PROTECTIVE DEVICES & ENGINEERING MAINTENANCE

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

7.4.1.20 LIST OF SUPPLIERS OF SAFETY EQUIPMENT

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

7.4.1.21 FIRE PREVENTION PLAN

- List of major work-place fire hazards
- Potential ignition sources
  - Sparks from electrical fitting/motors
  - Sparks from welding operations
  - Ignition system of boiler house
  - Sparks from static electricity
- Fire prevention & control measures
- Use of flameproof electrical fittings and electric motors wherever necessary

- No welding shall be done anywhere in the plant without prior permission from safety officer and necessary precautions from in charge of the area.
- Ignition system of boiler should be provided with guard.
- All vessels and pipeline should be properly earthed to prevent static electricity.
- The vent lines of all vessels and tanks holding flammable materials should be provided with flame arrestors.
- Fire extinguishers shall be provided at all critical locations in the unit.

7.4.2 POST EMERGENCY ACTIVITIES

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

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

7.4.3 EMERGENCY TIME ACTIVITIES

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

7.4.3.1 FLAMMABLE RELEASES

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

Control action –

1. Any one who notices fire shall sound emergency alarm.
2. SMC/IC who is at site, shall immediately rush to the scene and assess the situation. For fire due to spillage of combustible material, he activates the on-site plan as -

- SMC/IC will cut off electric supply to that area and evacuates all the persons to safe assembly points.
- SMC/IC will call in DIC (if DIC is not present there) and asks essential workers to fight fire with dry chemical/CO_2 fire extinguisher or sand.
- SMC/IC will inform fire brigade telling them in briefly about kind of fire and type of extinguishers required
- SMC/IC will inform mutual aid teams and asks for necessary help.
- SMC/IC will arrange first-aid/hospitalization for the affected persons.
- Fire officer on reaching the site, will take charge of the fire-fighting operations
- Mutual aid teams shall be asked for help in the form of first-aid, transport etc.
- If fire is growing, fire officer will inform IC who alerts neighboring units and through SMC gets more fire-fighting help.
- Fire fighting shall be continued till fire is fully overcome
- After extinguishing fire, fire officer shall cool the entire area with water spray and checks that no re-ignition shall be likely.
- SMC/IC will tell essential workers to sound all clear.
- The incident shall be recorded.
- SMC/IC will arrange to inform families / relatives of injured / dead.
- SMC/IC will issue authorized statement to press / media.
- SMC/IC will inform Factories Inspector about the incident and related information.

7.4.3.2 TOXIC RELEASES

Source/Incident – Pressure release due to failure of

- Stuffing box gland packing
- Pressure release valve
- Vessel/pipeline failure

Control action –

1. Any one who notices the release shall sound emergency alarm.
2. SMC/IC who is at site, shall immediately rush to the scene and assess the situation. For toxic release from a reactor, he activates the on-site plan as -

- SMC/IC will evacuate all the persons to safe assembly point.
- SMC/IC will call in DIC (if DIC is not present there) and asks essential workers to wear self-breathing apparatus and if the reaction is exothermic, start cooling water flow in the reactor jacket and cool the reactor as soon as possible.
- The essential workers will stop all the charging pumps of that reactor and the nearby reactors.
- SMC/IC shall inform mutual aid teams and asks for necessary help.
- SMC/IC shall arrange first-aid / hospitalization for the affected persons.
- Mutual aid teams shall be asked for help in the form of first-aid, transport etc.
- When the leak stops and the air shall clear of toxic release, IC tells essential workers to sound all clear.
- The vessel/rupture disc/gland packing will be attended by maintenance department.
- The incident shall be recorded.
- SMC/IC will arrange to inform families / relatives of injured / dead.
- SMC/IC will issue authorized statement to press / media.
- SMC/IC will inform Factories Inspector about the incident and related information

7.4.3.3 CHEMICAL SPILL

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

7.4.4 EVACUATION & TRANSPORTATION

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

7.4.5 SAFE CLOSE-DOWN

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

7.4.6 USE OF MUTUAL AID

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

7.4.7 HELP OF EXTERNAL AUTHORIES

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

7.4.8 MEDICAL TREATMENT

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

7.4.9 ACCOUNTING FOR PERSONNEL

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

7.4.10 ACCESS TO RECORDS

In order to inform families/relatives of injured/dead, a up-to-date list of names and addresses of all the workers shall be maintained in addition to the muster roll where shift-

wise attendance will be marked. Such list includes health records. This list will be available at the ECC and one such copy shall be available at our head office.

7.4.11 PUBLIC RELATIONS

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

7.4.12 REHABILITATION

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

In case of fire, the Senior Fire-Brigade Officer shall ensure that the area is cooled down and there are no chances of re-ignition. IC shall arrange for clean-up of the area and then only people shall be allowed to re-enter the area for work.

Even when all clear has been given, great care shall be taken when re-entering affected areas and no work in connection with the salvage, collection of evidence or start up shall be taken up until a thorough examination of the area has been carried out. The statutory powers of the Factory Inspector shall be kept in mind before any evidence is disturbed. Particular care shall be taken to avoid the introduction of possible sources of ignition, such as diesel engines, hand or power operated tools, flame cutting equipment, etc. until it has been established that no flammable materials are present where they could be ignited.

