CHAPTER – 7

ADDITIONAL STUDIES

7.1 PUBLIC CONSULTATION/HEARING

Public consultation was applicable for the proposed project as per Para 7(i) III (b) of EIA Notification, 14th September, 2006 as the project is located outside the notified industrial area. Public hearing was conducted on 13/10/2017, 11:45 hrs at Chhtral GIDC Industrial Association hall, 1st floor, GIDC shopping center, GIDC Chhtral, Kalol, Gandhinagar. Total 42 persons were attended public hearing and from them 4 persons have expressed their views. Major points were related to Product, employment generation, CSR and pollution. All persons welcome this project during public hearing. Detailed minutes of meeting is given as separate chapter in this EIA report.

7.2 RISK ASSESSMENT

7.2.1 INTRODUCTION

Industrial activities including production, storage, handling, transportation and operational practices presents levels of hazards to workforce, population and environment at large due to accidents, spills, leaks etc. These accidents results in personal and financial loss. The assessment of the threat posed, its control and prevention through good design, management and operational controls is of primal importance.

Events like the Bhopal tragedy have emphasized the need to address both on-site and off-site safety. It is against this background that the various Section and Rules under the Environment Protection Act, 1986, the Factories Act, 1948 and other Acts specify the requirements for a safe and reliable working of an industry. These require carrying out various studies and analysis to assess and mitigate hazards prevalent in the factory in line with the goal of safe and reliable working. These are more commonly known as "Risk Assessment Studies". Risk assessment refers to the technical, scientific assessment of the nature and magnitude of risk and uses a factual base to define the health effects of exposure of individuals or populations or ecological receptors to hazardous contaminants and situations.

The QRA report signifies that **trained** & skilled employees and supporting services can achieve improved safety & productivity levels. Together they can also achieve low maintenance cost, optimized use of Raw materials and negligible rejections/ wastes.

The project is advised to equip with a well planned Disaster **Management Plan** as an essential **Mitigation Control Measure.**

Substantial information is given in the chapter PREVENTIVE MEASURES of QRA, for choosing Plant and Equipment which will ensure **PRODUCT SAFETY**.

A good **Legal & Regulatory Compliance Register** shall be planned and be in place. All the Rules and Regulations of the land shall be strictly followed to achieve a hindrance free operation of the plant from the statutory point of view.

A good **safety Manual** shall be planned and be in place. All the requirements of Safety & Health of the operating plant shall be an essential part of the manual. The Safety manual will serve as a good communication medium to the employees of the plant. The systems to be complied by the operating level employees as part of their responsibilities and the operational requirements of the system will be readily available in the manual.

Risk Assessment study includes predictions of the WORST-CASE SCENARIO (catastrophic failure) and MAXIMUM CREDIBLE ACCIDENT SCENARIO along with damage distances and preparedness plan for effectively combating such situations. The report also discusses and demarcates the vulnerable zones and a detailed fire control plan for flammable substances.

No plan is complete or total of its requirements and its scope of improvement is a continuous process. Hence, the RISK ASSESSMENT REPORT is to be reviewed and updated as and when:

- any expansion, alteration, or extension of the plant is planned / implemented
- an incident has occurred and been dealt with, based on feedback gathered on any shortcomings in the handling of the situation
- any feedback is received from the users of the report

Risk Assessment is therefore 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:

- Mitigation or reduction of the risk of an incident.
- 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.
- Confidence building in employees by improving competency.

Preparedness and prompt response to deal with any accident

7.2.2 DETAILS OF MANUFACTURING PROCESS

Detail of manufacturing operation is given in section 2.7.4 of chapter-2.

7.2.3 STORAGE AND HANDLING

The details of storage and handling of hazardous chemicals are listed in table-7.1. This list also contains the hazardous characteristics of each Raw material. Permission for the storage of Methanol, Toluene and Acetone, etc. will be obtained from PESO (Petroleum & Explosives Safety Organization), Nagpur, if applicable.

TABLE-7.1 HAZARDOUS CHARACTERISTICS & STORAGE OF RAW MATERIALS

No.	Name of the Hazardous Substance	CAS No.	State	No. of tank /drums /bags/carboys	Quantity Stored	Place of its Storage	Possible type of Hazards
1.	2,6-Dichlorophenol	87-65-0	Solid	93 nos. Drum	23.25 MT	Solid RM Store	Toxic
2.	Potassium Carbonate	584-08-7	Solid	417 nos. Bag	10.425 MT	Solid RM Store	Toxic
3.	Toluene	108-88-3	Liquid	1 nos 16 KL Tank	16 KM	Tank Farm Area	Toxic & Fire
4.	MMCA	96-34-4	Liquid	65 nos. Drum	16.25 KL	Liquid RM Store	Fire & Toxic
5.	Aniline Oil	62-53-3	Liquid	1 nos. 20 KL Tank	20 KL	Tank Farm Area	Fire & Toxic
6.	Sodium methoxide	124-41-4	Liquid	1 nos 20 KL Tank	20 KL	Tank Farm Area	Toxic, Fire & Reactive
7.	Chloro Acetyle Chloride	79-04-9	Liquid	84 nos. Drum	21 KL	Liquid RM Store	Toxic
8.	Alluminium Chloride	7446-70-0	Solid	403 nos. Bag	10.075 MT	Solid RM Store	Toxic
9.	Caustic Soda	1310-73-2	Solid	105 nos. Bag	5.25 MT	Solid RM Store	Toxic
10.	Carbon	7440-44-0	Solid	30 nos. Bag	0.9 MT	Solid RM Store	Fire
11.	Diclofence Sodium	15307-79-6	Solid	22 nos. Bag	0.55 MT	Solid RM Store	Toxic
12.	Acetic acid	64-19-7	Liquid	1 nos 20 KL Tank	20 KL	Tank Farm Area	Toxic
13.	Diethyle Amine	109-89-7	Liquid	3 nos. Drum	0.69 KL	Liquid RM Store	Fire & Toxic
14.	Hydrochloric Acid	7647-01-0	Liquid	18 nos. Drum	3.6 KL	Liquid RM Store	Toxic
15.	4 Chloro-2 Aminophenol	95-85-2	Solid	55 nos. Bag	1.375 MT	Solid RM Store	Toxic
16.	Technical Grade Urea	57-13-6	Solid	33 nos. Bag	1.65 MT	Solid RM Store	Toxic, Fire
17.	Hydro Sulphide of Soda	7775-14-6	Solid	1 nos. Bag	50 KG	Solid RM Store	Fire, Toxic
18.	Caustic Lye	1310-73-2	Liquid	1 nos 10 KL Tank	10 KL	Tank Farm Area	Toxic
19.	Methenol	67-56-1	Liquid	2 no., 20 KL	40 KL	Tank Farm Area	Fire, Toxic
20.	4-Chloro-2- Nitro Aniline	89-63-4	Solid	163 nos. Bag	4.075 MT	Solid RM Store	Toxic
21.	Thiophenol	108-98-5	Liquid	18 nos. Drum	3.6 KL	Liquid RM Store	Toxic, Fire
22.	Forous Chloride	13478-10-9	Solid	15 nos. Bag	0.375 MT	Solid RM Store	Toxic
23.	Hydrazine Hydride	7803-57-8	Liquid	24 nos. Drum	4.8 KL	Liquid RM Store	Toxic, Fire

No.	Name of the Hazardous Substance	CAS No.	State	No. of tank /drums /bags/carboys	Quantity Stored	Place of its Storage	Possible type of Hazards
24.	Hydrogen Cynamide	420-04-2	Solid	17 nos. Drum	3.74 MT	Solid RM Store	Toxic, Fire
25.	Methyl Formate	107-31-3	Liquid	10 nos. Drum	2 KL	Liquid RM Store	Fire, Toxic
26.	Fenbendazole	43210-67-9	Solid	49 nos. Drum	1.225 MT	Solid RM Store	Fire, Toxic
27.	Dimethyle Sulxoxide	67-68-5	Liquid	3 nos. Drum	0.63 KL	Liquid RM Store	Fire, Toxic
28.	Hydrogen Peroxide	7722-84-1	Liquid	27 Nos. Carboys	0.81 KL	Liquid RM Store	Toxic
29.	Acetone	67-64-1	Liquid	1 no., 20 KL	20 KL	Tank Farm Area	Fire, Toxic
30.	N(4-5) Dicloro-2 Nitro Phenyle Acetamide	5462-30-6	Solid	12 nos. Drum	2.4 MT	Solid RM Store	Toxic
31.	DMF	68-12-2	Liquid	4 nos. Drum	0.8 KL	Liquid RM Store	Fire, Toxic
32.	2:3 Dichloro Phenol	576-24-9	Solid	2 nos. Drum	0.5 MT	Solid RM Store	Toxic, Fire
33.	Nitrogen Gas	576-24-9	Gas	2 nos. Cylinder	0.1 kg	RM Store	Toxic
34.	Hydrogen Gas	1333-74-0	Gas	3 nos. Cylinder	0.15 kg	RM Store	Fire
35.	Rancynickel	-	Solid	9 nos. Drum	45 KG	Solid RM Store	Fire, Toxic
36.	Hyflow	68855-54-9	Solid	1 nos. Bag	50 KG	Solid RM Store	-
37.	Potassium Hydroxide	1310-58-3	Solid	12 nos. Bag	0.6 MT	Solid RM Store	Toxic
38.	Calcium Disulphide	20548-54-3	Solid	6 nos. Bag	0.3 MT	Solid RM Store	Toxic
39.	Dimethyle Sulphate	77-78-1	Liquid	3 nos. Drum	0.75 KL	Liquid RM Store	Toxic, Fire
40.	IPA	67-63-0	Liquid	1 nos. Drum	0.2 KL	Liquid RM Store	Fire, Toxic
41.	2 Nitro-5(Phenylethio Aniline)	43156-47-44	Solid	2 nos. Drum	0.4 MT	Solid RM Store	Toxic
42.	Methoxy Acetyl Chloride	38870-89-2	Liquid	6 nos. Drum	0.6 KL	Liquid RM Store	Fire, Toxic
43.	Methylene Dichloride	75-09-2	Liquid	19 nos. Drum	3.8 KL	Liquid RM Store	Toxic, Fire
44.	Xylene	1330-20-7	Liquid	10 nos. Drum	2 KL	Liquid RM Store	Fire, Toxic
45.	Thiour	62-56-6	Solid	1 nos. Drum	0.1 MT	Solid RM Store	Toxic, Fire
46.	Decyl bromide	112-29-8	Liquid	6 nos. Drum	0.3 KL	Liquid RM Store	
47.	Methychloro Formate	79-22-1	Liquid	2 nos. Drum	0.4 KL	Liquid RM Store	Fire, Toxic
48.	1-1 Cyclohexane Diacetic Acid	99189-60-3	Liquid	2 nos. Drum	0.4 KL	Liquid RM Store	Toxic, Fire
49.	Bromine	7726-95-6	Liquid	3 nos. Drum	0.3 KL	Liquid RM Store	Toxic
50.	Caustic Flakes	1310-73-2	Solid	79 nos. Bag	3.95 MT	Solid RM Store	Toxic
51.	Trietylamine	121-44-8	Liquid	1 nos. Drum	0.2 KL	Liquid RM Store	Fire, Toxic
52.	1,3 Cyclohexadione	504-02-9	Solid	10 nos. Bag	0.5 MT	Solid RM Store	Toxic
53.	Phenyl Hydrazine	100-63-0	Liquid	3 nos. Drum	0.6 KL	Liquid RM Store	Toxic, Fire
54.	Zinc Chloride	7646-85-7	Solid	4 nos. Bag	0.2 MT	Solid RM Store	Toxic
55.	Phosphorous Trichloride	02-12-7719	Liquid	3 nos. Drum	0.6 KL	Liquid RM Store	Toxic
56.	Closantel Amine	57808-65-8	Solid	61 nos. Bag	1.525 MT	Solid RM Store	Toxic, Fire
57.	Diiodosalicycli Acid	133-91-5	Solid	85 nos. Drum	2.125 MT	Solid RM Store	Toxic, Fire
58.	Sodium Metal	7440-23-5	Solid	7 nos. Drum	1.05 MT	Solid RM Store	Toxic, Fire
59.	Caustic Potash	1310-58-3	Solid	15 nos. Bag	0.75 MT	Solid RM Store	Toxic
60.	Para Formaldehyde	30525-89-4	Solid	15 nos. Drum	0.375 MT	Solid RM Store	Toxic, Fire
61.	2-Methylimidazole	693-98-1	Solid	2 nos. Drum	0.4 MT	Solid RM Store	Toxic
62.	Liq. Ammonia	1336-21-6	Liquid	4 nos. Bottle	0.2 KL	Liquid RM Store	Toxic

