CHAPTER -VI

HAZARD ANALYSIS AND RISK ASSESSMENT

6.1 INTRODUCTION

M/s Raichur Laboratories Pvt. Ltd deal with materials, some of which are hazardous in nature by virtue of their intrinsic chemical properties or their operating temperatures or pressures or a combination of these. Fire, explosion, toxic release or combinations of these are the hazards associated with industrial plants using hazardous chemicals. More comprehensive, systematic and sophisticated methods of Safety Engineering, such as, Hazard Analysis and Quantitative Risk Assessment have now been developed to improve upon the integrity, reliability and safety of industrial plants. The primary emphasis in safety engineering is to reduce risk to human life, property and environment. Some of the more important methods used to achieve this are: Quantitative Risk Analysis: Provides a relative measure of the likelihood and severity of various possible hazardous events by critically examining the plant process and design. Work Safety Analysis: Safety Audit: Takes a careful look at plant operating conditions, work practices and work.

6.2 Risk Assessment

A three levels risk assessment approach has been adopted for the **M/s Raichur Laboratories Pvt. Ltd** facilities. The risk assessment levels are generally consistent with the practices encountered through various assignments for medium and large chemical complexes.

The brief outline of the three tier approach is given below:

6.2.1 Level 1 – Risk Screening

This is top-down review of worst- case potential hazards/risks, aimed primarily at identifying plant sites or areas within plant, which pose the highest risk. Various screening factors considered include: Inventory of hazardous materials; Hazardous Materials properties; Storage conditions (e.g. temperature and pressure); Location sensitivity (distance to residential areas / populace).

6.2.2 Level 2 – Major Risk Survey (Semi - Quantitative)

The survey approach combines the site inspection with established risk assessment techniques applied both qualitative as well quantitative mode. The primary objective is to identify and select major risks at a specific location in the plant considering possible soft spots / weak links during operation / maintenance. Aspects covered in the risk usually include: Process Hazards; Security Vulnerability; Impact of hazards consequences (equipment damage, business interruption, injury, fatalities); Qualitative risk identification of scenarios involving hazardous materials; Risk reduction measures. Selection of critical scenarios and their potential of damage provide means of prioritizing. mitigative measures and allocate the resources to the areas with highest risks.

6.2.3 Level 3 – Quantitative Risk Assessment (Deterministic)

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

i. Hazards identification utilizing formal approach (Level 2, HAZOP etc.);

ii. Frequency Analysis. Based on past safety data (incidents / accidents); identifying likely pathway of failures and quantifying the toxic / inflammable material release;

iii. Hazards analysis to quantify the consequences of various hazards scenarios (fire, explosion, BLEVE, toxic vapour release etc.).Establish minimum value for damage (e.g. IDLH, over pressure, radiation flux) to assess the impact on environment.

iv. Risk Quantification: Quantitative techniques are used considering effect / impact due to weather data, population data, and frequency of occurrences and likely hood of ignition / toxic release. Data are analyzed considering likely damage (in terms of injury / fatality, property damage) each scenario is likely to cause.

