CHAPTER – 7 ADDITIONAL STUDIES

(PUBLIC CONSULTATION AND RISK ASSESSMENT & SAFETY MANAGEMENT)

As per the prescribed ToRs, additional studies carried out for the proposed project are (1) Public Consultation / Hearing and (2) Risk Assessment and Safety Management. They are elaborated in the following sections.

7.0. PUBLIC CONSULTATION / HEARING

"Public Hearing/Consultation" refers to the process by which the concerns of local affected persons and others who have plausible stake in the environmental impacts of the project or activity are as certained with a view to taking into account all the material concerns in the project or activity design as appropriate.

The proposed project for manufacturing of various Synthetic Organic Chemicals (Pharmaceutical Bulk Drugs & Intermediates) is covered under Category **5(f)-A** of the EIA Notification–2006 and subsequent amendments. As per the Terms of Reference (ToR) issued by MoEF&CC, unit required to conduct Public Hearing. The public hearing for the project was conducted as per the procedure prescribed in Appendix-IV of the EIA Notification SO 1533 (E) dated 14/09/2006 and subsequent amendments, the details of the same are given below;

Date & Time : 18/10/2019 at 11:00 hrs

Venue : Project Site
Survey No. 424, 431,
Vil. Ganpatpura, Ta. Karjan,
Dist. Vadodara, Gujarat

Conducted by :
1) Shri D. R. Patel (GAS) – Resident Additional Collector & Additional District Magistrate, Vadodara
2) Shri R.B. Trivedi - Regional Officer GPCB, Vadodara

The crux of the public hearing showing issues / suggestions / objections / opinion rose by the participants and reply responded by the project proponent is summarized here below:

Sr. No.	Points / Issues Represented	Replies by Project Proponent / EIA Consultant	Compliance in the EIA Report
1.	Source of Water Supply and its usage in the unit.	Water requirement will be fulfilled by borewell. For industrial activities total 81 KLD water will be required. Moreover, we have applied for obtaining necessary permission from CGWA and necessary permission of CTE and CCA from board will be obtained.	Chapter 2 Section 2.11.1
2.	There was no objection regarding setting up the proposed project. However, they want ensurance that their crops should not get affected.	We will install all the equipment with latest technology to stop or reduce the pollution by providing proper environment Management.	Chapter 2 Section 2.11
3.	Employment opportunities and benefits to local population.	114 persons will required for employment for the proposed project and priority will be given to local persons as per Company's Act and also based on their education & skill sets.	Chapter 2 Section 2.9.7

The whole document of Public Hearing Proceedings is reproduced as an attached **Annexure 18.**

7.1. RISK ASSESSMENT & SAFETY MANAGEMENT

Increasing use of hazardous chemicals as raw materials, intermediates and finished products has attracted attention of the Government and the public at large in view of the chemical disasters. The serious nature of the accidents, which cause damage to the plant, personnel and public, has compelled industries to pay maximum attention to the safety issues and also to effectively manage the hazardous material and operations. It is mandatory for the industries handling hazardous chemical to maintain specified safety standards and generate an on-site emergency plan and keep it linked with off site emergency plan.

Risk assessment study for the proposed project of Livmore Life Sciences Pvt. Ltd. has been carried out and the details are elaborated in this chapter. Based on findings and recommendations of Risk Assesment report, Risk Management Plan for the proposed project has also been prepared and included.

Risk Assessment is defined as a continuous and integrated process of identification, evaluation and measurement of risks, along with their potential impact on the organization.

The benefits of risk assessment include the following:

- Prevention or reduction in occurance of accidents.
- Mitigation of the severity and/or consequences by way of improved process techniques, fire protection systems, arrangements of storage, inventory monitoring to fit production requirements.
- Confidences develop in employees by improving competency.
- Preparedness and prompt response to deal with any accident.

7.2. OBJECTIVE AND METHODOLOGY OF RISK ASSESSMENT

7.2.1. Objective

The principle objective of this study is to identify major risks in the manufacturing process and to evaluate on-site & off-site consequences of identified hazard scenarios. Pointers are then given for effective mitigation of hazards in terms of suggestions for effective disaster management, suggesting minimum preventive and protective measures and change of practices to ensure safety.

The following aspects and areas have been covered in this study;

- Identification of major risk areas.
- Hazard identification / Identification of failure cases.
- Consequential analysis of probable risks / failure cases;
    - Determination of the probable risk by Releasing of chemical due to leakage of storage tank and catastrophic failure.
    - Risk assessment on the basis of the above evaluation & risk acceptability.
    - Minimum preventive & protective measures to be taken to minimize risks to maximum possible extent.
- Giving pointers for effective disaster management.
- Suggesting measures to further lower the probability of risk.

7.2.2. Methodology

Design data, built in safety systems are studied. Discussions are held with officials. Safety related individual system is discussed. Hazard identification exercise is

conducted taking into consideration of materials, material handling methods, operating procedures, built in safety in reactors, operating parameters and safety measures to be taken in proposed plant. Containment failure scenario related to storage area is considered for hazard Analysis and consequences of such containment failures are considered in detail. Thus, this study is mainly oriented towards actual risks rather than chronic risks.

7.3. HAZARD IDENTIFICATION

Identification of hazard in proposed project activity is of primary significance. Following components of a plant presents potential for an accident.

- Storage and handling of hazardous chemicals,
- Manufacturing processes and allied operations in the plant

The unit will handle hazardous materials and will have organized hazard control and prevention system in place and comly with all the applicable provisions of the following statutes;

1. The Factories Act, 1948 and Gujarat Factories Rules, 1995
2. Manufacture, Storage and Import of Hazardous Chemicals (Amendment) Rules, 2000.
3. Petroleum Act, 1934 & Petroleum Rules, 2002
4. Static & Mobile Pressure Vessel (U) Rules, 1981
5. Public Liability Insurance Act & Rules, 1986

In Quantitative Risk Assessment (QRA), risk has been analyzed using methodology called Hazard Identification & Risk Assessment (HIRA). Hazard will be identified considering the following

- The physical and chemical properties of hazardous chemicals
- Storage conditions and modes of storage (Drum storage area, above ground storage i.e. tank farm area / underground storage etc.)
- Hazard ranking by threshold quantity of toxicity and NFPA code

Hence, all these components are to be thoroughly examined to assess their potential for an unplanned consequence of events, which can lead to an accident. While designing the proposed project the detailed hazard identification will be carried out to ensure plant operation in safely manner. After completion of designing stage or once

the design criteria are well established for proposed project, hazard identification methods to be used for the proposed project are listed below:

A. Hazard and Operability Study (HAZOP):

HAZOP refers to HAZard and OPerability studies. HAZOP is a structured and systematic technique for examining a defined system, with the objective of identifying potential hazards and operability problems in the system. The concept involves investigating how the plant might deviate from the design intent.

For the proposed project HAZOP study will be conducted at design stage i.e. while detailed designing of plant and processes are carried out. During HAZOP study, each pipeline as well as reaction vessel, storage tank, product and raw material storage area will be evaluated by considering certain limitations and deviations in flow, temperature, pressure, etc. All possible causes of deviation which gives the idea about severity of consequence arising from each type of deviation will be identified and accordingly designing of suitable safety measures for plant, utility and tank farm area will be incorporated in design.

B. Fault-Tree Analysis (FTA):

Fault- tree analysis (FTA) is logical structure displaying the relationship between an undesired potential event (top event) and all its probable causes in form of graphs/ trees. It starts with a potential undesirable event - top event and determining all the ways in which it can occur.

For the proposed project, FTA will be carried out by considering top events like fire or toxic hazards, explosion of reactors, boiler, rupture of vessels, loss of pressure in reactor, over pressurization of reactor and boiler, collapse of major plant machinery, overheating of boiler or reactors etc.

C. Event Tree Analysis (ETA):

Event tree analysis is a method to illustrate the intermediate and final outcomes which may arise after the occurrence of a selected initial event. ETA identifies the sequences of event following an initiating event that results in accident.

For the proposed project, ETA will be carried out by considering some initial event (bottom) like pipeline rupture and pump failure carrying Acids or flammable liquid, failure of rector stirring, failure of cooling/heating media circulation, stoppage of motor,

mistake of worker/operator. With each ETA mitigation measures will be designed and adopted to minimize the probability of the undesired event.

D. HAZAN, Hazard Analysis:

Hazard analysis is the initial study to determine hazard causes, effects and control. Hazard analysis includes analysis of mechanism of hazard occurrence and analysis of consequence which includes numbers of injury, fatality, property damage and other losses.

For proposed project, HAZAN has been carried out by considering storage details of raw material to get an idea of necessary safety measures for operation and environmental risk control. Analysis of mechanism of hazard occurrence for proposed project and consequence Analysis has been carried out in **Section 7.6.3** of this chapter.

7.3.1. Hazard Identification and Safety Management for storage of Hazardous Chemicals

The inventory of hazardous material in the storage area is significantly larger than the inventory involved in the process, hence storage tanks has been selected for consequence calculations. The chemical properties of each raw material along with its hazard identification are listed in **Annexure 13**.