The hazardous chemicals having high risks due to storage quantity, high Flammability and acute Toxicity are analyzed labeled and separately listed in table-7.2. These Hazardous chemicals have the potential to cause the maximum damage and create a vulnerability zone in and around the company operations. They

are selected and highlighted for better visibility. MSDS of chemicals to be handled is enclosed as annexure-XVI.

TABLE-7.2 LIST OF MAJOR HAZARDOUS CHEMICALS INVENTRY & PROPERTIES

No	Source	TPQ / MT	Cas No.	Nature of Hazards
1.	Methanol	20 KL	67-56-1	Highly flammable. Soluble in water. Flash Point: 52°F , B.P: 148.3°F Toxic use PPE while handling.. ERPG1: 200 ppm., ERPG2: 1000 ppm., ERPG3: 5000 ppm., IDLH: 6000 ppm. Regulated chemical. **FLAMMABLE**
2.	Aniline Oil	20 KL	62-53-3	Aniline oil is toxic and combustible in nature. Colorless liquid having Aromatic (Amine like) ordor and Soluble in oil. B.P.: 184.1 ^{o}C, Odor Threshold: 2.4 ppm, TWA: 7.6 (mg/m3) from ACGIH **TOXIC**
3.	Toluene	16 KL	108-88-3	Flammable liquid, insoluble in water. Flash Points: 4.4°C (40°F). Flammable Limits: LOWER: 1.1% UPPER: 7.1% Boiling Point: 110.6°C (231.1°F), Odor Threshold: 1.6 ppm, AEGL-1 (60 min): 67 ppm AEGL-2 (60 min): 560 ppm AEGL-3 (60 min): 3700 ppm, IDLH: 500 ppm **FLAMMABLE**
4.	Acetone	20 KL	67-64-1	Flammable liquid, Auto-Ignition Temperature: 465°C (869°F), Flash Points: -20°C (-4°F), Flammable Limits: LOWER: 2.6% UPPER: 12.8%, Boiling Point: 56.2°C (133.2°F), Odor Threshold: 62 ppm, AEGL-1 (60 min): 200 ppm AEGL-2 (60 min): 3200 ppm AEGL-3 (60 min): 5700 ppm **FLAMMABLE**

Hazardous scenarios for the purpose of RISK ANALYSIS which are most likely to happen during **a**. Storage conditions, **b**. during the manufacturing processes & handling are planned and listed in table-7.3. These hazardous chemicals are assessed with the scenarios, for deriving and identifying the vulnerable zones.

TABLE-7.3 RISK ANALYSIS

No.	Source Scenarios	Failure Mechanism	RISK Consequence	Probability[1]	Severity[2]	Risk Rating[3] (max = 25)
1.	Acid spillage from drums	Spillage during handling	Puddle formation - Toxic vapour	2	2	4
2.	Leakage during transfer of Hydrogen gas from the cylinder	Coupling fit not fully established	Leakage from the coupling joint. Fire or explosion.	2	2	4
3.	Unloading pipe coupling Loose in Methanol unloading	Spillage during handling	Puddle formation in unloading area – flammable vapor	3	2	6
4.	Release of Toluene from tank	Leakage from tank	Puddle formation – Pool fire	3	2	6
5.	Release of Acetone from tank	Leakage from tank	Puddle formation – Pool fire	3	2	6
6.	Release of Aniline Oil from tank	Leakage from tank	Puddle formation - Toxic vapour	2	2	4

LEGEND

[1]PROBABILITY:
1 – HIGHLY UNLIKELY
2 – UNLIKELY
3 – SOMEWHAT LIKELY
4 – LIKELY
5 – VERY LIKELY

[2]SEVERITY:
1 – EXTREMELY MILD
2 – MILD
3 – MODERATE
4 – SEVERE
5 – MOST SEVERE

[3]RISK RATING:
PROBABILITY x SEVERITY

- There are few toxic severity scenario risks, on the operational and storage of chemicals.
- The worst-case scenario is also well within the reach of fire protection/mitigation measures, planned for installation.
- Fire protection/ control / mitigation measures are incorporated.

All the raw material will be stored within premises in Drums, Carboys, bags and cylinder except Methanol, Aniline Oil, Toluene and Acetone which will be stored in tank. Considering above rating M/s. Orbit Pharma Laboratories can be categorized as a medium hazard industry who can manage their risks through invoking On site emergency plan and actively participating in Off-site emergency plan.

During the navigation of above sequence of activities, it is drawn to the understanding that the storage & handling are to be closely associated with the **Threshold Planned quantities (TPQ)** of hazardous chemicals. This will ensure, the associated preventive / mitigating facilities planned and installed for managing the projected risk scenarios will be serving the **desired objectives**.

The in-house regulatory measures for implanting safety shall be appropriate to the risks, and to be handled by trained persons for the purpose. SOPs are to be documented and identified people are to be trained. Regular mock drills shall be planned and executed, as a preparation/ precaution for dealing with emergency operations.

7.2.3.1 ANTIDOTES OF MAJOR PRDUCTS/RAW MATERIALS

Antidotes of major products/raw materials are shown in following table-7.4.

TABLE-7.4 ANTIDOTES OF CHEMICALS

No.	Name of Chemical	Antidote
1.	Bromine	Wash the skin plenty of water. Apply sodium bi carbonate and again wash the skin plenty of water. If gone in eye, wash plenty of water through spray up to 15 minutes. Put two or three drops of pontocane (0.5 solution) or benoxinate (novesine) 0.4%. if problem in respiration, give milk, butter milk or lemon juice or make a small cotton ball and drench with ethanol or ether solution drops and put it near victim's nose for smell. Apply pure oxygen. If go in the intestine give milk. Milk butter and milk of magnesia. Dexona, Avil
2.	Phenol and derivatives	Take the patient in clean air, activated charcoal and 240ml milk, if the eye or skin affected than wash with plenty of water, clean the skin with poly ethylene glycol.
3.	Acetic Acid	Milk of magnesia
4.	Aniline Oil	Methylene Blue
5.	Di Methyl Amine	Methylene Blue
6.	Hydrochloric Acid	Drink Larqe Quality of water , Milk of Maqnesia
7.	Iso Propyl Alcohol	Novasine Eye Drops
8.	Acetic Acid	Milk of maqnesia
9.	Methanol	Oxygen or Baking Soda in a glass of water or Ethanol, Novasine Eye Drops
10.	Monochloro Acetic Acid	Silver Sulphadiazine
11.	Xylene, Toluene.	Wash the skin area plenty of water if affected. Fresh air or Oxygen, 0.1 mg/kg slowly through injection rest in bed. Don't apply Epinefrin, Ifridin etc. Don't apply milk, vegetable oil or alcohol.

7.2.3.2 ACTION PLAN FOR SAFETY PRECAUTIONS FOR THE STORAGE OF MATERIALS

Storage in HDPE drums / Carboys or bags:

- Separately stored with proper enclosures and marked, within premises in closed shed
- Proper ventilation will be provided
- Sufficient fire extinguishers and PPE will be provided
- Flame proof fittings will be provided

- Smoking will be prohibited
- Bags/drums/ carboys will be stored on pallet with the suitable trap

Hazardous chemical handling, Storage, transportation and unloading:

- Hazardous material will be stored away from the plant and safe distance shall be maintained
- Dyke wall shall be provided to all above ground storage tank
- Proper selection of MOC for tank
- Fire hydrant system shall be installed
- Safety shower and eye washer shall be installed near storage area
- Sprinkler system shall be installed at flammable material storage area
- Flame proof light fitting shall be provided at flammable storage area
- Earthing/bonding shall be provided for static charges
- Only authorized person shall be permitted in storage tank area
- Methanol, Toluene, Acetone, Aniline Oil, etc shall be transported through road tanker
- Procedure shall be prepared for loading and unloading of Methanol received through road tanker
- Flame proof electric motor shall be used during loading/unloading
- Personal Protective Equipments (PPEs) shall be provided
- Term Card shall be provided to all transporters and shall be trained for transportation emergency of hazardous chemicals

7.2.4 HAZARD AND ITS CONTROL MEASURES

Details of possible hazards or emergency at the site along with safety measures are given in following table.