FIGURE 6.1: COMPREHENSIVE RISK ASSESSMENT – AT A GLANCE

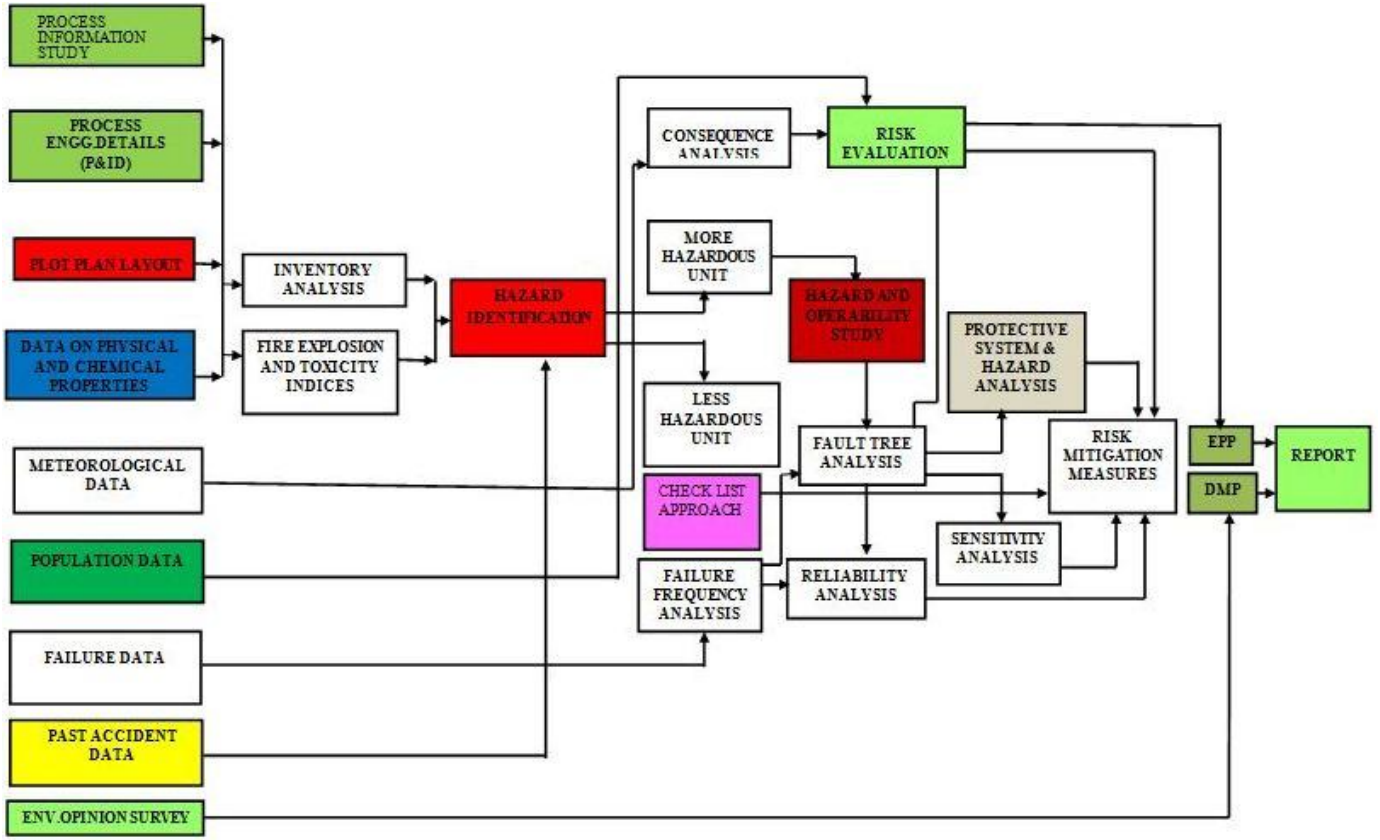

TABLE: 6.1. DETAILS OF STORAGE OF RAW/HAZARDOUS MATERIALS AND CONTROLS MEASURES

S.NO	NAME OF RAW MATERIAL	PHYSICAL STATE	TYPE OF STORAGE	MAX. QUANTITY OF STORAGE AT ANY POINT OF TIME [Tons]	PLACE OF STORAGE	STATE & OPERATING PRESSURE TEMP.	POSSIBLE TYPE OF HAZARDS	CONTROL MEASURES PROVIDED
1	Methyl vinyl Phosphate	Solid	HDPE Drums	0.500	Stores	Ambient	Harmful	Stored in well ventilated separate storage room/Storage Shed. Stored on identified suitable drums. Drums are stacked on pallets with proper identification and compatibility.
2	Mercapto side chain	Liquid	HDPE Drums	0.250	Stores	Ambient	Harmful	
3	Tri ethyl amine	Liquid	HDPE Drums	0.500	Shed	Ambient	Flammable	
4	Sodium hydroxide	Solid	PP bags	1.000	Stores	Ambient	Corrosive	
5	Hydrochloric acid [36%]	Liquid	PP Carboys	1.000	Shed	Ambient	Corrosive	
6	10% Palladium Carbon	Solid	MS Drums	0.025	Stores	Ambient	Flammable	
7	Pyrazole triazolium chloride	Liquid	HDPE Drums	0.250	Shed	Ambient	Corrosive	
8	Diisopropyl ethyl amine	Liquid	HDPE Drums	0.500	Shed	Ambient	Flammable	
9	Hydrogen	Gas	MS Cylinders	20 No’s	Shed	Ambient	Flammable	
10	Sodium carbonate	Solid	PP Bags	0.500	shed	Ambient	Irritant	
11	Sodium -2-ethyl hexanoate	Liquid	HDPE Drums	0.500	Stores	Ambient	Corrosive	
12	N- Metyl-2-pyrrolidine	Liquid	HDPE Drums	0.500	Shed	Ambient	Flammable	
13	Sodium bicarbonate	Solid	PP Bags	0.250	stores	Ambient	Irritnant	

14	Activated Carbon	Solid	PP Bags	0.100	Shed	Ambient	combustible	Stored in well ventilated separate storage room/Storage Shed. Stored on identified suitable drums. Drums are stacked on pallets with proper identification and compatibility
15	Amino ethane thiol	Liquid	HDPE Drums	0.250	Shed	Ambient	Corrosive	
16	Diisopropyl amine	Liquid	HDPE Drums	0.250	Shed	Ambient	Flammable	
17	Formamidine	Solid	Fibre Drums	0.250	Stores	Ambient	Corrosive	
18	PTSC	Solid	HDPE Drums	0.250	Stores	Ambient	Corrosive	
19	N-Ethyl diisopropyl amine	Liquid	HDPE Drums	0.500	Shed	Ambient	Flammable	
20	Cyclohexyl 1-chloro ethyl carbonate	Liquid	HDPE Drums	0.250	Stores	Ambient	Corrosive	
21	Formic acid	Liquid	HDPE Drums	0.500	Shed	Ambient	Corrosive	
22	Trifluoro acetic acid	Liquid	HDPE Carboys	0.250	Shed	Ambient	Corrosive	
23	Sulfuric acid	Liquid	HDPE Carboys	0.250	Shed	Ambient	Corrosive	
24	4-Methyl acetophenone	Liquid	HDPE Drums	0.500	Stores	Ambient	Flammable	
25	Sodium methoxide	Solid	MS Drums	0.250	Stores	Ambient	Flammable	
26	4-Amino benzene Sulfonamide	Solid	Fibre Drums	0.250	stores	Ambient	Corrosive	
27	Sodium Nitrite	Solid	Fibre Drums	0.250	Stores	Ambient	Harmful	
28	Sodium metabisulhite	Solid	Fibre Drums	0.250	stores	Ambient	Harmful	
29	L [-] Camphor sufonic acid	Solid	HDPE Drums	0.200	Stores	Ambient	Corrosive	
30	Benzene sulfonic acid	Solid	HDPE Drums	0.250	Stores	Ambient	Corrosive	
32	Para chloro benzophenone	Solid	Fibre Drums	0.500	Stores	Ambient	Harmful	
33	Ammonium formate	Solid	Fibre Drums	0.500	Stores	Ambient	Harmful	
34	Tartaric acid	Solid	Fibre Drums	0.500	stores	Ambient	Corrosive	