Many raw materials required for manufacturing of the proposed products fall under the definition of hazardous material/chemicals as per MSIHC Rules, 2000. None of the products has been mentioned namely as hazardous in MSIHC rules but may fall under the definition of hazardous material/ chemicals either due to toxicity or flammability. Hazardous details of raw materials and products in form of MSDS are enclosed in **Part 3 of EIA Report.**

Out of the 242 raw materials required for manufacturing of proposed products, 17 chemicals have been selected for consequence analysis as given in **Table 7.1**. Hazardous areas identified with view point of their storge within the proposed project are highlighted in **Figure 7.1.**

Table 7.1: Details of hazardous chemical identified for risk assessment

Sr. No.	Hazardous chemicals	Details of Storage Unit				Threshold Value of Toxicity, ppm					$NFPA Code				
		Type	Size of Storage	Max. Storage Cap.	Storage Press. & Temp.	*Std.	Level 1	Level 2	Level 3	#IDLH	H	F	R	S	Type Of hazard identified
1	Acetic Acid	Drum	200 Lit	20 KL	Amb.	ERPG	5	35	250	50	3	2	0	-	Toxicity, Fire
2	Acetic Anhydride	Drum	200 Lit	40 KL	Amb.	ERPG	0.5	15	100	200	3	2	1	-	Toxicity, Fire
3	Ammonia (Liq.)	Drum	200 Lit	40 KL	Amb.	AEGL	30	160	1,100	300	2	0	0	-	Toxicity
4	Benzyl Amine	Drum	200 Lit	20 KL	Amb.	PAC	2	22	130	--	3	2	0	-	Toxicity, Fire
5	Bromine (Liq)	Drum	200 Lit	3 KL	Ambient (<25°C)	AEGL	0.033	0.24	8.5	3	3	0	0	-	Toxicity
6	Ethanol	Drum	200 Lit	10 KL	Amb.	ERPG	1,800	3,300	--	3,300	1	3	0	-	Toxicity, Fire
7	Hydrochloric Acid	Tank	5 KL	30 KL	Amb.	AEGL	1.8	22	100	50	3	0	1	-	Toxicity, Corrosivity
8	Hydrogen Gas	Cylinder	50 kg	1 MT	Amb.	PAC	65,000	2,30,000	4,00,000	--	0	4	0	-	Fire
9	Iso Propyl Alcohol	Drum	200 Lit	12 KL	Ambient	PAC	400	2,000	12,000	2,000	1	3	0	-	Toxicity, Fire
10	m-Xylene	Drum	200 Lit	6 KL	Amb.	PAC	130	920	2500	900	2	3	0	-	Toxicity, Fire
11	Methanol	Drum	200 Lit	12 KL	Amb.	AEGL	530	2,100	7,200	6,000	1	3	0	-	Toxicity, Fire
12	n-Butanol	Drum	200 Lit	14 KL	Amb.	PAC	60	800	8,000	1,400	1	3	0	-	Toxicity, Fire
13	n-Hexane	Drum	200 Lit	5 KL	Amb.	AEGL	--	2,900	8,600	1,100	1	3	0	-	Toxicity, Fire
14	Nitric Acid	Tank	2 KL	4 KL	Amb.	ERPG	1	6	78	25	4	0	0	-	Toxicity
15	Thionyl Chloride	Drum	200 Lit	40 KL	Amb.	AEGL	--	2.4	14	--	4	0	2	-	Toxicity, Reactivity
16	Toluene	Drum	200 Lit	4 KL	Amb.	AEGL	67	560	3,700	500	2	3	0	-	Toxicity, Fire

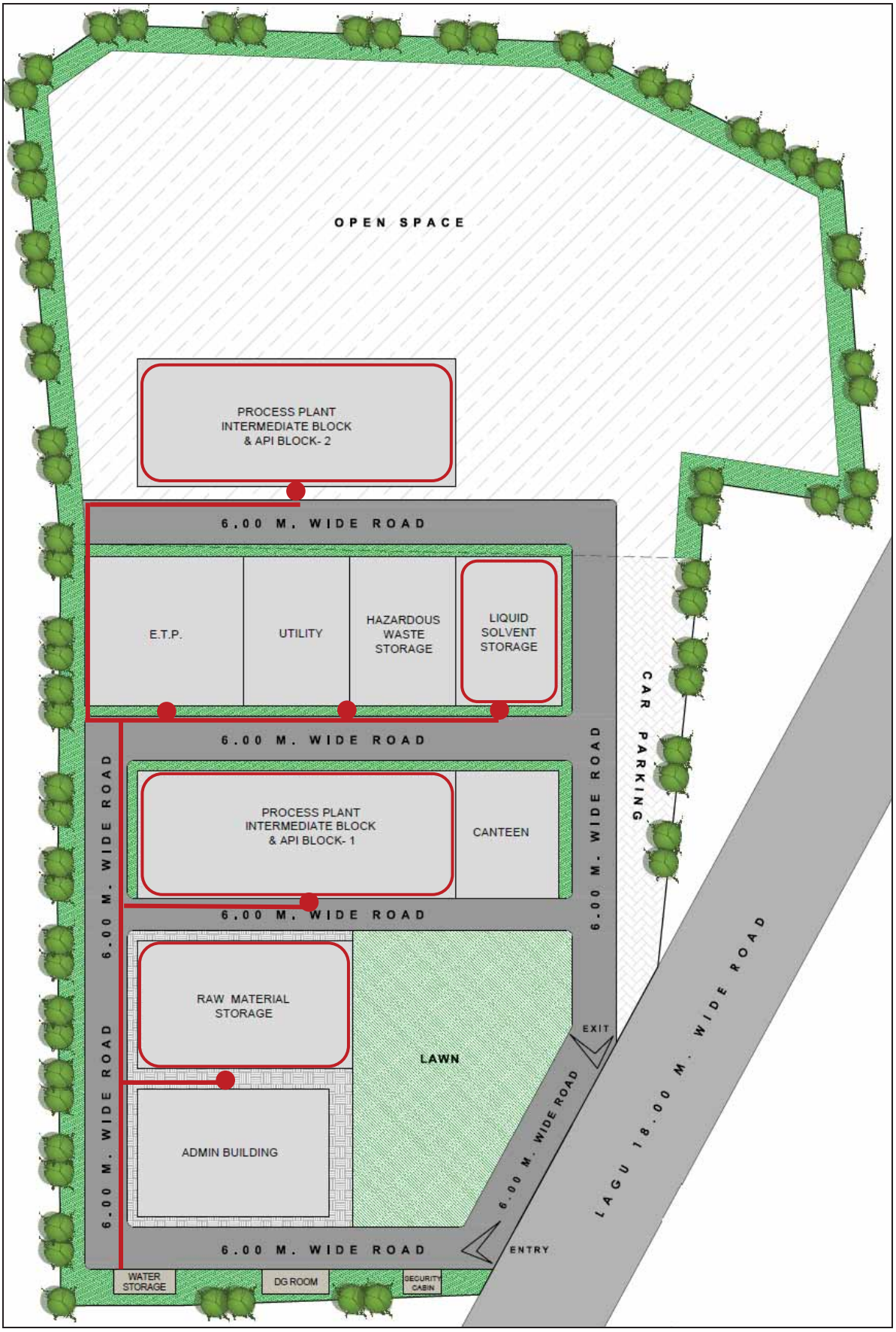
***PAC**: Protective Actions Criteria for Chemicals, **#IDLH**: Immediate Danger to Life and Health
$ NFPA: National Fire Protection Association **(H-** Health**, F-**Flamability**, R-**Reactivity**, S-**Specific hazard**)**

For the storage of certain hazardous chemicals in addition to above listed hazardous chemicals a license will be required from Petroleum & Explosives Safery Organization (PESO) as per the details given in **Table 7.2.**

Table 7.2: Applicability of licence from PESO

Sr. No.	Name of Chemicals	Classificat-ion	Stoarge		Appplicable Act / Rule	Licensing Autority
			Max. Qty.	Type		
1	Hydrogen Gas	Gas Cylinder (50 kg)	1 MT	Bulk	The Pertroleum Act, 1934 & Static & Mobile Pressure Vessel (U) Rules, 1981	Circle / Sub Circle Office (Chief Controller of Explosive)
2	Acetone	Class A	2 KL	Bulk	The Pertroleum Act, 1934 & The Petroleum Rules 1976	
3	Acetonitrile		1 KL	Non-Bulk		
4	Cyclohexane		2 KL	Bulk		
5	Ethanol		10 KL	Bulk		
6	Heptane		7 KL	Bulk		
7	Isopropyl Alcohol		12 KL	Bulk		
8	Methanol		12 KL	Bulk		
9	n-Hexane		5 KL	Bulk		
10	Tetrahydrofuran		1 KL	Bulk		
11	Toluene		4 KL	Bulk		
Total Quantity			**56 KL**	**Bulk**		
12	Acetic Acid	Class B	20 KL	Bulk		
13	Acetic Anhydride		40 KL	Bulk		
14	m-Xylene		6 KL	Bulk		
15	n-Butanol		14 KL	Bulk		
Total Quantity			**80 KL**	**Bulk**		

Figure 7.1: Identification of hazardous areas



Legend: Fire Hydrant Hazardous Area Identified

Unit will adopte adequate safety measures for transportation, storage & handling (spillage and leakage) for various hazardous chemicals in the existing plant. These measures are listed as follows.

A. General safety measures for transportation, storage & handling (spillage & leakage)

- Layout and location of hazardous chemical storage tank as per natural and mechanical ventilation.
- Storage of hazardous chemicals based on their compatability characteristics.
- Provision of display boards on all storage tanks showing name of chemicals, mterial of construction, calibration of tanks and date of painting.
- Installation of level indicators on all storage tanks to know the exact liquid level inside the tank and to avoid the accidental spillage or overflow.
- Provision of On-site detectors for fire based on heat &/or smoke detection with alarm system as required.
- Installation of VOC detectors for implementation of LDAR programme.
- Provision of dyke walls and transferring pumps on all the storage area for the hazardous chemicals which helps to reduce the risk of tank leakages.
- Provision of spare barrels/tanks of sufficient quantity for any emergency spillage or leakage.
- Regular inspection of all the drums/tanks of hazardous chemicals and damaged drums for separation and disposal to avoid the possibility of catastrophic rupture.
- Provision of double earthing to all storage tanks to prevent the firing due to static charges. Regular inspection of earthing pit.
- Installation of on-site detectors for fire, based on heat &/or smoke detection, with alarm system are provided as required.
- Periodic calibration and maintenance of all equipments related to hazardous chemical storage.
- Installation of NRV on all pump discharge lines.
- Insertion of heavy-duty gaskets to all pipe joints to prevent any leakage.
- Thorough examination of piping for transfer of hazardous chemicals on yearly basis for finding out any defects and rectify the same in due time. Maintain record of such examination.
- Use of drum trolley for the movement of drums of hazardous chemicals to avoid accident due to manual error.