TABLE-7.5 HAZARDS AND ITS CONTROL MEASURE

Sr. No.	Name of the possible hazard or emergency	Its souses & reason	Its effect on person, property, & environment	Place of its effect	Control measure provided
1.	**BOILER** 1) Burning physical injury explosion	Over pressure in the boiler if safety valve not working. Water level indicator not working. Low water level indicator fail. High temp. system fail.	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 farm, ID fan. Periodical checking & inspection maintenance done. Yearly inspection done by boiler inspector
2.	**ELECRICITY** (1) Burning (2) Fire (3) Shock	Loose contacts, weak earthing short circuit improper insulation	Burning, shock, Death	Surrounding the accident area	Proper Earthing, Periodical Checking of joints, proper insulations of Equipment, 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 explosion	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.
4.	**PIPELINE LEAKAGES** Spillages etc. (1) Corrosion (2) Toxic gas release	Leaking of pipe line 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.	**Fire**	Transformer Transfer oil short circuit etc.	- Electrical power failure - Production hindrance	Transformer near power control centre	- Fire Fighting Equipment's - Graved bed for oil spillage or soaking

Sr. No.	Name of the possible hazard or emergency	Its souses & reason	Its effect on person, property, & environment	Place of its effect	Control measure provided
			- Loss of transformer		- isolated fenced area - Lightening arrestor nearby - DG set for emergency power supply
6.	**Fire & Toxic chemical spillage**	- Natural Disaster i.e. Earthquakes, storm, Lighterning - Sabotage Fire in neighboring - industries	- Production hindrance - Trapping under debris, death Chemical burn Toxic chemical spillage	Whole factory & population nearby	- Hydrant system - Sprinkler system in storage area - Lightening arrestor at buildings - First aid & ambulance available - Smoking prohibited inside the factory - Security at all the time guarding important locations
7.	**Fire & smoke**	Solvent fire in storage tank	Burns Storage tank catching fire Production hindrance	Whole factory & population nearby	- Hydrant system with water monitors - Adequate earthing Tanker unloading permit - Unauthorized person not allowed to enter - Breathing Apparatus for rescue operations - Alarm system for indicating unusual incidence

7.2.5 RISK IDENTIFICATION AND ANALYSIS

Identification of risks is done qualitatively and quantitatively through the selection of hazardous substances and by studying the manufacturing process, to arrive at possible failures and their inherent causes. Probability of risk occurrence is also ascertained in order to determine the MAXIMUM CREDIBLE ACCIDENT SCENARIO and the WORST CASE SCENARIO.

Hazardous substances have been identified as follows considering the applicable criteria laid down under the Chemical Accident (Emergency Planning, Preparedness and Response) Rules, 1996, as well as other relevant guidelines:

The risks are then analyzed quantitatively in terms of probability, and severity. The risks have also been rated according to the matrix R = Probability x Severity.

7.2.5.1 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.

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.

7.2.5.2 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-7.6 herein:

TABLE-7.6 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 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.

TABLE-7.7 EFFECTS DUE TO INCIDENT RADIATION INTENSITY

Incident Radiation in 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:

TABLE-7.8 DAMAGE DUE TO OVERPRESSURES

Peak Overpressure	Damage Type
0.83 bar	Total Destruction
0.30 bar	Heavy Damage

Peak Overpressure	Damage Type
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.) have 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.

7.2.5.2.1 SOFTWARE USED FOR CALCULATIONS

ALOHA (Areal Locations of Hazardous Atmospheres):

Aloha is a computer program designed especially for use by people responding to chemical accidents, as well as for emergency planning and training. ALOHA can predict the rates at which chemical vapors may escape into the atmosphere from broken gas pipes, leaking tanks, and evaporating puddles. It can then predict how a hazardous gas cloud might disperse in the atmosphere after an accidental chemical release.

ALOHA is an air dispersion model, which you can use as a tool for predicting the movement and dispersion of gases. It predicts pollutant concentrations downwind from the source of a spill, taking into consideration the physical characteristics of the spilled material. ALOHA also accounts for some of the physical characteristics of the release site, weather conditions, and the circumstances of the release. Like many computer programs, it can solve problems rapidly and provide results in a graphic, easy-to-use format. This can be helpful during an emergency response or planning for such a response.

ALOHA provides output as amount of chemical discharged from the source as well as its concentration in air it takes in to account different levels of concentrations for a specified chemical. Different concentration levels are given below:

ERPG 1: is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined, objectionable odor.

ERPG 2: is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action.

ERPG 3: is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects.

IDLH: The Immediately Dangerous to Life or Health (IDLH) level. A chemical's IDLH is an estimate of the maximum concentration in the air to which a healthy worker could be exposed without suffering permanent or escape-impairing health effects.

7.2.5.3 VULNERABILITY ANALYSIS

A vulnerability analysis is carried out on the MAXIMUM CREDIBLE ACCIDENT SCENARIO. The analysis is carried out using the help of sophisticated computer software which provides the zone of influence as well as the geographical risk contours.

The calculations are complex in nature, and various parameters are defined to assist the software in simulating the risk contours. The parameters include details such as the size of the leakages / holes, quantity of materials released, duration of the release, weather and geographical conditions.

The simulations are generated under standard operating conditions. Data given in the reports and manuals are taken as correct information. The weather conditions are taken as per table-7.9 for all simulations.

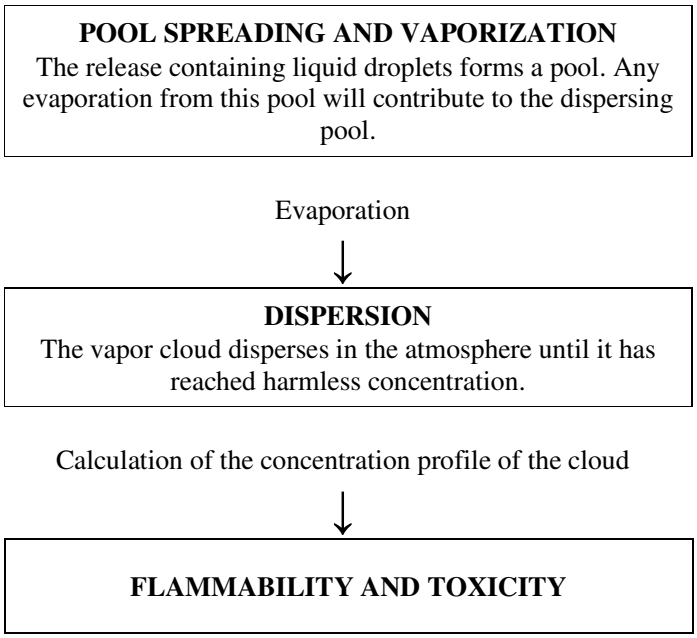
TABLE-7.9 WEATHER CONDITIONS

Parameters	Condition A	Condition B
Wind Speed	10.0 m/s	3.0 m/s
Pasquill Stability	D	F
Ground Roughness	Urban Forest	Urban Forest
Air Temperature (°C)	30	25
Surface temperature	30	25
Relative Humidity	50%	50%
Cloud Cover	50%	50%

7.2.5.4 MAXIMUM CREDIBLE ACCIDENT SCENARIO

The MAXIMUM CREDIBLE ACCIDENT SCENARIO was analyzed based on flammable vapor and toxic vapor risks. The ALOHA simulation software was used to obtain the risk contours and the zone of influence, as well as levels of risk associated with each zone.

The calculations performed are based on Unified Dispersion Modeling and provide the foot prints of hazardous chemical dispersion and the distances of critical concentrations for flammability and toxicity. The model considers a three stage method as given in the following illustration:



The results of the ALOHA simulation as well as the parameters used for carrying out the simulations is given below in tables. Downwind concentrations of chemicals are shown.

SCENARIOS CONSIDERED:

1. Maximum Credible Accident scenario for Toluene – "Pool Fire" - Threat Zone Evaluation :

Chemical Data:

Chemical Name: TOLUENE
CAS Number: 108-88-3 Molecular Weight: 92.14 g/mol
AEGL-1 (60 min): 67 ppm AEGL-2 (60 min): 560 ppm AEGL-3 (60 min): 3700 ppm
IDLH: 500 ppm LEL: 11000 ppm UEL: 71000 ppm
Ambient Boiling Point: 110.4° C
Vapor Pressure at Ambient Temperature: 0.048 atm
Ambient Saturation Concentration: 48,691 ppm or 4.87%

A. For Atmospheric Stability Condition 'D'

Source Strength:

Leak from hole in horizontal cylindrical tank
Flammable chemical is burning as it escapes from tank
Tank Diameter: 2 meters
Tank Length: 5.1 meters
Tank Volume: 16.0 cubic meters
Tank contains liquid
Internal Temperature: 30° C
Chemical Mass in Tank: 13.7 tons
Tank is 90% full
Circular Opening Diameter: 1 inches

Opening is 5 centimeters from tank bottom
Max Flame Length: 5 meters
Burn Duration: ALOHA limited the duration to 1 hour
Max Burn Rate: 24.5 kilograms/min
Total Amount Burned: 1,451 kilograms
Note: The chemical escaped as a liquid and formed a burning puddle.
The puddle spread to a diameter of 2.5 meters.