7.5 OFF – SITE EMERGENCY PLAN

7.5.1 NEED OF THE OFF – SITE EMERGENCY PLAN

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

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

1. To provide basic information about the risk and environmental impact assessment related to the unit to local/district authorities, police, fire-brigade, surrounding units, and the general public. To appraise them of consequences and the protection/prevention measures and control actions and to seek their help to communicate with public in case of a major emergency. The information from all industries shall enable district authorities to educate public about what could go wrong, and to train them of measures to be taken as an individual.
2. To enable district authorities to prepare the off-site emergency plan (contingency) for the district or particular area and to organize rehearsals and initiate actions learnt from these incidents.

Our Emergency Plan shall be made after considering the all possible effects of incidents on the neighboring population and the remedial measures will be devised in consultation with the local authorities and emergency services.

7.5.2 STRUCTURE OF THE OFF-SITE EMERGENCY PLAN

IC SMC Essential Workers (Implementing Action plan,	⟶	District Authorities (Collector, Factory Inspector, Police) Information, Evacuation	⟶	Mutual Aid teams, outside services, voluntary organizations (Fire-fighting, Gas leak control, First-aid, Shelter,

Informing nearby	Hospitalization,
Public)	Transportation)

7.5.3 ROLE OF FACTORY MANAGEMENT

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

7.5.4 ROLE OF EMERGENCY CO-ORDINATION OFFICER (ECO)

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

7.5.5 ROLE OF THE FIRE AUTHORITIES

The control of fire is normally the responsibility of the senior fire officer who would take over the handling of fire from the IC on arrival at the site.

- The senior fire brigade officer may also have similar responsibility for other events such as explosion and toxic releases. Fire authority having major hazard units in the area shall familiarize themselves with the location and site of all stages of flammable materials, water and foam supply points, fire fighting equipment.
- Act as observer of an on-site exercise involving only site personnel

7.5.6 ROLE OF THE HEALTH AUTHORITIES

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

7.5.7 ROLE OF TELEPHONE DEPARTMENT

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

7.5.8 ROLE OF POLICE AND EVACUATION AUTHORITIES

- To protect life and property
- To control traffic movement
- To inform people to remain indoors or evacuate
- To carry-out evacuation
- To identify dead, deal with casualties and inform relatives of dead or injured.

For evacuation, the following criteria will be useful:

a) In case of major fire, only houses close to fire and in the direction of smoke need evacuation.

b) If fire will be escalating and in turn threatening a store of hazardous material, it is necessary to evacuate people nearby if time is available; otherwise they should be informed to keep themselves indoor and shield from the fire.

c) For release of toxic gases, limited evacuation may be appropriate in downwind direction with windows closed and provides good protection. Toxic gases which are hazardous down to much lower concentration cover a long distance. This factor must be considered while deciding upon the need and extent of evacuation.

7.5.9 ROLE OF THE MUTUAL-AID AGENCIES

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

7.6 OCCUPATIONAL HEALTH AND SAFETY

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

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

7.6.1 OCCUPATIONAL HEALTH

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

7.6.1.1 CONSTRUCTION AND ERECTION

The occupational health problems envisaged at this stage can mainly be due to constructional accident and noise. To overcome these hazards, in addition to arrangements

to reduce it within Threshold Limit Values (TLV's), necessary protective equipments shall be supplied to workers.

7.6.1.2 OPERATION AND MAINTENANCE

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

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

7.6.1.3 HOSPITAL FACILITIES

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

7.6.1.4 FACTORY MEDICAL OFFICER (FMO)

A qualified doctor will be appointed as FMO on retainer ship basis. Apart from FMO, paramedical staff will be employed.

7.6.1.5 PROPOSED FACILITY TO BE MADE AVAILABLE AT OHC

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

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

7.6.1.6 AMBULANCE VAN

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

7.6.1.6 FIRST AID BOX

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

7.6.1.7 PERIODIC MEDICAL EXAMINATION

It is proposed that client will ensure that…

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

(a) Once in a period of 6 months, to ascertain physical fitness of the person to do the particular job;

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

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

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

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

1. It is proposed to formulate and implement an EMP for Occupational Safety and Health with following aims…
    - To keep air-borne concentration of toxic and hazardous chemicals below PEL and TLV.
    - Protect general health of workers likely to be exposed to such chemicals
    - Providing training, guidelines, resources and facilities to concerned department for occupational health hazards.

- Permanent changes to workplace procedures or work location to be done if it is found necessary on the basis of findings from workplace Monitoring Plan.