- Display SOP for handling of hazardous chemicals in local language for safe operating procedure.
- Maintain proper inventory of hazardous chemical and keep buffer stock as minimum as possible.
- Implement standard procedure for safe unloading of road tanker.
- Provision of static earthing for tanker unloading.
- Mount muffler on silencer of tanker during entering in factory premises.
- Provision of water showering system (Automated sprinkling system) to the flammable liquid storage tanks, wherever required to avoid vaporization due to increase in ambient temperature.
- Provision of adequate firefighting system. Details of the same are elaborated in **Section 7.7 F.**
- Provision of first aid boxes at prominent places in the plant.
- Declare entire plant area as “NO SMOKE ZONE.”

Specific safety measures for storage and handling of hazardous chemiacls to be followed and implemented are listed as follows:

B. Storage and handling of Hydrogen Gas

- Mark cylinder with standard colour code (Red colour without any band).
- Storage in a well-protected, well-ventilated, dry area and separate from combustible matierals.
- Take care so that cylinder temperature does not exceed 52 °C.
- Separate cylinders from oxygen cylinders or other oxidizers by a minimum distance of 20 ft, or by a barrier of noncombustible material at least 5 ft.
- Storage of cylinders in upright position with valve protection cap in place and firmly secured to prevent falling or being knowcked over.
- Provision of suitable hand truck for movement of cylinder to avoid physical damage from rolling, sliding or dropping accidently.
- Keep away from all possible sources of ignition and make all electrical equipments explosion proof.
- Open cylinder valve only after connection is made in order to avoid self-ignitaion of hydrogen.
- Check leakages with leak detection solutions, never with flames.
- Design piping and equipments adequately to withstand pressure to be encounterd.

- Use of check valve and other protective apparatures in any line or piping from the cylinder to prevent reverse flow.
- Use of only nonsparking tools and equipments.
- Wear an approved respirator, chemical resistant glovesand safety goggles and other protective clothing while handling Hydrogen.
- Strict prohibition of sources of ignition such as smoking and open flames where hydrogen is handled.
- Follow safety recommendations and safe operating procedures by persons handling hydrogen.
- Storage of empty cylinders in separate area from filled cylinders. Fix an 'EMPTY' tag on cylinders immediately upon emptying.

C. Storage and handling of Bromine (Liq.)

- It will be labled properly and stored in a cool, well-ventilated and fire-resistant area.
- Air tight glass bottles will be first cooled and then opened with extreme caution. Bromine bottle may develop some pressure hence, it will be opened carefully
- It will not be stored in a polyethylene container. It will be kept away from combustible materials.
- Mechanical means of siphon will be used to charge bromine into reactor from glass bottle.
- At all times proper ventilation will be provided so that exposure level will remain at or below threshold limit of 0.1 ppm, which is safe for repeated eight-hour exposure.
- Prolonged and repeated exposure will be avoided.
- Bromine will be handled under chemical fume hood only with equipments made of Teflon, Monel, Pyrex glass and lead-lined steel.
- Safety shower and eye- wash fountain will be placed near bromine storage area.

D. Storage and handling of Ammonia (Liq.)

- It will be labled properly and stored in a cool, well-ventilated and fire-resistant area in a tightly closed container. Separate storage area will be preferred.
- Containers of liq. ammonia will be protected from physical damage and should be separated from oxidizers, combustible materials, heat, sparks, and open flame.
- Explosion proof electrical service will be installed in storage areas.

E. Storage and handling of Methanol

- Labeled properly and keep in a cool and well-ventilated designated storage area.
- Paint outside of methanol tanks with heat reflecting paint to reduce vapor losses from the tanks.
- Provision of proper earthing to prevent static electricity from accumulating.
- Avoid all possible sources of ignition and no welding & cutting activity in nearby area.
- Equip tank vent with flame arrester.
- Give proper handling training considering physical, chemical and flammable properties of methanol.
- Availability of Safe methanol handling procedure.

F. Storage and handling of Solvents & other Organic Chemicals

- Storage for sealed drums out of direct sunlight and remote from sources of heat to avoid generation of pressure.
- Paint outside of solvent storage tanks with heat reflecting paint to reduces vapor losses from tanks.
- Storage of drums at ground level and take measures to prevent corrosion of the drum base.
- Availablility of adequate ventilation to ensure that in case of incidental release of solvent (vapour) the vapour concentration is as low as possible, and in any event within the regulatory requirements
- Transfer of solvent by mechanical seal pump through fixed pipeline as far as possible.
- Loading and unloading under nitrogen blanket to exclude moisture. If moisture could enter into the container via seals or valves, blanket it by slight overpressure of Nitrogen.
- Pump unloading using secured dry connections and vapour return lines preferred for larger containers.
- Fitting of atmospheric vent of the tank with air dryer in order to prevent moisture from entering the storage tank and equip it with flame arrestor.
- Fitting of a pressure-vacuum relief valve of stainless steel, cast iron or brass to avoid oxidation. It prevents damage to the tank if the vent becomes blocked.

- Construction of dyke walls around storage tanks to keep liquid from flowing out in case of damage to tank.
- Provision of emergency showers and eyewash fountains in the unloading area in case of accidental skin or eye contact.
- Availability of safe handling procedure for storage of solvents.

G. Storage and handling of Concentrated Acid

- Storage of all acids in chemically compatiable containers and properly marked with hazardous symbol.
- Provision of suitable level indicator for storage and day tanks.
- Provision of all acid containers with containment tray.
- Provision of emergency transfer arrangements for transferring material into another tank.

7.3.2. Hazard Identification, Safety Management for Manufacturing Process and Allied Operations

Critical safety measures are the most important aspect of selection of process technology to ensure safety in production unit. For the safety in production area, some important critical safety measures must be provided within the process technology/ equipment itself. The details of the general and specific safety measures adopted for manufacturing process and allied operations are as below.

A. General safety measures and Preventive Maintenance for Process Units and Allied Operations

- Any reaction upsets to be confined to the reaction vessel itself. Charge defined quantity of raw materials to the reaction vessel/Day tank by metering pumps/load cells.
- Define process parameters control as per Standard Operating Procedures.
- Connect all reaction vents to either vapor condensers system or gaseoue scrubber system.
- Engagement of trained persons for handling of processes and provision of proper PPEs.
- Examine all the vessels periodically by a recognized competent person.
- Earthing of all the vessels, equipments and drums to protect against static electricity.
- Disconnect all the motors and pull out fuse before any maintenance work.

- Purging of empty process equipments with Nitrogen and Air before cleaning or maintenance.
- Installation of temperature indicators on all reactors and distillation systems.
- Display caution note, safety posters, stickers, periodic training and updates in safety and emergency preparedness plan.
- Availability of all the necessary fire fighting equipments in plant area.
- Availablity of presons to be contacted, in case of emergency, at prominent places of the unit.

B. Reactor Charging

- Charging of raw materials in a reactor having mechanical seal with powder charging system and safety devices.
- Check reactor for any leakages before process initiation.
- Proper assessment by using reactivity and reaction data from laboratory experiments or past experiences and evaluate to prevent accidents due to exothermic reactions.
- Charging of raw materials through permanent lines for avoiding direct contact.

C. Distillation

At the time of carrying out distillation of crude product there is possibility of organic vapour release and spillage of crude material from the system.

- Regular monitoring of distillation column pressure and temperature data and evaluate assessment of properties of solvent to avoid fire/explosion scenarios.
- Loss of cooling media in the condenser system could lead to increase in vapor/gases of distillate and rise in temperature and pressure could trigger decomposition of substance in the column. Therefore, continuously monitor cooling media circulation.
- Loss of vaccum in the Column could increase boiling point of the mixture and could trigger decomposition in reboiler. Monitor and caliberate vaccum and temperature gauges at regular intervals to avoid vaccum loss.

D. Centrifugation

Centrigugation during separation of solid liquid phase may lead to mechanical friction from bearing, vibration, leakage of seals, static electricity and overspeed and may cause hazard in the plant. Following measures will be taken care to avoid accidents.

- Redundant monitoring of critical components along with reliable maintenance for mechanical parts.
- Selection of appropriate materials of construction to withstand additional stress put on the materials from centrifugal forces.
- Flexible connections for process and utility lines will be preferred so that vibration cannot be transmitted to connected equipment.
- For toxic slurries batch operation of closed centrifuge will be preffered to avoid frequent toxic exposure to operator.

E. Filtration

At the time of separating catalyst from crude product, there is a possibility of hot vapour release or spillage of process material from filter or pipinig.

- Availability of trained personnel during separation of process material.
- Availablility of proper collection system in order to avoid dropping of the material on the floor.

F. Drying

Cool product material and pass in dryer where thermal energy is required to convert slurry into dry cake formation. Depending on the temperature, the drying takes place below the boiling point or at the boiling point of liquid to be removed.

- Carry out drying process at particular temperature so as to avoid generation of excess vapor from the crude product, which may be volatile in nature.
- Monitor and maintain temperature of dyer so as to avoid decomposition of finished product.

7.4. OCCUPATIONAL HEALTH & SAFETY PROGRAM

The main ill-effects anticipated to the health of workers in proposed project are due to the exposure of toxic chemicals. No other source of adverse effects on occupation health & safety is likely to occur. However, MSDS of hazardous chemicals will be prepared and made available with the management as well as concern personnel working with the materials or area likely to be affected by the materials.

Following key safety measure will be followed and implemented for the proposed project.

- Provision of all necessary equipment like portable detector, online detectors and other laboratory equipments as proposed for regular monitoring of workplace air and other conditions.
- Implementation of safety policy.
- Provision of proximity suits and self- breathing apparatus.
- Provision and compulsory use of necessary PPEs like helmate, safety goggles, face mask, hand gloves and safety shoes etc. for all workers.
- Provision of ear muffs/ ear plugs to the workers exposed to higher noise level.
- Provision of first-aid boxes (Containing Tincture iodine, Eye Drops, Burnol, Soframycin (ointment), Sterilized cotton wool, Band-aid, Antiseptic Solution (Sevlon), Bandage, Rose Water, etc) at various places in the premises.
- Organize training program for information on accident prevention, proper control and maintenance of equipment, first aid training and safe material handling practices.