35	n,n-bis[2-chloro ethyl]amine HCl	Solid	Fibre Drums	0.500	Stores	Ambient	Corrosive	Stored in well ventilated separate storage room/Storage Shed. Stored on identified suitable drums. Drums are stacked on pallets with proper identification and compatibility.
36	Hydrobromic acid	Liquid	HDPE Carboys	0.200	Shed	Ambient	Corrosive	
37	Sodium mono chloroacetate	Solid	Fibre Drums	0.250	stores	Ambient	Corrosive	
38	4- Chlorobutyryl chloride	Liquid	HDPE Carboys	0.250	Shed	Ambient	Corrosive	
39	TBAB	Solid	Fibre Drums	0.050	Stores	Ambient	Harmful	
40	KOH	Solid	PP Bags	0.250	Stores	Ambient	Corrosive	
41	Dimethy Sulphate	Liquid	HDPE Drums	1.000	Shed	Ambient	Corrosive	
42	Ammonium carbonate	Solid	PP Bags	0.500	Stores	Ambient	Corrosive	
43	Phosphorous oxy chloride	Liquid	HDPE Carboys	0.250	Shed	Ambient	Corrosive	
44	Hydrogen peroxide[30%]	Liquid	HDPE Carboys	0.250	Shed	Ambient	Corrosive	
45	Acetic acid	Liquid	HDPE Drums	1.000	Shed	Ambient	Corrosive	
46	Acetic anhydride	Liquid	HDPE Carboys	0.500	Stores	Ambient	Corrosive	
47	Thionyl chloride	Liquid	MS with PP lining Drums	0.500	Shed	Ambient	Corrosive	
48	5-Difluoro methoxy -2-mercapto benzimidazole	Solid	FIbre Drums	0.500	Stores	Ambient	Harmful	
49	Magnesium chloride	Solid	Fibre Drums	0.250	Stores	Ambient	Corrosive	
50	[S]-2-Amino butanamide HCl.	Solid	Fibre Drums	0.250	Stores	Ambient	Corrosive	
51	3-Hydroxy Acetophenone	Solid	Fibre Drums	0.500	Stores	Ambient	Flammable	
52	Liquid bromine	Liquid	Glass Bottles	0.250	Shed	Ambient	Corrosive	
53	Ammonium chloride	Solid	Fibre Drums	0.250	Stores	Ambient	Corrosive	

54	N- Methyl benzyl amine	Liquid	HDPE Drums	0.250	Shed	Ambient	Corrosive	Stored in well ventilated separate storage room/Storage Shed. Stored on identified suitable drums. Drums are stacked on pallets with proper identification and compatibility.
55	IPA HCl	Liquid	HDPE Carboys	0.100	Shed	Ambient	Corrosive	
56	Liq Ammonia	Liquid	HDPE Drums	0.250	Shed	Ambient	Corrosive	
57	2- Amino biphenyl sulfide	Solid	Fibre Drums	0.200	Stores	Ambient	Corrosive	
58	Phenyl chloro formate	Liquid	HDPE Drums	0.500	Shed	Ambient	Corrosive	
59	Phosphoric acid	Liquid	HDPE Carboys	0.250	Shed	Ambient	Corrosive	
60	Piperazine	Solid	Fibre Drums	0.500	Stores	Ambient	Corrosive	
61	Chloro ethoxy ethanol	Liquid	HDPE Drums	0.500	Shed	Ambient	Flammable	
62	2,3-Lutidine	Liquid	HDPE Drums	0.500	Shed	Ambient	Flammable	
63	Nitric acid	Liquid	Aluminium Cans	0.250	Shed	Ambient	Corrosive	
64	3-Methoxy -1-propanol	Liquid	HDPE Drums	0.500	Stores	Ambient	Flammable	
65	2-Mercaptobenzimidazole	Solid	Fiber Drums	0.500	Store	Ambient	Harmful	
66	MMA in methanol	Liquid	HDPE Drums	0.500	Shed	Ambient	Corrosive	
67	2-phenyl ethyl amine	Liquid	HDPE Drums	0.250	Shed	Ambient	Corrosive	
68	Phosphorus pentoxide	Liquid	HDPE Carboys	0.250	Shed	Ambient	Corrosive	
69	Sodium borohydride	Solid	MS Drums	0.100	Stores	Ambient	Flammable	
70	OTBN	Solid	Fibre Drums	0.500	Stores	Ambient	Corrosive	
71	Ethylene glycol	Liquid	HDPE Drums	1.000	Shed	Ambient	Flammable	
72	DDH	Solid	Fibre Drums	0.250	Stores	Ambient	Corrosive	

73	Isobutyl boronic acid	Solid	HDPE Drums	0.250	Stores	Ambient	Corrosive	Stored in well ventilated separate storage room/Storage Shed. Stored on identified suitable drums. Drums are stacked on pallets with proper identification and compatibility.
74	Zinc Chloride	Solid	PP Bags	0.250	Stores	Ambient	Corrosive	
75	N- Hexyl lithium	Liquid	Cylinders	3No.S	Shed	Ambient	Flammable	
76	Tri fluoro acetic acid	Liquid	HDPE Drums	0.250	Shed	Ambient	Corrosive	
77	L- phenyl alanine	Solid	Fibre Drums	0.250	Stores	Ambient	Harmful	
78	Pyrazine carboxylic acid	Solid	Fibre Drums	0.500	Stores	Ambient	Corrosive	
79	N- Hydroxyl succinimide	Solid	Fibre Drums	0.500	Stores	Ambient	Corrosive	
80	Di cyclohexyl Carbodimide	Solid	Fibre Drums	0.250	Stores	Ambient	Corrosive	
81	N-Methyl morpholine	Liquid	HDPE	0.250	Stores	Ambient	Flammable	
82	Isobutyl boronic acid	Solid	HDPE Drums	0.200	Stores	Ambient	Corrosive	
83	70% Vitride [toluene solution]	Liquid	HDPE Caboys	0.250	Shed	Ambient	Flammable	
84	3,,4,5 –Trimethoxy benzoic acid	Solid	Fibre Drums	0.250	Stores	Ambient	Corrosive	
85	Tri phosgene	Solid	Fibre Drums	0.250	Stores	Ambient	Toxic	
86	Maleic acid	Solid	Fibre Drums	0.300	Stores	Ambient	Harmful	
87	Lysergol	Solid	Fibre Drums	0.250	Stores	Ambient	Toxic, Harmful	
88	Chloro ethyl formate	Liquid	HDPE Drums	0.500	Shed	Ambient	Corrosive	
89	4-Dimethyl amino pyridine	Solid	Fibre Drums	0.250	Stores	Ambient	Corrosive	
90	Di – tert butyl dicarbonate	Solid	Fibre Drums	0.250	Stores	Ambient	Toxic	
91	Iodo benzene diacetate	Solid	HDPE Drums	0.250	Stores	Ambient	Corrosive	
92	Sodium thio sulphate	Solid	PP Bags	0.250	Shed	Ambient	Harmful	