Threat Zone:
Threat Modeled: Thermal radiation from pool fire
Red : less than 10 meters(10.9 yards) --- (10.0 kW/(sq m) = potentially lethal within 60 sec)
Orange: 10 meters --- (5.0 kW/(sq m) = 2nd degree burns within 60 sec)
Yellow: 13 meters --- (2.0 kW/(sq m) = pain within 60 sec)

B. For Atmospheric Stability Condition 'F'

Source Strength:
Leak from hole in horizontal cylindrical tank
Flammable chemical is burning as it escapes from tank
Tank Diameter: 2 meters
Tank Length: 5.1 meters
Tank Volume: 16.0 cubic meters
Tank contains liquid
Internal Temperature: 25° C
Chemical Mass in Tank: 13.7 tons
Tank is 90% full
Circular Opening Diameter: 1 inches
Opening is 5 centimeters from tank bottom
Max Flame Length: 7 meters
Burn Duration: ALOHA limited the duration to 1 hour
Max Burn Rate: 24.5 kilograms/min
Total Amount Burned: 1,454 kilograms
Note: The chemical escaped as a liquid and formed a burning puddle.

The puddle spread to a diameter of 2.6 meters.

Threat Zone:

Threat Modeled: Thermal radiation from pool fire

Red : less than 10 meters(10.9 yards) --- (10.0 kW/(sq m) = potentially lethal within 60 sec)

Orange: 11 meters --- (5.0 kW/(sq m) = 2nd degree burns within 60 sec)

Yellow: 15 meters --- (2.0 kW/(sq m) = pain within 60 sec)

2. Maximum Credible Accident scenario for Methanol - "Pool Fire" - Threat Zone Evaluation :

Chemical Data:

Chemical Name: METHANOL

CAS Number: 67-56-1 Molecular Weight: 32.04 g/mol

AEGL-1 (60 min): 530 ppm AEGL-2 (60 min): 2100 ppm AEGL-3 (60 min): 7200 ppm

IDLH: 6000 ppm LEL: 71800 ppm UEL: 365000 ppm

Ambient Boiling Point: 64.7° C

Vapor Pressure at Ambient Temperature: 0.21 atm

Ambient Saturation Concentration: 216,411 ppm or 21.6%

A. For Atmospheric Stability Condition 'D'

Source Strength:

Leak from hole in horizontal cylindrical tank

Flammable chemical is burning as it escapes from tank

Tank Diameter: 2 meters

Tank Length: 7.35 meters

Tank Volume: 23.1 cubic meters

Tank contains liquid

Internal Temperature: 30° C

Chemical Mass in Tank: 19.0 tons

Tank is 95% full

Circular Opening Diameter: 2 inches

Opening is 5 centimeters from tank bottom

Max Flame Length: 5 meters

Burn Duration: ALOHA limited the duration to 1 hour

Max Burn Rate: 93.6 kilograms/min

Total Amount Burned: 5,263 kilograms
Note: The chemical escaped as a liquid and formed a burning puddle.
The puddle spread to a diameter of 10.9 meters.

Threat Zone:

Threat Modeled: Thermal radiation from pool fire
Red : 12 meters --- (10.0 kW/(sq m) = potentially lethal within 60 sec)
Orange: 13 meters --- (5.0 kW/(sq m) = 2nd degree burns within 60 sec)
Yellow: 16 meters --- (2.0 kW/(sq m) = pain within 60 sec)

B. For Atmospheric Stability Condition 'F'

Source Strength:

Leak from hole in horizontal cylindrical tank
Flammable chemical is burning as it escapes from tank
Tank Diameter: 2 meters
Tank Length: 7.35 meters
Tank Volume: 23.1 cubic meters
Tank contains liquid
Internal Temperature: 25° C
Chemical Mass in Tank: 19.0 tons
Tank is 95% full
Circular Opening Diameter: 2 inches
Opening is 5 centimeters from tank bottom
Max Flame Length: 6 meters
Burn Duration: ALOHA limited the duration to 1 hour
Max Burn Rate: 93.8 kilograms/min
Total Amount Burned: 5,274 kilograms
Note: The chemical escaped as a liquid and formed a burning puddle.
The puddle spread to a diameter of 11.0 meters.

Threat Zone:

Threat Modeled: Thermal radiation from pool fire
Red : 12 meters --- (10.0 kW/(sq m) = potentially lethal within 60 sec)
Orange: 15 meters --- (5.0 kW/(sq m) = 2nd degree burns within 60 sec)
Yellow: 20 meters --- (2.0 kW/(sq m) = pain within 60 sec)

3. Maximum Credible Accident scenario for Acetone : "Pool Fire"- Atmospheric Stability Condition 'D'

Chemical Data:

Chemical Name: ACETONE
CAS Number: 67-64-1 Molecular Weight: 58.08 g/mol
AEGL-1 (60 min): 200 ppm AEGL-2 (60 min): 3200 ppm AEGL-3 (60 min): 5700 ppm
LEL: 26000 ppm UEL: 130000 ppm
Ambient Boiling Point: 56.3° C
Vapor Pressure at Ambient Temperature: 0.37 atm
Ambient Saturation Concentration: 377,520 ppm or 37.8%

A. For Atmospheric Stability Condition 'D'

Source Strength:

Leak from hole in horizontal cylindrical tank
Flammable chemical is burning as it escapes from tank
Tank Diameter: 2 meters
Tank Length: 7.4 meters
Tank Volume: 23.2 cubic meters
Tank contains liquid
Internal Temperature: 30° C
Chemical Mass in Tank: 19.0 tons
Tank is 95% full
Circular Opening Diameter: 2 inches
Opening is 5 centimeters from tank bottom
Max Flame Length: 7 meters
Burn Duration: ALOHA limited the duration to 1 hour
Max Burn Rate: 93.3 kilograms/min
Total Amount Burned: 5,494 kilograms

Note: The chemical escaped as a liquid and formed a burning puddle.
The puddle spread to a diameter of 6.3 meters.

Threat Zone:

Threat Modeled: Thermal radiation from pool fire
Red : 13 meters --- (10.0 kW/(sq m) = potentially lethal within 60 sec)
Orange: 16 meters --- (5.0 kW/(sq m) = 2nd degree burns within 60 sec)
Yellow: 21 meters --- (2.0 kW/(sq m) = pain within 60 sec)

B. For Atmospheric Stability Condition 'F'

Source Strength:

Leak from hole in horizontal cylindrical tank
Flammable chemical is burning as it escapes from tank
Tank Diameter: 2 meters
Tank Length: 7.4 meters
Tank Volume: 23.2 cubic meters
Tank contains liquid
Internal Temperature: 25° C
Chemical Mass in Tank: 19.0 tons
Tank is 94% full
Circular Opening Diameter: 2 inches
Opening is 5 centimeters from tank bottom
Max Flame Length: 9 meters
Burn Duration: ALOHA limited the duration to 1 hour
Max Burn Rate: 93.7 kilograms/min
Total Amount Burned: 5,511 kilograms
Note: The chemical escaped as a liquid and formed a burning puddle.
The puddle spread to a diameter of 6.3 meters.

Threat Zone:

Threat Modeled: Thermal radiation from pool fire
Red : 13 meters --- (10.0 kW/(sq m) = potentially lethal within 60 sec)
Orange: 17 meters --- (5.0 kW/(sq m) = 2nd degree burns within 60 sec)
Yellow: 24 meters --- (2.0 kW/(sq m) = pain within 60 sec)

greater than 10.0 kW/(sq m) (potentially lethal within 60 sec)
greater than 5.0 kW/(sq m) (2nd degree burns within 60 sec)
greater than 2.0 kW/(sq m) (pain within 60 sec)

RISK ASSESSMENT& MANAGEMENT

1. Hazardous materials list is prepared for raw materials / intermediate products. Analyzed for possible On-site Emergency and Off site emergency conditions.
2. Threshold Planned quantities (TPQ) are planned for the plant operations. Most of the raw materials are indigenous and locally procured. Hence the storage of materials are planned max. only for 30 days. Makeup quantities shall be planned as a on-line system liking to the quantity of storage.
3. QRA analysis done for the hazardous raw materials. Vulnerability study done to assess the impact on the nearby areas / Working persons inside the plant.
4. Quantum of Raw materials / Finished products are so low that there is practically no vulnerability zone. Persons working in the plant, who are away by 10m down wind direction and 5 m on cross wind direction, are safe to work with designated PPEs.
5. It is easy to control the manpower due to less number of employees and automated systems of processes.
6. The finished products also pose less risk. The quantity of less per day, does not pose any high risk and these products are immediately shipped out in the same shift.
7. Incompatibility standards of storage of hazardous materials advised, to avoid any escalation of risk. As the storage space is limited, Vertical storage is advised with suitable design of racks.

7.2.6 RISK PREVENTION AND RISK MITIGATION

Accident prevention is the primary safety goal of any organization. There are risks that can be eliminated through preventive measures and those which can be reduced through mitigation measures.

7.2.6.1 PREVENTIVE MEASURES

The 4 **E**'s for elimination of hazards and prevent accidents are as follows:

- **E**ngineering and technological innovation to improve reliability
- **E**xperience in the study of hazards and operations- Risk analysis
- **E**nforcement of decisions on study results – Preventive mechanisms
- **E**ducation, awareness, and practice in prevention of accidents (Training & drills)

Various measures will be adopted at each stage of the project for ensuring safety of people, environment, and property. These measures include the following:

- Site selection
- Choice of technology
- Equipment design incorporating domestic and international safety codes
- Plant layout with utmost consideration given to operational safety aspects
- Incorporation of interlocks and protection systems in plant design
- Safety awareness for key management persons
- Safety training of all operational , maintenance staff
- Regular safety monitoring - Audits and inspections

A. Site Selection

The plant is located adjacent Kadi Chhatral Highway. The site soil conditions are rigid and safe, complying with the requirements of the load bearing capacity of various installations.

B. Choice of Technology

The process is carefully chosen for reducing wastes, reducing the risk to human beings and the environment. It is the proven one and acknowledged internationally.

C. Equipment Design

Mechanical

1. All process equipments operating under pressure are designed as per ASME Section VIII pressure vessel code for un-fired pressure vessels. The material of construction selected is compatible with the chemicals handled to ensure minimum corrosion effects.
2. Heat exchangers are designed as per TEMA Class B and Class C standards as applicable.
3. Process tanks and vessels are sized taking into account minimum storage of intermediates and are provided with adequate instrumentation to measure temperature, pressure, level etc.
4. All process pumps are either glandless canned or provided with double mechanical seals to ensure no leakage during operation. Critical process pumps are also provided with bearing temperature monitors which will ensure timely maintenance of rotating parts.