Following measures will be followed and implemented for Occupational Health of the workers.

- Pre medical checkup at the time of employment and regular medical checkup of employees as per details given in **Section 7.2.4.** Maintain all the records in Form 33 certifying fitness for employment in hazardous process and operation as per Factories Act guidelines. Maintain health register of all the employees in Form 32.
- Monitoring of occupational hazards like noise, ventilation, chemical exposure at frequent intervals as per details given in **Section 7.2.4** and maintain all records as per Factories Act guidelines.
- Provision of occupational health center (OHC) and part time qualified medical officer as per factories act guidelines
- Provision of drinking water supply for the employees as per standard of the drinking water as per WHO guidelines.
- Availability of proper sanitary facilities for the employees so that they do not suffer from any health ailments.

7.5. MONITORING PROGRAM

Important components for the monitoring of occupational health and safety performance are identified and are given in following **Table 7.3.**

Table 7.3: Monitoring Program for occupational health and safety

Sr. No.	Components	Locations	Parameters	Frequency
1.	Work Place Air Quality	3-5 within plant area	As specified under Gujarat Factory Rules	Quarterly
			Gas detector for Hydrogen, NH_3 & VOC	Continuous
2.	Noise	All prominent locations within the premises	Noise levels	Quarterly
3.	Ventilation & Illumination	Process plant & Chemical storage area	Volumetric Air change, Room Temperature, Light Intensity	Six Monthly
4.	Occupational Health	Pre-employment check-up	Vision, Audiometry, Spirometry, Chest Skiagram, Urine, Complete blood count, etc.	Once at the time of appointment
		Periodical check-up	Vision, Audiometry, Spirometry, Urine, RBS, Liver function tests (LFT), Complete blood count, Anemia, etc.	Once in a year
		Post-employment check-up	Vision, Audiometry, Spirometry, Chest Skiagram, Urine, Complete blood count, etc.	Once at the time of relieving
5.	Risk Assessment and Hazard Management	Whole unit	Safety Audit	Yearly
		• Utilities • Manufacturing plant • Storage tank Farm Area	**HAZOP Study** Operation parameters will be evaluated for deviation from standard operating condition	• At design stage i.e. while designing proposed plant & processes • At pre-start up stage i.e. when construction is completed and operation is to be started • At every 5 years of plant operation • At the time of plant &/or process modification and upgradation

Sr. No.	Components	Locations	Parameters	Frequency
		• Storage tank Farm Area • Reaction vessels	**Event Tree Analysis and Fault Tree Analysis** Sequence of all unit-process/ operation will be evaluated to identify all fault and abnormal condition leading to abnormal event	• After completion/ finalization of plant design. • At the time of plant &/or process modification and upgradation

7.6. RISK ASSESSMENT STUDY

Chemical process industries have undergone tremendous changes during last five decades. Process conditions such as pressure and temperature have become severe; concentration of stored energy has increased. The scale of possible fire, explosion, toxic release, body injuries and occupational diseases has grown considerably. These factors have greatly increased the risk for major industrial disasters, involving loss of human lives, plant & property and environmental degradation.

Identification analysis and assessment of hazard and risk are very useful in providing information to risk management. It provides basis for what should be the type and capacity of its on-site and off-site emergency plan also what types of safety measures are required. Risk and consequence analysis are carried out by considering storage and handling of various hazardous raw materials, intermediates and products as well as manufacturing process.

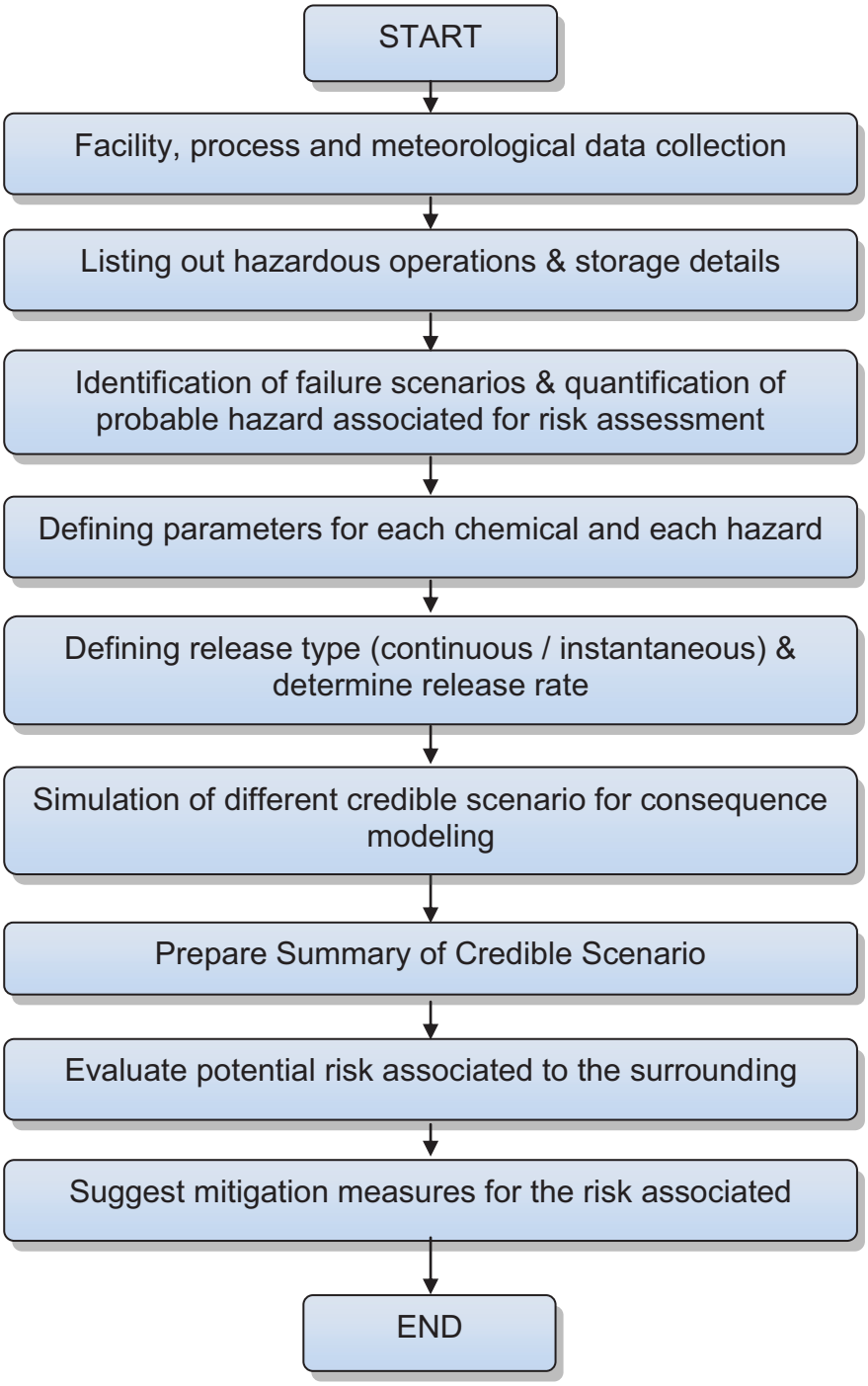
The objectives considered for Risk Assessment study are as follows;

- To assess the risk involved in transporting, storing & processing raw material up to final product.
- To evaluate the risk and to get the complete view of the available facilities.
- To take appropriate action to control the incidents.
- To safe guard employees and people in vicinity.
- To minimize damage to property and neighboring environment.
- To inform the employees, general public and Government authority about various types of hazards, assessed risk, safe guards provided, residual risk if any.
- To inform Police, Fire Brigade, District authority and Statutory authority for providing help during emergency.

- To work out a plan with all provisions to handle emergencies and to provide training to employees through mock rehearsals.
- To rescue and give treatment to the casualties and to count the number of injured persons.

Matrix given in **Figure 7.2** describes methodology adopted for Risk Assement study.

Figure 7.2: Risk Assessment Methodology



7.6.1. Modes of Failure

Storages system can fail in different ways depending on the materials stored, storage conditions & may involve systems in their vicinity. Conditions such as over filling, over pressure & missile, lightening or bomb attack, earthquake & resultant replier or release scenarios have been identified. Outcomes of such incidents are determined by presence of ignition either immediate or delayed. As can be seen depending upon modes of failure different scenarios are possible viz:

1. Continuous release
2. Instantaneous release

This may be of gas / liquid depending upon type of material stored/released and its characteristics. More examples, a liquid boiling at ambient conditions, will immediately be converted to gas upon exposure to atmosphere.