2. It is proposed that this EMP be formulated on the guidelines issued by Bureau of Indian Standards on OH&S Management Systems: IS 18001:2000 Occupational Health and Safety Management Systems
3. Proposed EMP will be incorporated in Standard Operating Procedure also.
4. **The proposed EMP will also include measure to keep air-born concentration of toxic and hazardous chemicals below its PEL and TLV, like…**
    a. Leak Surveys
    b. Separate storage for toxic chemicals
    c. Exhaust Ventilation
    d. Proper illumination
    e. On-line detectors toxic chemicals like Chlorine and Bromine
    f. Close processes to avoid spills and exposures
    g. Atomization of process operations to hazards of manual handling of chemicals
    h. Supply of proper PPEs like Air mask, Berating canisters, SCBA sets, On-line breathing apparatus at the places where there is possibility of presence of toxic chemicals.
    i. Decontamination procedure for empty drums and carboys.
    j. Regular maintenance program for pumps, equipment, instruments handling toxic and corrosive chemicals.
    k. Display of warning boards.
    l. Training to persons handling toxic and corrosive chemicals.

5. Workplace Monitoring Plan

- It is proposed that a Workplace Monitoring Plan to be prepared & implemented in consultation with FMO and industrial hygienists.
- Each workplace must be evaluated to identify potential hazards from toxic substances or harmful physical agents. Air-borne concentration of toxic chemicals will be measured and record will be kept.
- The current state-of-the-art exposure measurement model is as follows: For purposes of measuring worker exposure across a single shift it is sufficient t o place a reasonably accurate exposure measuring device on the worker , within t he worker ’s

breathing zone, and have it operate for nearly the full shift. Client has been proposed to study the exposure data when the plant is operative.

6. **Health Evaluation of Workers**

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

7.6.1.9 MEDICAL SURVEILLANCE PROGRAM

Pre-employment Medical Check Up

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

Periodical Medical Check up

1. Lung Function test
2. Cardiogram
3. Audiometry

4. Hematological Examination
5. Urine examination
6. Vision test
7. Colour blindness test
8. Biomarker in Blood & Urine

7.6.2 SAFETY PLAN

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

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

- To promote through the established machinery, joint consultation in health and safety matters to ensure effective participation by all employees;
- To publish/notify regulations, instructions and notices in the common language of employees;
- To prepare separate safety rules for each type of occupation/processes involve in a plant; and
- To ensure regular safety inspection by a competent person at suitable intervals of all buildings, equipments, work places and operations.

7.6.3 SAFETY ORGANIZATION

Construction and Erection Phase

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

Operation and Maintenance Phase

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

7.6.4 SAFETY CIRCLE

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

7.6.5 SAFETY TRAINING

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

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

- Compartmentalization of cable galleries, use of proper sealing techniques of cable passages and crevices in all directions would help in localizing and identifying the area of occurrence of fire as well as ensure effective automatic and manual fire fighting operations;
- Spread of fire in horizontal direction would be checked by providing fire stops for cable shafts;
- Reliable and dependable type of fire detection system with proper zoning and interlocks for alarms are effective protection methods for conveyor galleries;
- Housekeeping of high standard helps in eliminating the causes of fire and regular fire watching system strengthens fire prevention and fire fighting; and
- Proper fire watching by all concerned would be ensured.

7.6.6 HEALTH AND SAFETY MONITORING PLAN

The health of all employees shall be periodically monitored for early detection of any ailment due to exposure to heat and noise.

7.7 TRAINING, REHERASAL & RECORDS

7.7.1 NEED OF TRAINNING & REHEARASAL

Training is important in order to –

- Teach worker's how to handle chemicals safely, how to act as a runner/messenger, how to use PPE, how to start and shut down the plant, how to carry out emergency repairs etc.
- Teach one to be a safe and alert worker.

Rehearsal is essential for -

- Explaining and making key personnel and essential workers aware of their role in case of an emergency.
- Testing the emergency procedure, emergency arrangements and ability of all involved with it to grasp the procedure and implement the same.

- Testing the effectiveness of communication system including the alternative arrangement in case of failure.
- Testing the speed of mobilization of resources, search, rescue and treatment of casualties, emergency isolation and shut down.
- Detecting the shortcomings in the emergency plan and incorporating remedial measures.
- Allowing professional emergency services to test their parts of the plan and testing co-ordination.
- Building confidence in workers which is helpful in facing real situations.

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

7.7.2 SOME CHECK POINTS

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

- Does the plan cover the range of incidents that can realistically be anticipated?
- Have the consequences of the various incidents considered been adequately assessed?
- Are there sufficient resources in terms of personnel and equipment on the site to carry out the Emergency Plan for the various incidents in conjunction with the public emergency services?
- Have the time scales been assesses correctly?
- Is there a logical sequence of actions for each person given a role in the plan? Whether key personnel, especially the nominated incident controllers, consulted in the preparation of the plan?
- Is there 24 hours cover, to take account of absences due to sickness and holidays, minimum shift manning, operator only periods, silent hours, shutdown periods, only security personnel being present, or for unmanned sites etc.?

- Is there satisfactory co-operation with the local emergency services and district emergency planning officers?
- At sites where an off-site plan to protect people and the environment outside the site in the event of an incident is appropriate what is the procedure for initiating the off-site plan and is this satisfactory?

7.7.3 RECORDS AND UPDATING THE PLAN

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