Piping

1. All pipes, fittings, and valves carrying the haz-chem are made of appropriate grade Steel, stainless steel and with PTFE (Teflon) envelop gaskets.
2. All pipes carrying haz-chem are designed to ensure non-restrictive flow from one equipment to another with minimum hold up of haz-chem in the lines.
3. All pipelines will be color coded as per the standard for easy identification of materials.
4. Pipeline sizes will be chosen such that pressure drops due to flow will be within permitted limits. Critical velocity parameters are exceeded to avoid static electricity generation.
5. Wherever required, design incorporates suitable by-pass system to carry out maintenance work during plant operations and also to enable sectional close-down during machinery break down, etc.

6. Safety valves, relief valves, breather valves and rupture discs are mounted on hook-up piping to all critical equipment.
7. Moderately warm pipes carrying fluids at > 50-60 °C will be insulated from the point of personnel protection.
8. All manually operated valves will be located within easy reach of operator and at a operable height. Wherever necessary approach platforms will be provided.
9. Adequate number of flange joints shall be provided with adequate supports in long lines for easy dismantling and maintenance.

Electrical

1. Plant areas are segregated into zone areas as per the hazards present, with adequate distances to separate the two zones vide Petroleum Rules.
2. Areas designated as Zone -0,1 areas will have all electrical fixtures including lighting fixtures, switches, junction boxes, cable glands, etc. of approved make and flameproof type.
3. For stand by power diesel generator of adequate capacity will be installed with auto-start facility in case of power trip/failure. This DG set will be located far away from the processing area.
4. All tanks, pumps, tankers, and pipelines are properly earthed and bonded for electrical continuity and prevention of static electric charges. Double earthing will be provided to drain electrical charge to two independent earth pits.
5. All incomers to the electrical panels including MCCs and PCC will have air circuit breakers of adequate capacity for electrical protection of equipments connected to the outgoing feeders.
6. All feeders in MCCs and PCC will have user point identification at both termination ends for easy tracking of faults and rectification.
7. Adequate ventilation fans will be provided in electrical panels for effective heat dissipation.
8. Earthing pits locations and requirements with looping grids shall be provided as per the legal and regulatory requirements.
9. Overhead cable routing will take into account safe distances from buildings and facilities. Underground cabling shall be marked with metal markers as per the regulatory requirements.
10. All panels will have incomer earth fault relay.
11. Lightning arrestors will be provided on top of all structures.
12. All cables running on trays at elevation shall be properly dressed up and tied with clamps for rigidity.
13. All areas of plant and machinery and roads including all open operating areas are illuminated sufficiently to carry out operations round the clock.

D. Plant Layout

1. The plant is laid out in such a way that hazards are either eliminated or isolated so as to manage it effectively.
2. The location of the disaster prone areas of the plant is such that, they cause less impact to the nearby factories or inhabitations.
3. Room housing heat generating equipment or containing chemicals are well-ventilated with adequate air circulation.
4. Process plants which handles hazchem are designed as an open structure with all sides open for adequate ventilation
5. Administrative office is located away from process plants and storage tank.
6. Security office is located close to gate and away from process plants and storage area.
7. Workers' rest area, shower, and dispensary is located close to administrative office, away from process plants.
8. Canteen is located close to administrative office and away from process plants.

9. Adequate number of safety showers and eye wash fountains are provided in areas close to storage facilities and process plants and on each floor wherever necessary
10. A separate area has been provided on site in the upwind direction for emergency evacuation-Assembly Points.
11. Interconnecting roads within the plot are made circular so that more than one get-away is available at any point.
12. A second gate is provided for use in case of emergency.
13. Proper drainage and enclosures are provided to drain away storm water from unforeseen flooding.
14. Flame proof areas have been isolated from the non-flameproof areas.
15. DG room and electrical transformer located away from administrative office, process plant and storage area.
16. The storage area of hazchem is located in an isolated area, with adequate facilities for handling spills and leakages.
17. Fire hydrant system covers the entire operating area of the plant.
18. Warning boards will be put up in areas where entry is restricted
19. No Smoking boards will be put up at the entrance and at other locations throughout the plant
20. Boards showing the numbers and contact details of government / district officials as well as fire department, police department, district commissioner, etc. will be installed at security gate as well as in the operational area.
21. Battery-cum-electrically operated emergency alarms will be made available.
22. Speed breakers and speed limit signs will be displayed as required
23. Hazardous chemicals shall be stored as per compatibility and based on corrosive and reactive capabilities as per the guidelines in the MSDS.
24. MSDS of all hazardous chemicals will be kept in the areas where such materials are used and stored.
25. Waste containers will be located at appropriate locations throughout the plant, and will be coded according to the type of waste.

F. Safety Awareness for Key Management

1. Key management personnel will be made aware from the beginning of the project of the key issues regarding the safety in design and operation of the plant.
2. Project management personnel have visited several industrial plants where hazchem is used in bulk as a raw material for the production of finished products. Discussions with operational staff of the plants during these visits has given them valuable insight into the safety aspects of handling of hazchems.
3. Discussions on safe handling of hazchems have been carried out with various safety experts, technical collaborators, and with overseas suppliers through conference calls.

G. Safety Training for All Operational Staff

1. All operational staff will be given safety training as a compulsory part of their induction program.
2. Safety training will include, among other things, the following important aspects:
    a. awareness of hazards of individual chemicals through study of MSDS
    b. correct usage of Personal Protective Equipment (PPE)
    c. explanation of the hazards and risks present in the premises, as well as their analysis
    d. impact on safety, health, and environment due to improper handling of hazardous chemicals
    e. guidelines for safety in operations
    f. Do’s and Don'ts

H. Safety Audits and Inspections

1. Regular safety audit will be conducted to ascertain the safety levels followed in the plant and suggestions for improvement
2. Special safety audits will be conducted whenever there are process-related equipment / operational changes made in the plant
3. Testing and inspection of high pressure equipment with periodical hydrotesting and thickness testing will be carried out during maintenance shutdown
4. Testing of pressure safety valves and setting will be carried out once in a year during maintenance shutdown
5. Calibration of control valves, instruments as and when required, but at least once in a year during maintenance shutdown
6. Testing of electrical measurements, such as earthing resistance, will be carried out every year.
7. Testing of all fire hydrant installations, fire extinguishers, fire pumps, fire water level monitors will be carried regularly.

7.2.6.2 MITIGATION MEASURES

Risk mitigation involves the reduction of the likelihood of a loss occurring due to an accident and the reduction of the severity of such a loss.

Several risk mitigation measures have been taken into consideration in the planning of this project:

- Personal Protective Equipment
- Medical facilities
- Handling of leakages and spills
- Firefighting system
- Engineering controls
- Emergency Control Centre
- Disaster Management Plan

A. Personal Protective Equipment

Personal protective equipment (PPE) are needed to protect individuals from injury. Several types of PPE are necessary for providing the optimum protection to individuals from the various risks. In addition to the PPE which will be used for regular plant operation, the following PPE has been selected for preservation at the plant's Emergency Control Centre room for use in case of emergency:

TABLE-7.10 LIST OF PERSONNEL PROTECTIVE EQUIPMENT

No.	List of personal protective equipment	Total (nos.)
1.	B. A. set	1
2.	Ear Plug	50
3.	Hand Gloves	50
4.	Gum Boots	10
5.	Goggles	50
6.	Helmets	25
7.	Safety Belts	5
8.	Aprons	5
9.	Fire Proximity Suit	4
10.	Safety Shoe	20
11.	Ear Muff	5
12.	Face Shield	10
13.	Chemical Splash Goggle	10

Details of Personal Protective Equipment (PPE's), its Care and Management System proposed by the company are given below:

Training:

1. **Induction Training:**
   All employees including contract workmen given Induction training at the time of Joining for proper use of safety equipment and PPEs with demonstration.
2. **Special Training:**
   Company will arrange Special training for types of PPEs and adequate Use of PPEs as per training calendar.
3. **On Job training:**
   During On Job training , company will cover the right Use of PPEs as hazard and work
4. **Training for Self Contained Breathing Apparatus and Emergency Life Saving Apparatus:**
   Company arranges training for Use of Self Contained Breathing Apparatus and Emergency Life Saving Apparatus for all Employee including contract workmen.

Body Protection (Non Respiratory):

1. **Protecting Clothing**
   1. Chemical Resistant Suit: for protection against chemical other then Acid.
   2. PVC Suit: for protection against Acid & Alkali other then Hydrofluoric Acid
   3. Apron: for working in Laboratory, Laboratory Apron is compulsory.

2. **Head Protection (Safety Helmet):**
   Use of different color helmet for easy identification during the Emergency Situation.
   - Yellow Color Helmet : for the Employees of the company
   - Green Color Helmet : for Contract Workmen.
   - White Color Helmet : for Visitor
   - Blue Color Helmet : for Incident Controller at time of Emergency Handling.

3. **Face & Eye Protection :**
   1. Face Shield: For working at Hazardous chemical, grinding work etc.
   2. Safety Spectacles: for working in anywhere in plant side.
   3. Safety Goggle: for covering of Full eye at time of certain defined job.

4. **Ear Protection :**
   Ear Muff/Ear Plug: For working in High noise area.

5. **Hand Protection:**
   1. PVC Gloves: For Hazardous chemicals like Acid, alkali, Hydrocarbons etc.
   2. Chemical Resistant Gloves (Neoprene): for Chemical where PVC gloves not suitable.
   3. Leather Gloves: for protection from cuts, abrasions, flying particles mildly hot materials.
   4. Rubber Gloves (Electrical): for electrical work available with different voltage ratings
   5. Rubber Gloves: for chemicals, oil greases

6. **Foot Protection:**
   1. Safety Shoes: all employees of the company should wear safety shoes compulsory.
   2. Gum Boot: for working in water, deep mud or bottom sediment.

Respiratory Protection:

1. **Air Purifying Type:**
   1. Dust Mask: for protection against dust particle use at dusting atmosphere.
   2. Chemical Cartridges Respirators: for toxic gaseous area. It is used for exit from the area if any gas leakage.