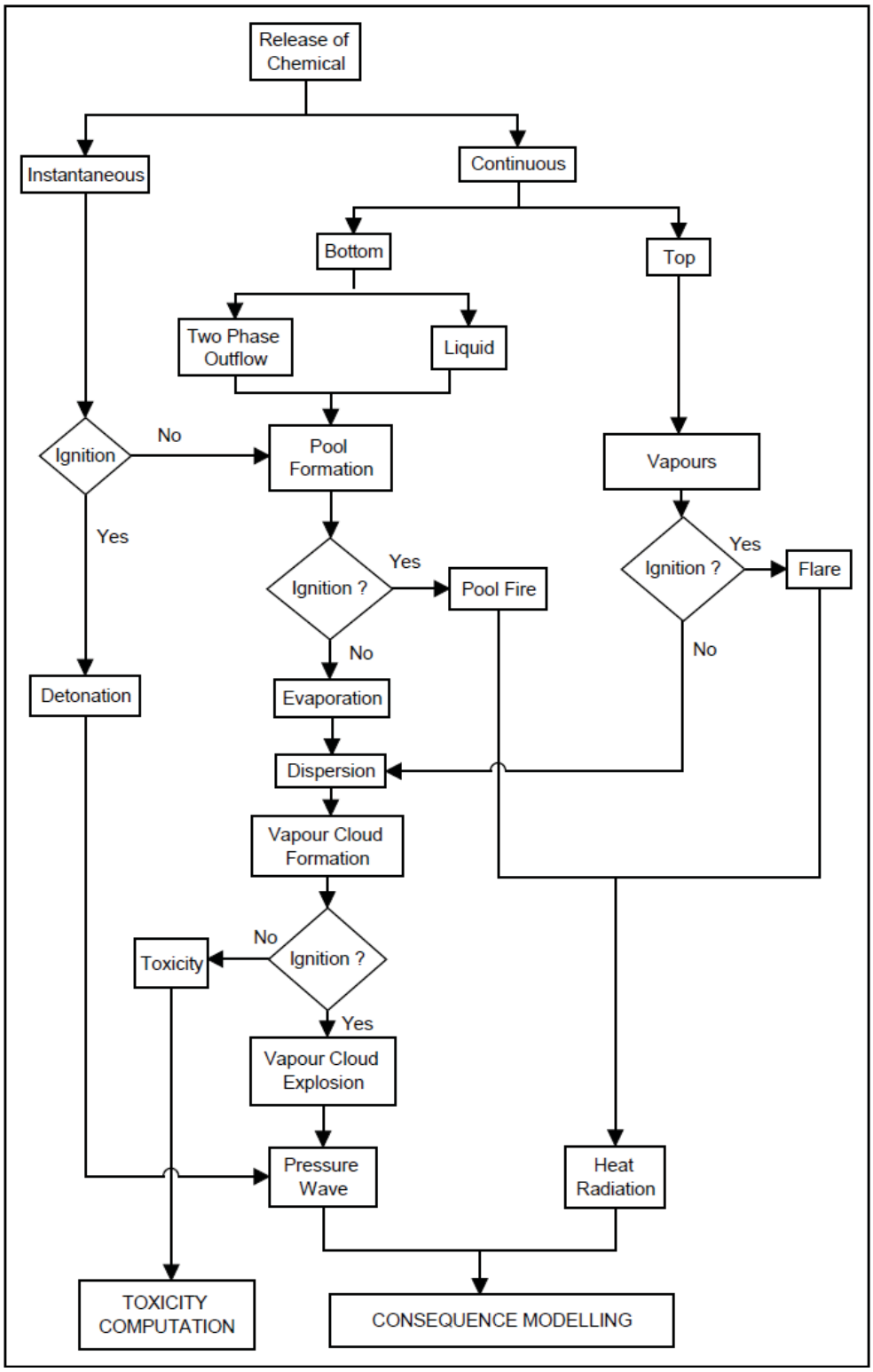
An instantaneous release is any release occurring for a period less than 15 seconds. Failure mode responsible for instantaneous releases may be catastrophic failure of road tanker. For an instantaneous gas release, important parameters are release height & quantity released whereas for instantaneous liquid release, important parameters are amount spilled, spill area & pool temperature, evaporation rate, vapour mass etc.

Continuous release occurs when the material is released over a period greater than 15 seconds. For a continuous gas release, important parameters include height of leak above ground, emission rate & total time of release. For continuous liquid release, important parameters are spill rates, duration, area & pool temperature, evaporation rate and vapor mass or Gas mass.

7.6.2. Maximum Credible Accident / Catastrophic Failure and Its Mitigation Measure

A Maximum Credible Accident (MCA) can be characterized 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. An 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. Flow chart given in **Figure 7.3** is considered for modeling various scenarios for accidental release of chemical.

Figure 7.3: Accidental release of chemical



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 judgment, the cases have been found to be credible and modeling for assessing vulnerability zones is prepared

accordingly.

The objective of the study is Emergency planning, hence only holistic & conservative assumptions are used for obvious reasons. Hence, though the outcomes may look pessimistic, the planning for emergency concept should be borne in mind whilst interpreting the results.

In 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. The Consequence Analysis has been done for selected scenarios by ALOHA (Areal Locations of Hazardous Atmosphere: Version 5.4.7) of EPA.

ALOHA models key hazards like toxicity, flammability, thermal radiation (Heat), and over pressure (expansion blast force) related to chemical releases that result in toxic gas dispersion, fire and/or explosion.

7.6.3. Consequences Analysis

From the proposed raw materials, chemicals listed in **Table 7.1** have been taken for the consequence analysis considering their hazardous / flammable / toxic nature. Details of these chemicals in the form of MSDS are enclosed as **Annexure 13.**

7.6.3.1. Possible Accident Scenario

Different possible ways of occurrence of any accidents due to storage/usage of above hazardous chemicals are prescribed here below;

Scenario-A: Release of chemical due to leakage and form evaporating puddle (Not burning)

Scenario-B: Release of chemical due to leakage and form burning puddle (Pool fire)

Scenario-C: Release of chemical due to catastrophic failure (BLEVE)

Atmospheric conditions assumed at the time of accidents are mentioned in **Table 7.4.**

Table 7.4: Atmospheric Condition Assumed

Particulars	Details
Wind	3 m/s
Ground Roughness	Urban
Cloud Cover	5 tenths
Air Temperature	37° C
Stability Class	C
Relative Humidity	50%

Detailed Maximum Credible Accident scenarios for hazardous chemical is given in **Annexure 14.**

7.6.3.2. Summary of MCA Scenarios

Summary of different credible accident scenarios for prediction of risk are given in **Table 7.5.**

Table 7.5: Summary of MCA Scenarios

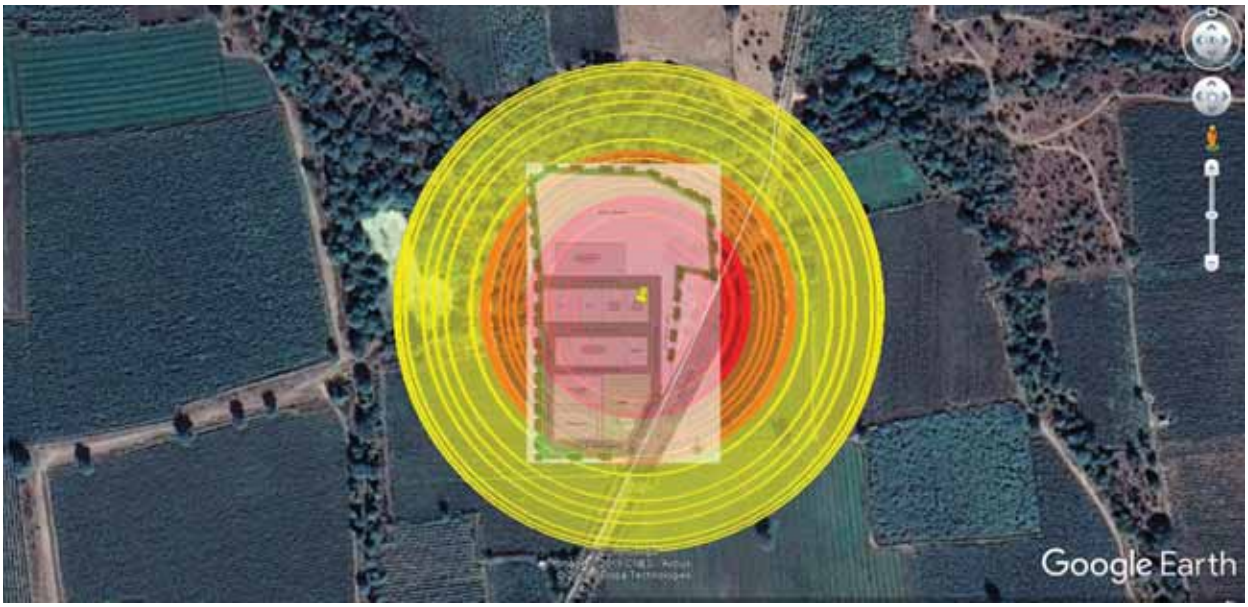
Sr. No.	Hazardous Chemicals	SCENARIO A Toxic Threat Zone, m			*SCENARIO B Thermal Radiation from pool fire / jet fire, m			*SCENARIO C Thermal Radiation from Catastrophic Rupture, m		
		Red	Orange	Yellow	Red	Orange	Yellow	Red	Orange	Yellow
1.	Acetic Acid	<10	41	116	<10	<10	<10	41	60	96
2.	Acetic Anhydride	<10	38	224	NA	NA	NA	47	68	108
3.	Ammonia (Liq.)	<10	22	50	NA	NA	NA	NA	NA	NA
4.	Benzyl Amine	<10	22	90	NA	NA	NA	69	98	154
5.	Bromine (Liq)	18	107	**301**	NA	NA	NA	NA	NA	NA
6.	Ethanol	--	<10	<10	<10	<10	<10	55	79	124
7.	Hydrochloric Acid	<10	<10	19	NA	NA	NA	NA	NA	NA
8.	Hydrogen Gas	<10	<10	<10	<10	<10	<10	NA	NA	NA
9.	Iso Propyl Alcohol	<10	<10	11	<10	<10	<10	59	84	132
10.	m-Xylene	<10	<10	<10	NA	NA	NA	71	100	157
11.	Methanol	<10	<10	18	<10	<10	<10	47	68	108
12.	n-Butanol	<10	<10	18	NA	NA	NA	62	88	139
13.	n-Hexane	<10	<10	--	<10	<10	<10	68	96	150
14.	Nitric Acid	<10	<10	36	NA	NA	NA	NA	NA	NA
15.	Thionyl Chloride	110	268	--	NA	NA	NA	NA	NA	NA
16.	Toluene	<10	<10	33	<10	<10	<10	71	**100**	**156**

***THERMAL RADIATION INTENSITY**
Red: 10 kW/sq.m. (Potentially lethal within 60 sec)
Orange: 5.0 kW/sq. m. (2nd Degree burn within 60 sec)
Yellow: 2.0 kW/sq. m. (Pain within 60 sec)

Figure 7.4 and **Figure 7.5** shows risk countours plotted on plant layout which is super imposed on the google map for scenarios of toxic threat zone and thermal radiation threat zone of catastrophic rupture respectively.

Figure 7.4: Toxic threat zone of all the chemicals considered

Figure 7.5: Threat zone of catastrophic rupture of all the chemicals



- Maximum distance of Toxic threat zone is observed at 301 m from leakage of Bromine, which is confined within the proximity of project site where there is no permenanate habitat exist.
- Maximum distance of thermal radiation from catastrophic rupture is obsered at 157 m from leakage of m-Xylene, which is confined within the proximity of project site where there is no permenanate habitat exist.