93	Allyl bromide	Liquid	HDPE Drums	0.250	Shed	Ambient	Corrosive	Stored in well ventilated separate storage room/Storage Shed. Stored on identified suitable drums. Drums are stacked on pallets with proper identification and compatibility.
94	Mycophenolic acid	Solid	Fibre Drums	0.250	Stores	Ambient	Corrosive	
95	Morpholine ethanol	Liquid	HDPE Drums	0.250	Shed	Ambient	Flammable	
96	Zinc oxide	Solid	Fibre Drums	0.250	Stores	Ambient	Corrosive	
97	Aluminium chloride	Solid	PP Bags	0.500	Shed	Ambient	Corrosive	
98	Ethane thiol	Liquid	HDPE Drums	0.250	Shed	Ambient	Corrosive	
99	Hexamethyl tetramine	Solid	Fibre Drums	0.250	Stores	Ambient	Flammable	
100	Isobutyl bromide	Liquid	HDPE Drums	0.250	Shed	Ambient	Corrosive	
101	Hydroxyl amine hydrochloride	Solid	HDPE Drums	0.250	Stores	Ambient	Corrosive	
102	Iodine	Solid	HDPE Drums	0.025	Stores	Ambient	Corrosive	

SOLVENTS

S.NO	NAME OF RAW MATERIAL	PHYSICAL STATE	TYPE OF STORAGE	MAX. QUANTITY OF STORAGE AT ANY POINT OF TIME	PLACE OF STORAGE	STATE & OPERATING PRESSURE TEMPERATURE	POSSIBLE TYPE OF HAZARDS	CONTROL MEASURES PROVIDED
1	MDC	Liquid	MS Drums	4.000	Shed	Ambient	Harmful	Stored in well ventilated separate storage room/Storage Shed. Stored on identified suitable drums. Drums are stacked on pallets with proper identification and compatibility. Bulk Quantities are stored in storage tanks.
2	Ethyl acetate	Liquid	MS Tank	10.000	Open	Ambient	Flammable	
3	Toluene	Liquid	MS Tank	10.000	Open	Ambient	Flammable	
4	IPA	Liquid	MS Tank	10.000	Open	Ambient	Flammable	
5	Acetone	Liquid	MS Tank	10.000	Open	Ambient	Flammable	
6	Tetra hydro furan	Liquid	HDPE Drums	3.000	Shed	Ambient	Flammable	
7	DMF	Liquid	HDPE Drums	3.000	Shed	Ambient	Flammable	
8	Methanol	Liquid	HDPE Drums	3.000	Shed	Ambient	Flammable	
9	MIBK	Liquid	HDPE Drums	3.000	Shed	Ambient	Flammable	

6.3 SOLVENTSTORAGE TANKS /DRUMS HANDLING PRECAUTIONS

DRUMS

MDC will be transferred to the day tank situated at the production block with the help of AOD pump through pipe lines from the drums. From day tank to reaction vessel unloading by gravity.

Other Solvents will be transferred to the Reaction vessel through pipe lines from the drums with vacuum

STORAGE TANKS

Solvent will be transferred to the day tank situated at the production block with the help of mechanical seal pump through pipe lines from the tank, from day tank to reaction vessel unloading by gravity.

Tank is connected to chilled water circulated condenser with reflux system

MEASURES TO AVOID EVAPORATION

Flammables area, keep containers tightly closed.

Keep away from heat, sparks, and flame

Keep away from sources of ignition

Store in a cool, dry, well ventilated area away from incompatible substances

SAFETY SYSTEMS

- Designated areas with proper indication & safety sings
- Double earthing systems
- Flame arrestor to the vent
- Flame proof transferring pumps
- Handling precautions/sop protocol
- Pressure Gauges
- Level indicators
- Flame proof lighting to storage yard

6.4 EFFECT AND CONSEQUENCE ANALYSIS

As a part of risk assessment study, worst case scenarios analysis is carried out to determine the maximum loss scenarios. The selection of the accident scenarios is based on the engineering and professional judgment, accident descriptions of the past in similar type of plants & the expertise in risk analysis studies.

6.5 INCIDENTS IMPACT

The identified failure scenarios in plant have been analyzed for the impact zones considering damage due to thermal, explosive and toxic impacts. Each incident will have Impact on the surrounding environment which in extreme case may cross plant boundary.

6.6 SAFETY AT THE PROPOSED PLANT

6.6.1 System Specific Measures

The proposed plant will adopt various safety measures for handling and storage of hazardous materials. Safety initiatives to be adopted at the proposed plant have been described below:

6.6.2 Occupational Health, Environment and Safety Policy

The plant will prepare Occupational Health, Environment and Safety Policy. The Occupational Health, Environment and Safety Policy will be displayed at locations prominently within the plant and will be circulated to all employees.

6.6.3 Environment, Health & Safety Organization

The HSE department will be managed by qualified, experienced and competent personnel and strict controls will be enforced for each hazardous activity

6.7 Accident Reporting, Investigation and Analysis

A record for near-miss, incidents and accidents is and will be maintained and analyzed to take precautionary measures (Ref. Annexure - VII). All near-miss incidents and accidents will be reported and investigated to take corrective measures. The accident statistics and data will be maintained by Environment, Health & Safety Department. Accident statistics and data will be reviewed regularly by senior management to take corrective measures.

6.8 SAFETY INSPECTIONS AND INTERNAL AUDIT

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

6.8.1 Safety Education and Training

A. Safety Training

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

B. Periodic Training / Reporting

The workers will be trained as per need of training.

C. Safety Communication / Motivation / Promotion

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

6.8.2 First Aid

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

6.9 OCCUPATIONAL HEALTH

Occupational Health

Hazardous and toxic substances are defined as those chemicals present in the work place which are capable of causing harm.