2. Air Supplying Type:

1. Self Contain Breathing Apparatus (SCBA): for emergency Handing.
2. Emergency Life Saving Apparatus (ELSA): as like SCBA but its capacity is low.
3. Air Hood Mask: for working in Confined space or gaseous atmosphere, there will be continue supply of Fresh air by Blower.

General Protection:

1. Safety Belt: double harness full body safety belt is compulsory for work at height.
2. Safety Net: used for work at height.
3. Safety Shower: for first aid treatment in case of chemical exposure on body
4. Eye Washer Fountains: for first aid treatment in case of eye exposure.

Care of PPE's:

- Each and every personal protective equipment should be visual checked by the user for its integrity before its use and, if any defects are observed, the concerned supervisor should be promptly informed and the defects corrected or PPE replaced.
- Self-contained breathing apparatus must be inspected monthly and details of the inspection and maintenance recorded.
- All employees should familiarize themselves with different types of PPEs available in the company.
- When not in use, PPE should be carefully stored in a designated place. Do not put it in tool box where it is likely to be damaged or allow it to lie in an open place where it may collect dust. Store PPE in a safe place well covered, away from sunlight and dust.
- Do not use the PPE's other than its purpose or don't temper with any PPE's.

B. Medical Facilities

Medical facilities are needed to provide immediate medical attention to people who may be exposed to certain health risks during an accident.

1. First Aid Centre will be located at the Workers' Facility near the administrative building and canteen.
2. A doctor will visit the plant periodically.
3. First Aid Centre will be equipped with a safety shower, eye wash centre, and oxygen-administering facility, etc.
4. Medicines and antidotes for relevant hazardous chemicals will be stored for 5 persons.
5. The contact numbers of all nearby hospitals and medical facilities will be kept and put up on a board in the First Aid Centre.
6. A general agreement for immediate treatment will be made between the nearest hospital and the plant.

dC. Handling of Leakages and Spills

Quick and safe handling of leakages and spills is the most effective method of risk mitigation in the plant. The company will take the following steps to ensure that leakages and spills can be effectively handled:

1. Ensuring availability and provisioning of suitable PPE for handling spills and leakages.
2. Preparation of handling manuals and placement of the same at important locations.
3. Placement of sand buckets, AFFF (aqueous film forming foam) fire extinguishers, and dry chemical (potassium bicarbonate-based) fire extinguishers at high risk areas.
4. Provisioning of specially marked containers for disposal of spillages.
5. Decontamination area has been earmarked for clothing contaminated by spills.
6. Creation of dykes in the areas where likelihood of spillages and leakage is greatest.
7. Eye-wash stations and showers.

In case the leakage or spill can be handled by on-site trained personnel using proper protective clothing and equipment, the incident is not considered an emergency situation. Such non-emergency situations can include malfunctioning pumps, defective pipelines or leaking valves or seals. Also small spills may occur but can generally be handled without alarm.

The MAXIMUM CREDIBLE ACCIDENT SCENARIO can be suitably handled without creating an emergency situation. In the WORST CASE ACCIDENT SCENARIO, the designated incident controller will be alerted and he will ensure that the emergency is properly dealt with and mitigated with all resources available at our disposal, as per the guidelines laid out in the Disaster Management Plan.

D. Firefighting Systems

Due to the handling of flammable chemicals in the plant, it is necessary to provide an effective and efficient firefighting system. A map of the firefighting installations is given in the plant site layout. Some of the salient features are described as follows:

1. Fire water tank capacity and pump capacity of are based on the number of monitors, risers, and outlets provided.
2. All firewater piping is located **above ground** to prevent hidden corrosion effects.
3. All fire hydrant points will have two independent ring mains for adequate water flow and safety. All fire Nozzles shall be Spray type OR Mist type suitable for surround fighting system.

M/s. Orbit Pharma Laboratories management shall 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 manufacturing operation shall be handled and processed, the chances of outbreak of fire is however less but cannot be refuted. Hence to avoid such a scenario, a well laid fire protection system is provided in the factory which will be upgraded. List of existing and proposed firefighting equipment's are given in table-7.10.

TABLE-7.11 LIST OF PROPOSED FIRE FIGHTING EQUIPMENTS

No.	Firefighting equipment's	Capacity	Quantity		
			Existing	Proposed	Total
1.	Fire Extinguisher (DCP and CO_2 type)	5, 8 & 10 Kgs	16	25	42
2.	Mechanical Foam	9.0 Liters	0	4	4
3.	Sand Bucket Stand	3 – 4 Buckets	1	2	3
4.	Sand Buckets	08 Liters	1	2	3
5.	Hydrant Post	-	0	15	15
6.	Water Reservoir	300 KL	0	300 KL	300 KL
7.	Hose rill	63 mm Día	0	10	10
8.	Foam Monitor	100 mm Dia.	0	1	1
9.	Foam Trolley	50 Ltr.	0	1	1
10.	Smoke Detector	-	0	10	10
11.	Heat Detector	-	0	2	2
12.	Public communication	- Electric Siren System - Manual Siren System - Public Announcement System covered all Plant Area - Mega Phone 01 KM Cap.	0 0 0 0	1 1 1 1	1 1 1 1

Facilities of fire and safety services are also easily available in the study area.

E. Emergency Control Centre

The Emergency Control Centre is a designated room that shall be occupied by the Incident Controller, the final authority to give directives, coordinate with various teams, communicate with district government agencies, and to deal with an emergency inside the plant. The following documents and equipment shall be kept here for the use of the Incident Controller during an emergency:

1. Updated drawings and P&I diagrams of plant
2. Site layout plan showing raw materials and finished products storage area, security gates, assembly points, process plants, utility building and other areas of the plant
3. Disaster Management Plan
4. List of key plant operating personnel
5. Telephone numbers and contact details of key plant operating personnel
6. Telephone numbers and contact details of district government officials and emergency offices
7. Personal Protective Equipment for emergency use
8. Fire extinguishers (dry chemical powder filled)

7.2.6.3 DO'S AND DON'TS

Suitable notices / boards displayed at several locations indicating appropriate hazards warning as well as DOs and DON'T for ensuring operational and personal Safety for information of workers / staff and visitors.

Do's:

1) Check the available raw material as per the job on hand required for all stages.
2) For good physical condition, check the vessels expected to be used in the process.
3) Check the availability of utilities required till the end of the batch / job.
4) Check for proper manpower available till the entire operation in over.
5) Each and every equipment including the stand-by should be in operable condition.
6) Verify the test certificates of materials being taken for process.
7) Time schedule should prepare for material flow on basis of the process.
8) Monitor the temperature and pressure if possible during the process.
9) Use pumps for transferring the liquids to the reactor tank.
10) Familiarize the worker about what is the job on hand.
11) The worker or operator should have sufficient knowledge of the materials handling.
12) Visual instructions should properly display for characteristics of the chemicals.
13) Ensure proper training of personnel.
14) Ensure sufficient numbers of safety devices are available.
15) In view of the chemicals handled, whether required or not, please ensure availability of SCBA apparatus near every use and storage area of chemical.
16) Ensure the workers wear proper PPE of adequate grade.
17) Demarcation of the chemical storage area for chemical in test.
18) Ensure removal of used containers from workspaces.
19) Prepare and follow the safe work instruction.
20) Record every incident that led to an accident irrespective of the seriousness of the accident and analyze the same to improvise the system continuously.
21) Always check the fire water tank to be filled up to the brim to ensure availability of fire water in sufficient quantity at all times. The design of other water to be used shall be from the overflow of the fire water tank to ensure this system.
22) Never work bare foot or without safety shoes.
23) Never use mobile phones in work zones.
24) Use only proper grade PPEs and use them properly.
25) Open or use containers only on written instruction.
26) Verify the label with the instruction before use.
27) Participate wholeheartedly in all safety related exercises an keep yourself updated.

Don'ts:

1) Without checking of raw material don't use it as per the job on hand required for all stages.
2) Don't use the vessels expected to be used in the process without checking.
3) Don't fail to check the availability of utilities required till the end of the batch / job
4) Don't work without enough and proper man power.
5) Don't use the equipments which are not in operable condition.

6) Don't use the materials for process without verify the test certificates.
7) Don't use the material without Prepare time schedule of material flow on basis of the process.
8) Don't perform without Monitoring the temperature and pressure during process.
9) Don't handle chemicals with open hands where manual handling is a must.
10) Don't keep the workers under wraps about what is the job on hand.
11) Don't let the worker / operator do the work having lack of sufficient knowledge of the materials handled.
12) Don't use the chemical with unknown characteristics or having unreadable label.
13) Don't let the personnel do the work without giving proper training.
14) Don't work without sufficient numbers of safety devices.
15) Don't let the workers do work without wearing proper PPE of adequate grade.
16) Don't use material that is under testing for production.
17) Don't store used containers at workspaces.
18) Don't breach the safe work instruction.
19) Don't try to conceal information regarding missed accidents or small injuries. Remember every and any mishap can be fatal if not for yourself for others.
20) After any shutdown never start operation without having ensured the fire water tank filled up.
21) Don't work bare foot or without safety shoes.
22) Don't use mobile phones in work zones.
23) Do not use PPEs which are not relevant to the operational aspect that has been identified.
24) Don't open or use containers on which instruction are not written.
25) Don't work without Verifying the label with the instruction before use.
26) Don't ever even thinking of evading safety instructions.

7.2.7 DISASTER MANAGEMENT PLAN

7.2.7.1 OBJECTIVES OF EMERGENCY PROCEDURES

Measures those are required to be taken during emergency are co-ordination of activities with many departments/ services and outside resources.

The objective of the procedure is to define role of key personnel of different services during major emergency to be effectively utilized to:

1) Safeguard lives
2) Contains of incident and bring it under control
3) Minimize damage to property & neighboring environment
4) Rescue & treatment of casualties & evacuation of persons to safe areas
5) Identification of affected persons, information to relatives and extending necessary assistance.
6) Preservation of information, records etc. which will help in investigation
7) Welfare assistance to casualties
8) Providing relevant information to police, district authorities and news media
9) Mobilizing inside resources
10) Initiating and organizing evacuation of affected persons
11) Collecting latest status, other information and requirement

7.2.7.2 BASIS OF PLAN AND HANDLING OF EMERGENCY

1) It is not possible to envisage and detail every action, which should be taken during an emergency. The basic philosophy is to get key personnel of necessary discipline who have the knowledge and background to assess the situation and give directions as per the objectives as quickly as possible.
2) The plan identifies the services/departments required to combat emergencies and also identifies the key persons to discharge the duties.
3) Key personnel have been identified for emergencies and are responsible for providing necessary assistance.
4) Any outside assistance, which company shall get, shall be co-ordinate by the main site controller on duty.