- There will be no threat to nearby habitation located at a distance of 1.4 km from project site from toxic, flammable and explosive hazard due to leakage of hazardous chemicals.

7.7. RISK MITIGATIVE MEASURES

Risk is rated based on likelihood of various consequence. A risk matrix is prepared based on findings of likelihood of an event with various consequences involved which is given in **Table 7.6.**

Table 7.6: Risk matrix for emergency management

Risk Rating = Probability x Severity			Consequence / Severity				
			Insignificant / Negligible	Minor / Marginal	Moderate	Major / Critical	Severe / Catastrophic
			1	2	3	4	5
Likelihood / Probability	Highly Unlikely	1	1	2	3	4	5
	Unlikely	2	2	4	6	8	10
	Somwhat Likely	3	3	6	9	12	15
	Likely	4	4	8	12	16	20
	Certain	5	5	10	15	20	25

Based on calculated risk rating, level of an emergency can be defined and in the event of accident management can take necessary steps as per the standard operating procedure. Details of level of emergency associated with above risk rating is given in **Table 7.7.**

Table 7.7: Levels of emergency associated with risk rating

Risk Rating	Risk Acceptance Criteria	Emergency Alert Code	Type of Emergency	Management
1 - 4	Low	I	Any incident which is Minor in nature. No potential risk of threatning lives or facitilites in the plant. i.e. Minor fires which can be extinguished easily. Minor gas or toxic releases which can be isolated within short period of time, Minor spillage of hazardous materials which can	On-site impact. Within the capability of Unit at Plant Level and can be managed with routin procedure.

Risk Rating	Risk Acceptance Criteria	Emergency Alert Code	Type of Emergency	Management
			be contained by dike or absorbant materials	
5-12	**Medium**	**II**	Any incident which is Major / Serious in nature. Potential risk of threatening lives, facilities or buildings on-site or off-site. i.e. Fire involving flammable storage tanks or plant equipments, Gas or toxic releases of large quantity which can be isolated safely, Spillage of flammable or hazardous substances which requires substantial resouces for cleaning up or recovery.	On-site impact. Accetable risk within the capability of Unit with Management's review. SOP to be followed for mitigation of associated risk.
13-25	**High**	**III**	Any incindent which is severe / catastrophic in nature which requires assistance from external emergency agencies i.e. Major or prolonged fire involving spread over entire plant or storage area; Major or prolonged release of gas or toxic releases due to catastropic failure of process equipment or storage tanks which requires on-site evacuation.	Off-site impact. Off-site emergency plan to be followed.

Following precautionary mitigation measures associated with probable risk will be followed and implemented after proposed project.

A. General Mitigation Measures

- Installation of all the equipment as per guidelines of provision of The Gujarat Factories Rules, 1963.
- Storage of Hazardous chemicals in small sized multiple containers so as to avoid major hazard associated with large sized containers.
- Proper control of the operating parameters, mainly temperature, vacuums, cooling media circulation, during plant operation and solvent recovery.
- Common antidots like milk of magnesia, banana, jaggery, glucose and milk etc. are available in case of exposure to toxic chemicals. Details of antidots for other hazardous chemicals are given in MSDS enclosed as **Annexure 13**.
- For any case of fire emergency, providion of standard type of Fire fighing equipments and fire extinguishers in the storage area as well as required places in the plant.
- Strict prohibition of Smoking inside the factory.

- Provision of adequate and suitable personnel protective equipments to the operating workers.
- Availability of First-Aid facility and First-aid trained person at the time of handling operation.

B. Mitigation measures for leakage of Hydrogen Gas

- Cover leaked hydrogen gas by inert gas to stop supply of oxygen gas.
- During leakage, only properly trained & protected person remains in the area to handle leakage and restrict entry of others.
- Confine leak exposed area either by solid casing or by soft barriers (polyethylene sheets) to limit flammable cloud size.
- Provision of recombiners to avoid formation of flammable mixtures formed due to leakage of hydrogen gas.
- In case of fire due to leakage use DCP, CO_2 and/ or water type fire extinguisher.
- Move leaking cylinder to open air area to detect leakage or allow it to empty, If leakage of hydrogen cannot be stopped.

C. Mitigation measures for leakage of Bromine

- Neutralize small Bromine spillage by pouring a hypo solution (Sodium thiosulphate or lime), then absorb spilled material with sand or other non-combustible material.
- Neutralize large Bromine spill with a solution of potassium carbonate, sodium carbonate or sodium bicarbonate. Also, it may be absorbed with dry earth, sand or other non-combustible materials.
- Use water spray to divert vapor drift and to reduce vapors.
- Provision of Ammonia torches to detect bromine leakages.
- Release anhydrous Ammonia gas to the bromine spillage area from a safe distance and maintain mild ammonia atmosphere, until decontamination is completed.
- Give proper training to workers for handling of bromine, usage of PPE.
- Allow only trained perssonel to handle leakage and spillage.

D. Mitigation measures for leakage of Ammonia

- Evacuate surrounding area from leakge and shutoff all the ignition sources.
- In case of leakage, be advised to move away in perpendicular to the wind direction to avoid direct exposure.
- Use water fogging to divert vapor drift and to reduce air borne concentration.

- Provide personnel involved in dealing with ammonia with self contained breathing apparatus and chmical protective clothing.
- Give proper training to workers for handling of ammonia.
- Make use of ammonia Emergency Kit in case of leakage.

E. Mitigation measures for leakage of solvents and hazardous organic chemicals

- Allow only trained perssonel to handle leakage and spillage.
- Provide leak detection system proactively to control the leakge from source only.
- Respirators are not as effective as ventilation in protecting workers in most situations. However, allow respirators only in case of insufficient ventilation.
- In case of fire due to leakage, use DCP, CO2 and/ or water type fire extinguisher.

F. Mitigation measures for leakage of concentrated acids

- Neutralize Acid leakage by using lime, sodium bicarbonate, soda ash etc.
- Absorb acid leakage by using dry earth, sand or other non- combustible materials.
- Allow only trained perssonel to handle leakage and spillage.
- Use water spray to divert vapor drift and to reduce vapors.

G. Emergency Management

Possible emergencies and remedial measures to prevent accident for various scenarios are elaborated in **Table 7.8, Table 7.9** and **Table 7.10**.

Table 7.8: Possible Emergency - Spillage (Spill Control Plan)

Location	Scenario considered Action by	Hazard Consequence	Possible Causes	Action to be taken	Remedial measures to prevent recurrence of such incident
Chemical Storage area & Process Plant	Small spillage	Toxic vapour Exposure to drum handling operators.	Drum puncher or damage, wrong Storage method.	• Find out drum leakage • Raise alarm immediately for warning if large spillage observed. • Do not enter in confined room if spillage is inside a confined room. • Do not touch any electrical switches in spillage area. • Stop all hot work in this area. • Call fire and Safety department. • Cordon the area. • Evacuate non-essential persons from the affected area immediately. • Inform the area in-charge. • Try to control situation at department level with available resources with full PPEs. • Identify the spillage material and refer MSDS for control plan. • Segregate leakage drum from the area. • Inform the Site Main Controller (SMC) in detail. • Open all doors and windows in this area. • Take decision to declare onsite emergency. • Spill control and neutralization team member try to control spread material in more area by absorbing material and dry sand. • If material is toxic or any other flammable and toxic chemical, special	• SOP for handling will be displayed in local language for safe operating procedure. • FLP type light fittings shall be provided. • Proper ventilation shall be made available in Drum storage area. • Proper label and identification board stickers shall be provided in the storage area. • Proper inventory of hazardous chemicals should be maintained and buffer stock should be kept as minimum as possible. • Conductive drum pallets shall be provided. • Drum handling trolley / stackers/fork lift shall be used for drum handling. • Materials shall be stored as per its Compatibility study and separate area shall be made available for flammable, corrosive and toxic chemical drums storage. • Dyke wall will be provided to area where hazardous chemicals will be stored. • Smoking and other spark, flame generating items shall be banned from the entry Gate. • NFPA & GHS labels shall be provided on drums for hazard identification of the chemicals.
	Large spillage	Fire in case of ignition source available within LEL-UEL % concentration			

Location	Scenario considered Action by	Hazard Consequence	Possible Causes	Action to be taken	Remedial measures to prevent recurrence of such incident
				precautions needs to be taken as per chemical expert Key person guide line. • Do not spray water or Foam on spilled material. • Do not drain spilled material in any trench. • Collect the spilled material in close container and send to ETP for further neutralization of the residual contents. • Administer first aid to the victim. • Make arrangement to send injured person/s to Hospital. • If off site emergency situation occurs, inform to following agencies Request for Mutual aiders, local authorities like DISH office, Collectorate office, Disaster management cell, Police, fire brigade, nearby hospital, local GPCB office	• Exhaust shall be provided at ground level in drum storage area. • Drum loading unloading procedures are prepared and implemented. • Liquid chemicals will be transferred by mechanical seal pump through closed pipeline.