[In this definition the term chemicals include dust, mixtures and common materials-solvents.]

- For handling hazardous chemicals and to take care of employee's health, and predictive maintenance looking to the nature of hazardous chemicals being handled/processed. All the equipments in the plant areas shall be inspected/tested by an outside agency.
- The various safety equipments like breathing apparatus and critical instrumentation provided on various equipments are inspected and tested frequently to ensure their operability all the time. Besides, all the first aid, fire fighting devices are also being inspected, tested and maintained by a competent third party and kept all the time in ready to use condition.

- Health of all the employees in plant area is regularly monitored by outside physician. If any abnormality is found necessary treatment is also being given time to time. Necessary history cards, records are also be maintained which is up-dated time to time.

6.9.1Common Hazards

- Physical such as ventilation, poor illumination, noise, extreme temperature, humidity and radiation.
- Biological such as variety of pathogenic bacteria and parasites.
- Chemical due to hazardous gases and dusts.
- Ergonomic.

6.9.2 Industrial Hygiene Monitoring

- Industrial hygiene monitoring is to located and identify source of exposure in the workplace so that they can be corrected and to quantify the exposure of employees to chemicals in the air.
- Air monitoring is conducted by industrial hygienists or other person with specialized training he hygienist first record relevant data such as the process or activity sources of contamination and ventilation conditions then he or she uses special equipment to measure the levels of substance present in the workplace employees should be informed have a right to obtain monitoring results under the OSHA regulation.

6.9.3 Occupational Health Monitoring System

A. Air samples

Location of samples – air samples are generally collected in one or three locations:

- At the breathing zone of the worker [Personal sample]
- In the general room air [Area sample]
- At the operation which is generating the hazardous substance [Area sample]

Length of samples – Air samples are generally collected for two lengths of time.

- Grab samples [instantaneous] measure conditions at one moment in time and can be likened to a still photograph. They give only a picture of conditions at one place at one instant in time.
- Continuous Samples [range from twenty minutes to 8 – 10 Hours].These is used to evaluate all day exposure by a series of continuous samples. Continuous samples may be thought of as like a motion picture since they record activity taking place in various places over a period of time. They provide an average of conditions over a period samples.

B. Other sampling methods

Bulk samples

Bulk samples are collected from settled dust in the work place or from drums or bags of chemicals. Their purpose is to analyze and identify the substances present. For example, bulk samples are used to analyze the percent of asbestos in insulation or dust. Usually, a substance which is greater than one percent of bulk sample is considered a concern.

Wipe Samples

Wipe samples are used when skin absorption or ingestion is a suspected rote of exposure. The purpose is to show whether skin, respirators, clothing, lunch rooms, lockers, etc. are contaminated.

It can show which surfaces are clean and which are contaminated. It can also show if some surfaces are more contaminated than others.

Sampling Devices

The general principle of sampling is to collect an amount of a contaminant onto a medium from a known quantity of air.

Air samples are collected using small pumps to suck air from the workroom. The pump is attached by tubing to a sampling device which contains the sampling medium; for example a glass tube containing charcoal.

The sampling method used depends on the physical from of the substance:

- DUSTS –The sampling device is a filter of plastic or paper in s holder:
- VAPORS –The sampling device is a glass tube containing activated charcoal as a medium.

- GASES –The sampling device is a bubbler containing a fluid medium to dissolved or react with the gas

- **PEL**s [**P**ermissible **E**xposure **L**imits] – these are legal's limits which have been established by OSHA.
- Recommended **PEL**s – also reference to as **REL**s [**R**ecommended **E**xposure **L**imits] often these values are based on more recent scientific information than the legal PELs enforced by OSHA.
- **TLV**s [**T**hreshold **L**imit **V**alues] – These are exposure limits put out by a nongovernmental group, the **ACGIH** [**A**merican **C**onference of **G**overnmental **I**ndustrial **H**ygienists]. Many of these were adopted as legal requirements. Revised TLVs are often based on the most recent and accurate scientific information.
- Permissible Exposure Limits by **OSHA** [**O**ccupational **S**afety and **H**ealth **A**dministration] when it started back in 1970.
- **IDLH** [**I**mmediate **D**angerous to **L**ife and **H**ealth] limits are prescribed by **NIOSH [N**ational **I**nstitute **of O**ccupational **S**afety and **H**ealth]

CHEMICAL EXPOSURE CONTROLS / PERSONAL PROTECTION

S. No	CHEMICAL NAME	ACGIH [TLV]	OSHA [PEL]	NIOSH [IDLH]	PROTECTION
1	Acetic anhydride	5	5	200	Engineering controls, Ventilation and PPEs
2	Sodium hydroxide	2	2	10	Engineering controls, Ventilation and PPEs
3	Sulphuric acid	1	1	15	Engineering controls, Ventilation and PPEs
4	Formaldehyde	0.75	0.75	20	Engineering controls, Ventilation and PPEs
5	Hydrochloric acid	5	5	50	Engineering controls, Ventilation and PPEs
6	Liq.Ammonia	25	50	300	Engineering controls, Ventilation and PPEs
7	Hydrobromic acid	3	3	30	Engineering controls, Ventilation and PPEs
8	Hydrogen peroxide	1	1	75	Engineering controls, Ventilation and PPEs
9	Mono methyl amine	5	10	100	Engineering controls, Ventilation and PPEs
10	ethanethiol	0.5	0.5	500	Engineering controls,

					Ventilation and PPEs
11	Sodium methoxide	200	200	6000	Engineering controls, Ventilation and PPEs
12	Zinc chloride	1	1	50	Engineering controls, Ventilation and PPEs
13	Aluminium chloride	2	2	-	Engineering controls, Ventilation and PPEs