5) Messages via telephones are restricted to key personnel only. This is required to keep the telephones free for key personnel to contact for necessary feed-back.
6) Senior person who arrives on scene is automatically in charge for the service group. He should not leave the site without entrusting the charge to his deputy. All the key personnel should be available at the main control room. All key personnel of other services will report to main site controller, who will co- ordinate between various departments and outside agencies.

7.2.7.3 INFORMATION ABOUT EMERGENCY AND SUBSEQUENT ACTIONS

1) Any person noticing fire/explosion/re lease of hazardous gases should shout FIRE, FIRE or HELP, HELP and will activate the emergency bell
2) Inform respective control rooms
3) The Executive in-charge along with the concerned Dept. Head will immediately rush to the incidence site to assess and take immediate action required to control the source of incidence. They will also inform Security and Safety personnel to come to the place of disaster/emergency and assist them.
4) If he feels that the situation is likely to escalate and may lead to emergency will communicate following minimum information to all senior persons.
    a) Brief description of incident.
    b) Status & seriousness of the situation
    c) Actions immediately taken.
    d) Immediate assistance required.
    e) All key personnel of respective services, depending on nature of emergency will arrive at site to take charge of positions.

7.2.7.4 INSTRUCTIONS TO EMPLOYEES

The plan assumes certain discipline at site during emergency as given below;

1) Do not get panicky
2) Do not approach the scene of disaster as a spectator
3) Do not engage phones/ P.A. system unnecessarily
4) Non-essential personnel to gather at security gate after receiving instructions
5) Do not move here & there unnecessarily
6) Do not approach unnecessarily to get information or more inquiry
7) Remain at your working place unless called and be attentive to instructions
8) Ensure that all contract laborers working in the premises are immediately sent to main security gate. They will receive further instructions from main site controller

All non - essential staff members should gather at safe assembly point after assessing the wind direction (from the wind sock, stack of boiler chimney) and wait for further instructions which will be communicated through PA system or by other available means.

7.2.7.5 INSTRUCTIONS TO CONTRACTORS

The plan assumes certain discipline at site during emergencies as given below;

1) Do not get panicky
2) Do not approach the scene of disaster as a spectator
3) Do not engage phones/ P.A. system unnecessarily
4) Non-essential personnel to gather at security gate after receiving instructions
5) Do not move here & there unnecessarily.
6) Do not approach unnecessarily for information or more inquiry.
7) Remain at your working place unless called and be attentive to instructions
8) Ensure that all contract laborers working in the premises are immediately sent to main security gate. They will receive further instructions from main controller. All should gather at safe assembly points after assessing the wind direction (from the wind sock, stack of boiler chimney) and wait for further instructions which will be communicated through PA system or by other available means.

9) All fabricator contractors should ensure that all welding machines are switched off and all cylinders are closed before leaving the working area.
10) All civil contractors should be gathered at assembly points after declared emergency.

7.2.7.6 MITIGATION OF CONSEQUENCES DURING MAJOR ACCIDENT

No major hazard installation can ever be absolutely safe. Even if a hazard assessment has been carried out, if the hazards have been detected and appropriate measures have been taken, the possibility of an accident cannot be completely ruled out. So safely systems provide measures, which can mitigate the consequences of accident or emergency situation. In order to be able to initiate counter measures in the event of an accident, company shall install various safety systems to mitigate the consequences during Major Accident are as under:

(1) Emergency Control members available round the clock in all plants
(2) ECC room with full equipped with Fire Fighting Equipment
(3) Fire Men available in Fire Department round the clock
(4) TAC approved Fire Hydrant system with electric motor and D.G. Set and water reserved for fire fighting
(5) QRA to be done by competent party
(6) Alarm System and method of reporting / declaring emergency
(7) Regular rehearsal of emergency preparedness
(8) Training to all employees regarding emergency preparedness
(9) MSDS of all hazardous chemicals are available in safety department and in concerned department.

7.2.7.7 EMERGENCY CONTROL CENTRE WITH LIST OF EQUIPMENT AND ACCESSORIES

Safety Office in front of Operation Building will act as Emergency Control Center. It is equipped with all necessary accessories as mentioned below.

(A) DOCUMENTS
- Site Plan
- Disaster Control Plan copy
- List of essential telephone numbers
- List firefighting equipment
- Shift Schedule of Emergency Control members

(B) PERSONAL PROTECTIVE EQUIPMENT
- B. A. Sets (Breathing Apparatus)
- Face Masks
- Hand gloves
- Gum boots
- Goggles
- Helmets
- Safety belts
- Aprons
- Fire proximity suit

(C) EQUIPMENT LIST
- Internal / External Telephone
- Portable alarm
- Torches
- Emergency Cupboard with necessary PPE
- Artificial Respirator
- Racer watches (STOP WATCH)
- Gas Detector Tube
- Static Charge Meter

7.2.7.8 INFORMATION REGARDING KEY PERSONS AND THEIR RESPONSIBILITIES DURING EMERGENCY

A. SITE MAIN CONTROLLER

After getting information of emergency, the site main controller will rushed to the Emergency Control Center immediately.

1) On reaching he will assess the magnitude of the situation in consultation with Incident Controller and decide whether inside or outside help are to be called (i.e. Fire Service, Police, Ambulance etc.).
2) Ensure that key persons are called in.
3) Give guidance and direction in vital and important activities to control the emergency situation.
4) Direct to close down and evacuation of the plants in consultation with Incident controller and key personnel.
5) If necessary arrange for evacuation of neighboring population.
6) Inform the Government authorities such as Collector, MC, Factory Inspector, Health Officer & medical Officer and request them for their help as situation demands.
7) Give prime importance to human life and guidance in organizing the rescue operations as well as ensure whether injured people getting proper medical attention in time.
8) Always be in touch with the Incident Controller to get further progress and decide further plan.
9) On completion of emergency situation declare the normalcy through Administrative Officer.
10) Control the re-occupation of the affected areas on discontinuation of emergency.
11) Do not permit to re-start the plant unless it is safe.
12) Give authentic statement of the incident to News Media & Government Authorities.

B. INCIDENT CONTROLLER

1) Take the charge of situation and assess the magnitude of the event
2) Control and guide all the operations with priorities to the Safety of Personnel, minimize pollution, loss of material and loss to the plant equipment and property.
3) Provide advice and guide to the Fire Fighting and Rescuing squad and Fire Brigade while they arrive.
4) Establish communication with emergency control center.
5) Report on all significant developments to the emergency control center through phone/Messenger.
6) Ensure that evacuation of the areas in the factory getting affected is complete.
7) After the emergency situation is brought under control, assure that the necessary evidence for further investigation in the incident is preserved and inform Site Controller regarding control of emergency.

C. TECHNICAL STAFF / DEPARTMENT HEAD

1) As soon as informed, rush to the spot and take charge of the situation till senior group arrives.
2) Ensure that emergency siren is raised which gives information to Security, Safety, Administration Staff and Technical Staff.
3) On arrival of Incident Controller, inform him about the gravity of the situation and then to work under his guidance to control the situation.
4) Ensure that only experienced and essential people remains at the location for controlling, while others to be evacuated from the scene.

D. EMPLOYEES NEAR THE SPOT (INCIDENT AREA)

The employees near affected area, under the guidance of the **Incident Controller** shall

1) Tackle the emergency as per laid down procedures for the area bearing in mind the requirements of the situation called for by the progress of the emergency.
2) Remove all non-essential employees (who are not assigned any emergency duty) shall evacuate the area and gather at the specified assembly points.
3) Stop the operations as per the information of the Incident Controller.

E. EMPLOYEES OF OTHER DEPARTMENTS

1) On getting information of incident, take permission of superior and confirm own plant, department, safety and then after trained and skill persons will rush to incident spot with necessary personnel protective equipment.
2) Approach the spot from up wind direction and assemble at safe place near to the spot taking in to consideration the wind direction.
3) Extend help to control the situation as per the instruction and guidance given by the senior persons controlling the operation.

F. PERSONNEL OFFICER

1) When emergency declared immediately rushed to emergency control center.
2) Basically he will work as a Liaison Officer and will stationed at emergency control center during emergency. He will work under the direction of Site Controller.
3) To ensure that the casualties receives adequate attention at first aid center, also ensure additional help if require from Government authorities or outside agencies.
4) Arrange transport facility for injured personnel to get timely medical help.
5) He will also arrange for head count at assembly points and will inform Site Controller.
6) Also be in touch with the Security and Other Departments for help.
7) Will check the Roll call from Time Office for availability of trained personnel during emergency situation at the site.
8) Determine the need to inform statutory authorities of the accident and fill the necessary forms for submission with consultation of the Site Controller.
9) When emergency is prolonged, arrange for the relief of personnel as well as inform the families of injured persons and organize refreshments / catering facility.

G. ADMINISTRATIVE OFFICER

1) When emergency declared, immediately rushed to the emergency control center and establish contact with Site Main Controller.
2) Ensure the communication between site controller and incident controller. Keep messenger for communication.
3) Make arrangement to send portable megaphone and torches to the Incident Controller if required.
4) On receiving instructions from Site Controller, organize transportation for the evacuation of people from the assembly points.
5) As per instructions from Site Controller will inform to Head Office, Insurance Surveyor, other relevant authorities and neighboring areas.
6) On getting instructions from Site Controller / Incident Controller, he will be in touch with other Industries for help in emergency.
7) Will arrange to announce necessary instructions for all personnel.
8) Ensure that telephone operator keeps the EPABX free to extend possible for in coming calls.
9) Ensure that Press and other Media do not publish unauthentic news.