Table 7.9: Possible Emergency - Fire

Location	Scenario considered Action by	Hazard Consequence	Possible Causes	Action to be taken	Remedial measures to prevent recurrence of such incident
Chemical Storage area, Process Plant and Utilities	Small spillage	Fire in drum storage area	Drum leakage or damage, Improper storage Method.	• Raise fire siren or shout Fire…Fire….Fire… • Evacuate the area immediately. • Inform the area incharge. • Inform Incident Controller in detail. • Call fire department immediately and help them in fire fighting.	• SOP for handling will be displayed in local language for safe operating procedure. • FLP type light fittings shall be provided. • Proper ventilation shall be made available in Drum storage area.
	Large spillage	BLEVE of drums			

Location	Scenario considered Action by	Hazard Consequence	Possible Causes	Action to be taken	Remedial measures to prevent recurrence of such incident
			Ignition source like electrical source, Friction etc. BLEVE due to overpressure in drum	• Try to control situation at department level with available respiratory and non- respiratory PPEs. • If it is found uncontrollable condition by department level inform Site Main Controller for onsite emergency situation. • Declare on site emergency if required. • Remove unburned drums from the site if possible without any risk. • Start fire hydrant system or water hose rill and spray water on uninvolved drums in fire for cooling purpose. • Use foam fire extinguishers for firefighting of solvent fire. • Do not enter in fire prone area. • If fire found uncontrollable condition call fire brigade and mutual aider for help. • In case of BLEVE fire, immediate evacuate the area up to 50 meters of the area surrounding. • All hazardous activates stop at site. • Inform nearby company to remove hazardous material or inventory from the compound wall. • Ensure search and rescue and causalities receive attention. • Administer first aid to the victim. • Make arrangement to send injured person/s to Hospital and inform victim's family.	• Proper label and identification board stickers shall be provided in the storage area. • Conductive drum pallets shall be provided. • Drum handling trolley / stackers/fork lift shall be used for drum handling. • Materials shall be stored as per its Compatibility study and separate area shall be made available for flammable, corrosive and toxic chemical drums storage. • Smoking and other spark, flame generating items shall be banned from the entry Gate. • NFPA labels shall be provided on drums for hazard identification of the chemicals. • Exhaust shall be provided at ground level in drum storage area. • Drum loading unloading procedures are prepared and implemented.

Location	Scenario considered Action by	Hazard Consequence	Possible Causes	Action to be taken	Remedial measures to prevent recurrence of such incident
				• If off site emergency situation occur –Inform to following agencies. Request for Mutual aiders, local authorities like – DISH office, Collectorate office, Disaster management cell, Police, fire brigade, nearby hospital, local GPCB office.	

Table 7.10: Possible Emergency – Toxic Gas Release

Location	Hazard Consequence	Possible Causes	Action to be taken	Remedial measures to prevent recurrence of such incident
Chemical Storage area & Process Plant	Potential injury / fatality from large release	Toxic Gas Release Reactor / Heater Failure, Leakage in Process Line, Plugging of reactor outlet, leakage in pipeline	• Activate audio visual alarm • Evacuate the area immediately. • Inform the area incharge. • Inform Incident Controller in detail. • Call fire department immediately and help them in fire fighting. • Try to control situation at department level with available resources with full PPEs. • If it is found uncontrollable condition by department level inform Site Main Controller for onsite emergency situation. • Declare on site emergency if required. • All hazardous activates stop at site. • Inform nearby company to remove hazardous material or inventory from the compound wall.	• Provide accurate gas monitoring system on site. • Minimize on-site storage • Develop procedure for tank inspection and maintenance • Develop purge system to remove gas to another tank. • Provide temperature control inside reactor with authomatic shut-down of gas flow to the reactor. • Design collection system to remove and purify/recycle or discard unreacted gas. • Design control system to detect excess gases in exhaust and shut down gas flow. • Provide control system to detect extreme temperature variations and activate backup cooling system.

Location	Hazard Consequence	Possible Causes	Action to be taken	Remedial measures to prevent recurrence of such incident
			• Ensure search and rescue and causalities receive attention. • Administer first aid to the victim. • Make arrangement to send injured person/s to Hospital and inform victim's family. • If off site emergency situation occur –Inform to following agencies. Request for Mutual aiders, local authorities like – DISH office, Collectorate office, Disaster management cell, Police, fire brigade, nearby hospital, local GPCB office.	• Diver flow to temporary storage tank • Provide relief valve on reactor with outlet to a temporary storage tank • SOP for handling will be displayed in local language for safe operating procedure. • Provide training to employees in the area.

H. Fire fighting System

Adequate fire fighting system will be provided for the proposed project.

- Sufficient numbers of Fire extinguishers will be installed in all plants and storage area and details of proposed fire control equipments are given in **Table 7.11.**

Table 7.11: Details of fire extinguishers

Sr. No.	Type	Capacity	Quantity, Nos.
1	CO_2	5 kg	10
2	ABC	8 kg	20
3	Dry Chemical Powder	3 kg	5
3	Mechanical Foam	1 kg	3

- 6 nos. of fire hydrants will be installed for proposed project.
- Separate underground fire water tank of 25 KL will be provided with main pump, jockey pump and DG pump. Details of Fire water pump is given in **Table 7.12.**

Table 7.12: Details of fire-water pump

Sr. No.	Item	Location	Capacity	
			HP	Flow
1	Main Pump	Water Tank	7.5	90 Lit/min
2	Jockey Pump	Water Tank	5.0	60 Lit/min
3	DG Pump	Water Tank	7.5	90 Lit/min

- Adequate numbers of smoke detector, flame detector, explosive gas detector and heat detector with alarm will be provided. Automatic sprinkling system will be installed at various suitable locations. Details for the same is given in following **Table 7.13.**

Table 7.13: Details of provision for fire-fighting system.

Sr. No.	Particular	Location
1.	Smoke Detector	Process Plant
		Hazardous chemical storage area
		Admin building, canteen
2.	Flame Detector	Hazardous chemical storage area
3.	Explosive Gas	Process Plant

Sr. No.	Particular	Location
	Detector	Hazardous chemical storage area
4.	Heat Detector	Hazardous chemical storage area
5.	Automatic Sprinkling	Admin building, canteen, hazardous chemical storage area, utility

- D.G. Sets of 650 kVA is provided for emergency power supply.
- Mock drill and training will be scheduled and conducted once in six months.
- Respiratory PPEs like self contanined breathing appartus, bubble hood point with air compressor, online respirator and non-respiratory PPEs like PVC apron, gum boot, goggles, rubber hand gloves will be provided in case of fire.
- Nearest fire station is located at a distance of 11 km from project site. Also, nearby industrial units located within 1 km distance will provide mutual aid for firefighting.

7.8. ONSITE EMERGENCY PLAN AND DISASTER MANAGEMENT PLAN

As emergency is said to have risen when operators in the plant are not able to cope with a potential hazardous situation i.e. loss of an incident causes the plant to go beyond its normal operating conditions, thus creating danger. When such an emergency evolves, chain of events which affect the normal working within the factory area and / or which may cause injuries, loss of life, substantial damage to property and environment both inside and around the factory takes place and a DISASTER is said to have occurred.

Various steps involved in Disaster Management Plan can be summarized as follows:

1. Minimize risk occurrence (Prevention)
2. Rapid Control (Emergency Response)
3. Effectively rehabitate damaged areas (Restoration)

Disaster Management Plan is evolved by careful scrutiny and interlinking of

a. Types and causes of disaster
b. Technical know-how
c. Resource availability

Types of Disaster:

a. Due to Fire and Explosion
b. Due to Vapour Cloud

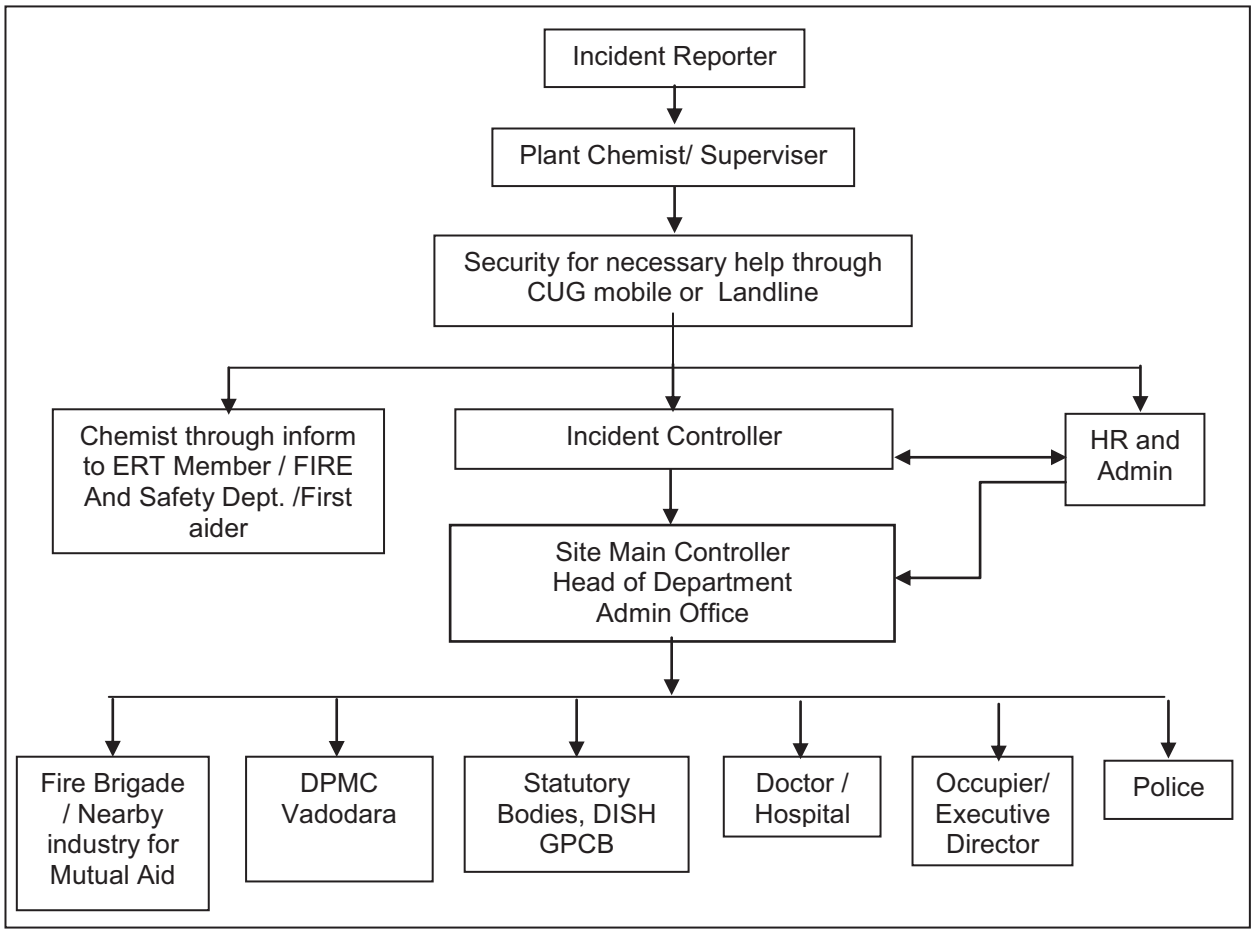
c. Due to Toxic Gas Release from:
    i. Within the Unit
    ii. External Sources
d. Hurricane, Flood, Cyclone and other Natural Calamities

This plan is developed to make best possible use of resources to:

- Reduce possibilities of accident.
- Contain the incident and control it with minimum damage.
- Safeguard others
- Rescue the victims and treat them suitable.
- Identify the persons affected/ dead.
- Inform relatives of the causalities.
- Provide authorative information to the news media.
- Preserve relevant records and equipment needed as evidence incase of any inquiry.
- Rehabilitate the affected areas.