SOLVENTS

S. No	SOLVENT NAME	EXPOSURE STANDARDS			PROTECTION
		ACGIH [TLV]	OSHA [PEL]	NIOSH [IDLH]	
1	Methanol	200	200	6000	Engineering controls, Ventilation and PPEs
2	Toluene	50	100	500	Engineering controls, Ventilation and PPEs
3	Acetone	750	750	2500	Engineering controls, Ventilation and PPEs
4	Ethyl acetate	250	250	2000	Engineering controls, Ventilation and PPEs
5	MDC	50	500	2300	Engineering controls, Ventilation and PPEs
6	IPA	400	400	2000	Engineering controls, Ventilation and PPEs
7	THF	200	200	2000	Engineering controls, Ventilation and PPEs
8	DMF	10	10	500	Engineering controls, Ventilation and PPEs
9	MIBK	50	100	500	Engineering controls, Ventilation and PPEs

Notes:

- All the above Values are in **ppm**
- Engineering Control means provision of Exhaust Fans, Fume Hoods, Fume Ducts etc.,
- Ventilation means Good Lighting, Air Circulation etc.,
- PPE Means Personal Protective Equipment like Helmets, Safety Google, Breathing apparatus, Nose Masks, Gloves, Gum Shoes etc.,

6.9.4 Medical Surveillance: Employees are under gone for medical checkup periodically in industry.

There are basically two types of job – related medical tests:

- Disease monitoring tests look for evidence that an employee has developed an occupation disease these include chest X-rays lung function tests blood or urine tests for kindly or liver function and EKG's to check the heart.
- Tests for toxic substances in our blood, breathe, urine. Hair or other part of our body, such tests known as biological monitoring.

Conclusion:

Exposure to occupational hazardous increases the risk for morbidity and mortality.
The most prevalent occupation practices that increase the risks for morbidity and mortality are lack of training in occupation health safety lack of PPE's inadequate training in the proper use of machinery and long hours of work the situation is further compounded by overcrowding and poor sanitary conditions.
There is an urgent need to introduce safe industrial hygiene practices based on accurate knowledge of existing hazards and job exposure matrix for reducing the risks associated with occupational hazards.

6.10 HAZARD CONTROL MEASURES

- Procedures and actions will be well defined and known to all operating personnel's for safe shut down of plant in case of failure of any power, instrumentation, cooling water, air, etc.
- All the vessels and tanks will be provided with temperature indicator, pressure gauge and safety valves as depending upon the process and operating parameters.
- Plant specific HAZOP studies will be carried out using P & IDs for identification of hazards during operation considering deviation of operational parameters, their possible cause and consequence and safe guards.
- Interlocks and DCS control will be provided during reaction process.

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

6.11 OPERATIONAL SAFETY

- All operators & maintenance personnel's concerned with the plant will be given data sheets for hazardous chemicals and to be trained to combat any leakage spillage, etc.
- Interlocks and DCS control will be provided during reaction process.
- Instrumentation provided will be calibrated at regular intervals.

- Detections and sensors for smoke, heat, ammonia, chlorine, etc. will be provided with alarm at strategic locations at the plant.
- Non-destructive thickness measurements will be carried out regularly to prevent sudden bursting by thinning out of metal by erosion or corrosion through competent person.
- Safety appliances like PVC suit, hand gloves, safety goggles, helmets etc. will be used during material handling. Also SCBA/emergency air masks will be kept available all the time.
- Emergency First Aid kits will be kept available in all departments.
- Preventive maintenance will be carrying out as per schedule to avoid failure.
- Internal and external inspection of vessel, tanks, piping, thickness measurement of piping, inspection and testing of lifting tackles, etc, will be carried out as per schedule.

6.12 TOXIC RELEASES: CONTROLS

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

6.13 SPILLAGES, LEAKAGES: CONTROLS

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

6.14 HAZARDS IN TRANSPORTATION: CONTROLS

Highly inflammable chemicals will be transported by road. Therefore, adequate safety precautions for transportation are followed. During transportation of hazardous chemicals, MSDS & TREM card will be provided to driver. As per

Motor Vehicle Rules, PESO rules and Factory Rules all safety precautions will be followed during transportation of hazardous chemicals.

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

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

6.15 SAFETY INSTRUCTIONS FOR TRANSPORTATION OF HAZARDOUS MATERIALS

- The name of the chemical along with pictorial sign denoting the dangerous goods should be marked on the vehicle and the packing material.
- The name of the transporter, his address and telephone number should be clearly written on the road tanker and on the vehicle.
- The important safety precautions should be mentioned on the tanker as a warning label.
- The tanker or vehicle should not be used to transport any material other than what is written on it.
- Only trained drivers and cleaners should transport hazardous chemicals.
- The transporter and the manufacturer must ensure the safe transportation of the material.
- Tankers

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

6.16 OTHER HAZARDS AND CONTROLS

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

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

6.17 MAINTENANCE HAZARDS

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

- Lifting tackles will be maintained and examined periodically as per rules & regulation.
- Hand tools/power tools will be used with approved types and of good quality.

6.18 RISK REDUCTION MEASURES

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

6.18.1 Risk Mitigation/Reduction Measures

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

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

- A written process safety information document may be compiled for general use.
- Personnel especially contractor workers at the plant should be made aware about the hazardous substance stored at the plant and risk associated with them.
- The process design information in the process safety information compilation must include P&IDs/PFDs; process chemistry; maximum intended inventory; acceptable upper and lower limits, pressures, flows and compositions and process design and energy balances.
- The document compilation should include an assessment of the hazards presented including (i) toxicity information (ii) permissible exposure limits. (iii) Physical data (iv) thermal and chemical stability data (v) reactivity data (vi) corrosivity data (vii) information on process and mechanical design.
- The adequate numbers of heat, smoke, ammonia, detectors may be provided at strategic locations in the plant and indication of detectors/sensors should be provided in main control room.

- Predictive and preventive maintenance schedule should be prepared for equipment, piping, pumps, etc. and thickness survey should be done periodically as per standard practices.
- Safety measures in the form of DO and Don‘t Do should be displayed at strategic locations especially in Telugu and English language.
- Safe work practices should be developed to provide for the control of hazards during operation and maintenance.
- Personnel engaged in handling of hazardous chemicals should be trained to respond in an unlikely event of emergencies.
- The plant should check and ensure that all instruments provided in the plant are in good condition and documented.