H. ENGINEERING SERVICES KEY PERSONNEL

1) When emergency declared, immediately proceed to Emergency Control Center.
2) Ensure the availability of electrical wiremen, utility, maintenance employees and drivers.
3) Ensure the water supply & electric power generator in case of power failure.
4) Be in touch with the Site controller / Incident Controller to extend help as and when required.
5) Ensure availability of Light Motor Vehicles as well as Fork Lifts, JCBs etc.
6) Arrange the vehicle as per required by Administrative / Personnel Officer.

I. SECURITY & FIRE IN-CHARGE

1) When emergency declared, ensure that the Fire man in the fire station and Security guards at the main gate are sufficient.
2) On getting instruction from Site Controller/Incident controller, cordon the affected area to maintain law and order.
3) As per instruction from Site Controller/ Incident controller, arrange to start the fire hydrant pump.
4) Ensure the following duties by Security Guards;

- Stop all vehicles and visitors entering into the factory, except any Government authorities such as Fire Brigade, Police, Factory Inspector, Medical Staff and inform the Administrative Officer on their arrival.
- If any press reporter and local Leader comes at the main gate, take them to the Administration Office.
- Do not allow any vehicle to park at the main gate or nearby at main road.
- Assure that the entrance of the gate is clear for thorough fare. In Similar way control/ guide internal traffic for smooth operations.
- Act according instructions given by Personnel and Administrative Officer.
- Ensure that all essential personnel evacuated and assembled at Assembly points.
- Arrange effective security nearby the incident place.

J. FIRST AID ATTENDANTS

1) As per the instructions given by the Incident Controller, arrange the supply of additional emergency related equipment to the incident place. Give necessary First Aid treatment to the affected persons immediately.
2) Inform the Personnel and Administration Officer regarding the severity of injury and advise for further medical help if necessary.
3) Ask for additional trained First-Aider, if required.
4) On arrival of Doctor, assist him to give medical treatment to the affected people.

K. SAFETY OFFICER

1) On hearing emergency siren rush to the spot and assume the position of incident controller and take care of the situation till a senior personnel arrives and on their arrival work with them in team, extending their own expertise.
2) Give instructions and guideline to the people involved in control measures. As well as help in providing required PPE.
3) Give instructions to the safety attendants.
4) Brief the Site Main Controller about the progress of control measures.
5) Advise site controller regarding type of help required from outside.
6) Give instructions to other department through internal phones /Communication Officer.
7) Make arrangement to carry out monitoring whenever necessary and appraise results to the concerned seniors

L. ESSENTIAL EMPLOYEES AND THEIRS DUTIES

[a] Fireman:

1) On getting information, check the water level in emergency tanks and overhead /under ground storage tanks. Maintain the emergency tank water level to its fullest capacity.
2) Start fire hydrant pump as per the instruction from Security & Fire incharge.
3) Ensure continuous water supply to the incident place.
4) Do not leave the Fire Hydrant pump house till further instruction

[b] Driver:

1) On getting information from Communication Officer remain alert and wait for further instructions along with Ambulance van to meet with emergency.
2) Extend help to shift the injured people from site of incident to First-Aid and if required to hospital through Ambulance / Other vehicle.
3) For material handling take Fork-lift / JCB to the spot if required.

[c] Electrical/Utility Personnel:

1) After getting the information rush to the spot with necessary personal protective equipment and if instructed by incident controller cut off the power supply to the affected area.
2) Ensure that the D.G. Set is in running condition.
3) Extend help to the Utility Operator in maintaining adequate supply of water and others under guidance of Supervisors.
4) Water in water hydrant storage tank is in full capacity or not

7.2.7.9 EMERGENCY ORGANIZATION FOR IDLE HOURS

1. SECURITY

i) After getting information through emergency hooter inform at least two senior persons at their residence by telephone/messenger.
   (a) Site controller
   (b) Safety Officer
   (c) Incident controller.
   (d) Technical Staff/Senior Staff

ii) Assure that the front side of the gate is clear for thoroughfare.

iii) Act according to the instructions of Incident Controller/Senior Officers

iv) Inform Emergency Control Center for emergency.

2. SAFETY/FIRST AID ATTENDANT

One attendant remains present around the clock.

Duties:

1) On hearing emergency hooter does not leave the Occupational Health Center.
2) As per the instructions given by the person In charge of the emergency operation or Incident Controller arrange the supply of additional emergency safety equipment to incident place.
3) Give necessary first aid to the affected person immediately. Inform the site controller about the severity of the Injury and advice for further medical help if required. On arrival of doctor, assist him for medical treatment offered to the affected people.

7.2.7.10 LIST OF IMPORTANT AUTHORITIES WITH THEIR ROLE IN EMERGENCY AND TELEPHONE NUMBERS

List of important authorities with their role in emergency and telephone numbers will be prepared and listed, same will be placed/displayed at important locations.

7.2.7.11 INFORMATION ABOUT EXTERNAL COMMUNICATION SYSTEM

(1) Communication will be through Emergency Central Alarm System

(2) Telephones: An EPABX unit will be installed to connect all departments internally. Company will also provide mobile connections to all important personnel at site.

(3) STD PHONE & FAX/TELEX: Will be provided at IMP places

(4) IN THE EVENT OF FAILURE OF TELEPHONE SYSTEM:

Communication officer will arrange special messengers for communication Minimum one vehicle with driver/trained security personnel are available in the company premises round the clock.
We will communicate through our Administration department by our vehicle to nearby community.

7.2.7.12 ANNOUNCEMENT SYSTEM DETAILS

During emergency it is necessary that the alarm should be heard by all employees wherever they work, for that speakers will be placed at various locations within plant.

7.2.7.13 OUT SIDE IMPORTANT ADDRESSES AND PHONE NUMBERS

List of important addresses in the nearby area such as hospitals, ambulance services, fire fighting services, Government personnel (Municipal Commissioner, district collector, zilla panchayat, police station and emergency control services and their telephone numbers will be prepared and displayed outside emergency control room.

7.2.7.14 REHERSAL AND UPDATION OF PLAN

1) Every year mock drills will be organized. Shortfalls in actions observed during drill will be explained to participants and will be corrected accordingly.
2) Any shortcomings regarding On–Site Emergency Plan observed during such drills will be corrected and incorporated in On-Site Emergency Plan and same will be communicated to all.
3) The On-Site Emergency Plan will be updated after any significant development in factory or change in the law.

7.2.7.15 INFORMATION OF ASSEMBLY POINTS

At the time of emergency, non - essential workers, casual workers, visitors and others are to be replaced to Assembly Points and separate in charge are nominated.

In case of an emergency, the visitors, contract persons and factory employees will gather at nearby assembly point. Pre-designated persons will take their roll call. If needed, they can be evacuated easily through any gate in a short period as per instruction of site main controller.

7.2.8 OCCUPATIONAL HEALTH AND SAFETY PROGRAM FOR THE PROJECT

Health hazards associated with the occupation are called occupational hazards. In chemical industry due to handling of toxic and hazardous chemicals there are possibilities of developing occupational diseases. Company shall carry out the following checks to curb the problem:

i. Pre - employment medical checkup at the time of employment.

ii. Annual medical checkup shall be done for all employees.

iii. First aid training shall be given to the employees.

iv. Monitoring of occupational hazards like noise, ventilation, chemical exposure shall be carried out at frequent intervals, the records of which shall be documented.

TABLE-7.12 OCCUPATIONAL HEALTH MONITORING

No.	Particular	Medical test	Remark
1.	Pre employment Check up	Vision, Audiometry, Spirometry, chest Skiagram, Unrin, RBS, etc.	<30 yrs. Once in five years 31-40 yrs. Once in four years 41-50 yrs. Once in two years Above >50 yrs. once every year
2.	Periodical Check up	Spirometry, Urin, RBS, etc.	
3.	Post employment check up	Vision, Audiometry, Spirometry, chest Skiagram, Unrin, RBS, ec.	

All precautions would be taken to avoid foreseeable accident like spillage, fire and explosion hazards and to minimize the effect of any such accident and to combat the emergency at site level in case of emergency. Some of the preventive safety measures to minimize the risk of accident with respect to Technical Safety, Organizational Safety and Personal Safety are listed below:

- The factory will take all reasonably practicable measures to minimize the risk of such accident in compliance with the legal obligation under the relevant safety.
- All building plans and installations are as per relevant acts and duly approved by competent government authorities.
- Process and Equipment will be designed by qualified and experienced professionals and fabricated to applicable national / international codes with stage wise inspection.
- Safety features such as fire extinguisher and suitable Personal Protective Equipment (PPE) shall be provided. Regular operations and testing of fire extinguishers shall be carried out.
- Periodic inspection and testing of pressure vessels, equipment, machineries and equipment handling substances.
- Training of workers and Staff for firefighting, work permit system, first aid, safe handling of materials and integrating safety, in all activities.

- Accident / Incident reporting system and information of employees about the same for better awareness.
- Suitable notices / boards displayed at several locations indicating appropriate hazards warning as well as DOs and DON'T for ensuring operational and personal Safety for information of workers / staff and visitors.

For the safety of the workers, personal protective equipments like hand gloves, helmets, safety shoes, goggles, aprons etc. & Ear protecting devices like earplugs/earmuffs will be provided. Nose mask will be provided at places, where there is possibility of dust generation.

Company shall adequately install fire-fighting system in different sections of the plant.
Some of the safeties precautionary measures shall be taken for manufacturing process are listed below:

i. Safety Relief Valve, Rupture disk, temperature scanner, pressure indicator, and flow meter will be installed to vessel wherever required.
ii. Cooling / Chilling water circulation arrangement will be provided to avoid abrupt increase of pressure and control heat and high temperature.
iii. Auto control system (ACS) to Monitor & Control.
iv. Vent will be connected with scrubber as per the requirement.
v. PPE will be provided to workers during charging of various raw materials and exhaust ventilation lines will be provided as per requirement.
vi. Necessary interlocking and alarm system will be installed wherever required.

MEDICAL AID SCHEME

For outside help, company authority will make a mutual understanding with the following authorities to extend their help whenever an emergency occurs;

(1) Doctors from Civil Hospital

(2) Police Station

(3) Fire Brigade

Time to time company shall inform/impart training to concerned employees for awareness about chemicals and its hazards and the precautionary measures on their part.