The primary purpose of the on-site emergency plan is to control and contain the incident and so as to prevent from spreading to nearby plant. It is not possible to cover every eventuality in the plant and successful handling of emergency will depend on appropriate action and decisions being taken on the spot. Following three staged activities suggested as they are co-related and provide better points for emergency preparedness, emergency action and subsequent follow up. Hierarchy of the emergency team is given below in **Figure 7.6**, which will be implemented for proposed project.

Figure 7.6: Hierarchy of the emergency team



7.8.1. Pre-emergency activity

For the systematic management of on-site emergency and to make emergency control measures more effective, certain pre-emergency activities and planning plays essential role. Following aspects are followed and implemented as a part of pre-emergency plan;

A. Training of workers

Training is most important for the effectiveness of an emergency plan. Before implementing an emergency action plan, a sufficient number of workers are trained for managing emergency. Details of various training to be given to workers are given below:

- Induction and safety training to all workers before engaging for work
- Safety and fire-fighting training to all employees as well as for contractors' employees periodically
- Training on using personnel protective equipment to all workers
- Training by calling external experts for imparting training on critical subjects

- Deputing selective employees of EHS department for specialized training being organized by different professional institution.

B. Internal Safety Survey

- To identify various hazards in plant area.
- To check protective equipment of workability.
- To check various Safety installations.
- To check fire fighting equipments, water shower etc.
- To suggest extra modification required.

Check–list will be prepared to conduct internal safety survey effectively and smoothly which will cover all the project activities and entire plant area. A template of checklist is attached as **Annexure 15.** It will be ensured that the check-list is used by HSE department as a part of SOP to conduct internal safety survey and will be updated from time to time for the effective implementation.

C. Third Party Survey

- To identify various hazards inside the factory.
- To conduct survey on available Safety equipments.
- To check built in safety system for its efficiency.
- To suggest modification/new additions in the system.

Different types of plant assessment and audits will be carried out by the unit as mentioned in **Section 7.2.4** to complete the above tasks.

D. Non-Destructive Testing (NDT)

- To prepare a list of equipments/pipe lines for Non-Destructive testing.
- To prepare a plan for replacements/repairs as per testing reports.
- To maintain plant wise record to compare with the last period.

E. Safety valve Testing

- To prepare a list in the plant.
- To prepare a periodic schedule for their testing & maintaining record.
- To prepare a plan for replacements/repairs.

F. Fire Fighting System Testing

- To prepare a list of fire hydrants, Fire Fighting appliances, Fire water pumps and other available appliances and maintain the record.

- To plan for testing schedule.
- To replace defective equipments/accessories.
- To check fire water pumps capacity.
- To check all fire fighting equipments/appliances under fire services for operability.

G. Mock drills

- Conduct internal mock drill for training the workers.
- Conduct periodic drills, once in six months, to check the performance of workers and equipments.
- To know the draw backs/defects of the system and its corrective actions.

H. Personal Protective Equipments (PPE)

- To arrange for sufficient quantity of personal protective equipments.
- To train workers to use each PPE.
- To maintain them in good condition.

I. Communication

- To maintain internal/external communication system in good working condition.
- To modify the siren sound for emergency.
- To install wind-socks to indicate wind direction.

J. Emergency Lights

- To check and maintain the emergency lights in control room and selected areas.
- To keep sufficient number of torches in supervisor's cabin/plant and in each department.
- Diesel operated power generator set will be maintained in working conditions as a stand-by in case of failure of normal power supply.

K. Emergency Control Room

- To identify the place of emergency control room.
- To identify the alternative emergency control room.
- To keep sufficient quantity of PPE in control rooms.
- To provide proper telephone system in emergency control room.
- To provide plan of the factory showing hazardous points and emergency control point in emergency control room.

L. Assembly Points

- To identify the location for assembling the plant emergency staff and co-ordinate in case of emergency
- To utilize the services of others to fix assembly points for non-essential workers and to assemble in case of emergency.
- Appropriate sign board showing fire exit, assembly points will be provided in the entire plant.

M. Liaison with State Authorities

- To keep liaison with police, fire brigade, Factory Inspector, Collector, local hospital and keep them informed.
- To inform them about the requirement in advance.
- To keep them informed about mock drills.

N. Safety measures for General Public

Following measures will be taken to ensure safety of nearby villagers:

- Nearby villagers will be trained in case of an emergency
- Unit will prepare and distribute the booklet in local language giving detail properties of hazardous chemicals and actions to be taken by them in case of any leakage.
- Emergency sirens will be installed at security cabin near the main gate of plant to inform the public about any type of emergency. All the sirens will be tested periodically.
- Periodical seminar and work shop in collaboration with industrial association or with coordination with nearby industry will be arranged at nearest village to make aware villagers for safety measures and emergency preparedness for accident.

7.8.2. Emergency Time Activities

Under these activities, the staff in the plant at various levels with pre-assigned duties is expected to work in a coordinated manner to meet emergency situation, remove the emergency conditions and bring the plant to normal with the help of resources available within and out side the plant. Availability and correct use of different means of communication and control is an important time activity. Sequence of action in case of various types of emergencies (Fire and Leakage of chemicals):

- Any person noticing fire or explosion or leakage of chemicals from pipeline or other equipment, should attract attention of nearby personnel by using siren available within premises.
- The area is checked clear of people and organize emergency shut down of the plant/ equipment.
- The total quantity of chemical leaked is ascertained and discharge of Air pollutants through stack is stopped.
- Other persons in the area will help the injured persons to go out of the place i.e. at open area and immediately arrange for first aid.
- Simultaneously by Telephone he will contact the emergency control centre.
- He will inform the Incident controllers and key personnel depending upon the nature of emergency.
- He will also guide the out-side agency emergency aid services till the Incident Controller/ Site Main Controller reaches to the site of Incident.
- As soon as Incident controller/Site Main Controller reaches to the site of incident he will take charge of the situation and guide/advice in tackling the emergency.
- It is necessary to know that every one on the site should be accounted for and that the relatives of causalities have been informed. As plant is small there is no problem of accounting the personnel. It is necessary to have an up dated list of the names of people at site on Holidays and weekly off days.
- If the situation is not likely to be controlled by the available sources incident controller/Site Main controller will assess the situation and declare the emergency as “OFF SITE EMERGENCY”.
- The incident controller/Site Main Controller will continue to do the available resources to control and contain the emergency till the outside authorities and aid services reaches to the incident site.
- After District Authority reaches to the site, he will extend all the necessary help, assistance and give required information/data as when required to control & contain the emergency.

7.8.3. Post – Emergency Activities

A post-emergency base activity of steps taken after the emergency is over so as to establish the reasons of the emergency and preventive measures to be taken.

The main steps involve:

- Collection of records
- Conducting inquiries and preventive measures.
- Making Insurance claims
- Inquiry reports and suggestions Implementations

7.9 OFF SITE EMERGENCY PLAN

The Off-site emergency plan will be made based on events, which could affect people and Environment out side the premises. The off-site plan is largely a matter of ensuring the co-ordination of proposed services and their readiness as far as possible, for the specific hazards and problems, which may arise in as incident. Briefly two main purposes of the plan are as under:

- To provide the local district authorities, police, fire brigade, doctors etc. the basic information of risk and environmental impact assessment and to appraise them of the consequences and the protection / prevention measures and control plans and to seek their help to communicate with the public in case of major emergency.
- To assist the district authorities for preparing the off-site emergency plan for the district or particular area. We have made our key personnel and other fully aware about this aspect. The function of the off-site plans is as under:

Structure of the off-site emergency plan includes the following: -

- Organizational set up-Incident controller /Site main controller, Key personnel, etc
- Communication facilities - List of important telephones
- Specialized emergency equipment - Fire fighting equipment
- Specialized Knowledge - Trained people
- Voluntary Organization - Details of organization
- Chemical information - MSDS of hazardous substances
- Meteorological information - Weather condition, Wind velocity etc
- Humanitarian arrangement - Transport, First aid, Ambulance

Role of the factory management

The on site and off-site plans are come together so that the emergency services are call upon at the appropriate time and are provided with accurate information and a correct assessment of situation.

Role of local authority

Generally, the duty to prepare the off-site plan lies with the local authority. They may have appointed an emergency planning officer (EPO) to prepare whole range of different emergency within the local authority area.

Role of fire authority

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

Role of police

The overall control of an emergency is normally assumed by the police with a senior officer designated as emergency coordinating officer. Formal duties of the police during emergency include protection of life and property and controlling traffic movements.

Role of health authorities

Health authorities, including doctors, surgeons, hospitals, ambulances etc. have a vital role to play following a major accident and they should form an integral part of the emergency plan. Major off-site incidents are likely to require medical equipments and facilities in addition to those available locally.

Role of the "Mutual aid" agencies

Some types of mutual aids are available from the surrounding factories, as per need, as a part of the on site and off-site emergency plan.

Role of the factory inspectorate

In the event of an accident, the factory inspector will assist the District Emergency Authority for information and help in getting mutual aid from surrounding factories.

Unit will maintain the records of details of emergency occur, corrective preventive measures to be taken. Unit will display the details like list of assembly points, name of the persons involve in the safety team like site controller, incident controller etc.