6.19 PERSONAL PROTECTIVE EQUIPMENT

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

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

6.20 IMPORTANT RISK MITIGATION MEASURES

- Safe Operating Procedures will be made for all processes & operations and these are being operated according to Safe Operating Procedures. Staffs are also trained for the same.

- Hazardous chemicals will be stored in separate storage along with all safety measures.
- Gas detectors will be installed and emergency gas leakage handling kits and scrubbing arrangements will be provided for handling emergency, at the chlorine station.
- Hazardous operations will be carried out by trained person & under supervision.
- Hazardous chemicals will be handling in close circuit.
- Enclosures will be provided with vent connected to scrubber
- Nitrogen blanketing will be done for storage & process of highly flammable liquids.
- Safety fittings like Safety valve, Pressure reducing valve, vent, flame arrestor, pressure / temperature indicators, level indicators, rupture discs etc. will be provided to the concern equipment.
- Periodical testing will be carried out by competent person for Pressure vessels and Lifting tackles.
- Preventive maintenance will be done periodically for all concern equipment.
- Calibration of all instruments in the plant will be carried out periodically.
- Interlocks will be provided as & where required, in manufacturing processes.
- Loading / Unloading will be ensured with earthing & bonding for flammable chemicals.
- Flameproof fitting, Earthing & Bonding of equipment & pipelines will be provided.
- Work permit system will be followed strictly.
- Periodic on site emergency Mock drills will be arranged.
- Work area monitoring will be done periodically.
- Safety training‘s will be given to the employees for handling of hazardous chemicals. First aid treatment will be provided through well-equipped first aid box & Occupational Health Centre. Trained first aid persons will be available in each shift. Pre-employment & periodic medical examination is done.

- Monthly Cholinesterase enzyme test will be done for those employees who are working in manufacturing process.
- Washing and Bathing facilities will be provided
- Well-maintained SCBA set & Emergency Airline respirators will be installed at conspicuous places.
- Protective clothing will be provided to all employees & casual workers and these are regularly washed properly.
- Necessary PPE's will be readily available. Jobs are accomplished using relevant PPEs
- Deployment of competent supervisors for supervising hazardous activities.
- Necessary cautionary placards will be displayed at conspicuous places in company.
- Eating & Chewing will be prohibited in manufacturing area.
- Vehicle and strangers movements will be regulated.

6.21 SPILL CONTROL

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

6.22 HANDLING OF HAZARDOUS MATERIALS

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

- General Working Conditions at the Proposed Plant

12.36) House Keeping

- All the passages, floors and stairways should be maintained in good conditions.
- The system should be available to deal with any spillage of dry or liquid chemical at the plant.
- Walkways should be always kept free from obstructions.
- In the plant, precaution, instructions and DO and Don‘t Do should be displayed at strategic locations in Gujarati and English Languages.
- All pits, sumps should be properly covered or securely fenced.

6.23 VENTILATION

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

6.24 SAFE OPERATING PROCEDURES

- Safe operating procedures will be available for mostly all materials, operations and equipment.
- The workers will be informed of consequences of failure to observe the safe operating procedures.

6.25 FIRE PROTECTION

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

6.26 STATIC ELECTRICITY

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

- Periodic inspections shall be done for earth pits and record shall be maintained.

6.27 COMMUNICATION SYSTEM

Communication facilities shall be checked periodically for its proper functioning.

6.28 SAFETY INSPECTIONS

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

6.29 SAFE OPERATING PROCEDURES

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

6.30 PREDICTIVE AND PREVENTIVE MAINTENANCE

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

6.31 ELECTRICAL SAFETY

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

6.32 COLOUR CODING SYSTEM

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

6.33 DISASTER MANAGEMENT PLAN

Level of emergency can be classified in three categories.

LEVEL-1

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

- Small fire in the plant
- Low toxic gas release for short duration.
- Collapsing of equipment that do not affect outside premises.

LEVEL-2

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

- Major fire inside the factory premises.
- Medium scale explosion confined to the factory premises.
- Heavy toxic/flammable gas leakage for short duration.

LEVEL-3:

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

- Explosion of high magnitude affecting the adjacent area
- Heavy/profuse leakage of toxic/flammable gases for a long duration.

6.34 OBSERVER

Any person noticing a fire, leakage of chemicals or an unusual occurrence will contact the security personnel a main gate and plant supervisor by:

- Giving a telephone message
- Sending message through a messenger
- Rush personally

While giving the message, he will:

- Identity himself
- State briefly type of emergency
- Location of incident/accident
- Severity of emergency

After giving message, he will return to the scene/area of emergency by taking all personnel protection measures, if possible and awaits instructions from plant supervisor (incident controller).

6.35 ROLE OF CHIEF EMERGENCY CONTROLLER

He will be chief manager in his absence, the plant supervisor will be the chief controller till any one of the designated manager arrives at site and assumes overall charge of the situation. His task will be to co-ordinate all internal and external activities from the emergency control centre at main security gate from where all operations will be directed. He shall:

- Immediately on being informed of the emergency and its location, will arrive at the scene and handle the situation.

- Relieve the incident controller from responsible of the main controller
- Co-ordinate to avail services from external agencies like fire brigade, hospitals etc.is called for, following the declaration of major emergency. If necessary, major installations in the vicinity may also be informed of the situation.
- Exercise direct operational control of the unaffected section of the plant.
- In consultation with the advisory team, expedite the shutting down of loading/unloading operations of tankers and if necessary, instruct the supervisor/security/personnel to evacuate tankers.
- Ensure that all employees are evacuated from the affected area and the casualties, if any, are given necessary medical attention. Instruct P&A Assistant/security for rushing casualties to hospitals if required.
- Liaise with fire and police officials, pollution control board officials and other statutory bodies and advise them of all possible consequence effects outside the premises.
- Arrange for relief of personnel when emergency is prolonged
- Issue authorized statement or press release to the news –media
- Ensure preservation of evidence for enquiries to be conducted by statutory authorities.
- Authorize the sounding of “All Clear” and “Evacuation Siren”
- Arrange for obtaining the head-count of all personnel within the premises and cross-checking with the data from records available for no. of persons within the premise.

TABLE- 6.2 DETAILS OF SITE MAIN AND ALTERNATIVE CONTROLLER

S. No	Site Main Controller						Alternate		
	Name & designation	Qualification	Place of availability		Telephone Nos.		Name& designation	Place of availability	Telephone Nos.
			Factory	Residence	Factory	Residence			

6.36 INCIDENT CONTROLLER

Role of Incident Controller [Plant Manager/Shift in Charge].He is the shift supervisor of the plant. Assume the role of the incident controller and take charge of the situation. Keep the chief controller informed of the situation from time to time.

1. Proceed to the scene of emergency and assess the situation
2. Direct all operation within the affected area with the following priorities

- Safety of personnel
- Minimize damage to property and loss of material
- Arrange for rescue of trapped workers and those in a state of shock
- Get all non-essential persons safely evacuated after stopping all the engineering/hot jobs.
- Set up a communication system with the main control center at the main security gate through telephone or messenger system.
- Pending arrival of the main controller, direct the shutting down and evacuation of the site
- Report all developments to the main controller
- Preserve all evidence for use in the subsequent enquiry.
- Intimate to the Emergency Control Center (Main Security Gate) the head count of plant.

TABLE- 6.3: INCIDENT CONTROLLERS

Shift	S. No	Incident controllers			Place of availability			Runners		
		Name	Designation	Qualification	Factory	Residence	Telephones Nos. Factory	Name	Designation	Place of availability
A										
B										
C										

6.37 FIRE SERVICES

Fire Fighting, Gas leak Control and Rescue operation

A] Role of Manager (Fire and Safety/shift in-charge [Fire and Safety]:

- Manager [EHS] shift in-charge will be the only person to direct the fire fighting and emergency operation.
- Keep the constant touch with the chief emergency controller.
- Direct the crew members to the scene of emergency and arrange replenishment of man power/equipment/extinguishing media etc.

B] Fire and Safety officer. [EHS Officer]:

- On being notified about the location of fire/gas leakage immediately proceed to the scene of incident with fire tender and crew.
- Position the fire tender in upwind direction.
- Decide his line of action in consultation with incident controller and take appropriate measures to handle the emergency.
- Assessing the severity of the incident immediately report to emergency controller about the gravity of the situation.
- He will assess the extra requirement required if any from the neighboring industry.

C] Fire Crew Members:

- On hearing fire alarm, emergency siren they shall immediately report to control room and proceed to the scene of emergency and work under the direction of shift fire & safety officer.
- The personal availability at the scene of incident to be made optimize.

6.38 PLANT OPERATIONS

1. Role of HOD:

He will take plant related decisions, which will facilitate the fire fighting operation.

2. Plant Employees:

They shall:

- On heaving the siren, report to plant supervisor

- Do as directed by plant supervisor
- Stop all hot works
- Remove unwanted persons from the affected area to the "Assembly Point "near main security gate viz visitors, guests
- Stop all non-essential operations

3. Non-plant Employees:

On hearing the siren, shall stop their work assemble at "Assembly Point" near main security gate along with guests and visitors.

6.39 MEDICAL SERVICES

A] Role of Chief Medical Officer/Medical Officer (Medical Assistance):

- He will contact immediately to chief emergency controller
- He will render necessary treatment as first aid center and hospital.
- He will arrange for hospitalization and treatment at outside hospitals if required.
- He will mobilize extra medical assistance from outside if necessary.
- He will make arrangement for treating public if necessary.

B] ROLE OF OTHER MEDICAL STAFF:

As directed by medical officers.

6.40 ADMINISTRATIVE SERVICES

A] ROLE OF Dy.MGR (HR):

- He will contact chief emergency controller immediately and keep in touch with local authorities and nearby fire services for their help.
- He will inform Collector, Inspector of Factories and Police department as per the legal requirements.
- Ensure that press does not publish inauthentic news.
- Coordinate to inform relative of affected persons.
- Depute one person each at assembly points to record all personnel arriving there and pass information to chief emergency controller.

- Arrange for round of the clock persons at hospitals to look after the need of the affected personnel.
- Prepare record of affected personnel with local and permanent address.

B] ROLE OF TELEPHONE OPERATOR**:**

- Ensure that telephone operator keeps the board free to the extent possible for incoming calls.
- He should immediately convey message to key person's operation director, all H.O.D.'s, and all concerns as directed by the chief emergency controller.

TABLE 6.4: MEDICAL ARRANGEMENTS

S. No	Name & Location	Telephone Nos.	In-charge person name and Designation	Address residence	Facilities & equipment's	Antidotes available	First aid available	accommodation

AMBULANCE VAN OR ALTERNATE ARRANGEMENT

	Place of availability	capacity	Facilities available in the van	Driver's name and address	Doctors nearby name and address, Telephone No.	Other medical staff		Mutual aid arrangement
						Name &address Telephone No.	Residence address Telephone no.	

6.41 SECURITY SERVICES

Role of H.O.D. (Security) / Security Officers.

- Receive message from the observer
- Initiate the emergency siren to declare the emergency
- Announce on the public address system
- Arrange to close all the gates and stop traffic
- Keep vehicle/ambulance ready and keep track of casualty sent to hospital during off hours
- Ensure that unauthorized persons/vehicles do not enter the premises\
- Organize the positioning and transport of vehicles near the main gate
- Depute security guard for controlling traffic at the scene of emergency
- Call up for additional help from the outside agency like fire brigade, hospitals during off hours

6.41.1 ROLE OF SECURITY GUARD

On hearing emergency siren contact security officer and work under his directions.

MUTUAL AID:

Role played by members of mutual aid scheme

- On receiving the call they shall proceed immediately with fire crew and fire tender.
- The place of incident will be guided by the main gate security guard.
- Fire crew in-charge will report to the fire officer of the unit in which incident has occurred and assist the emergency operation as guided by him.
- In-charge of assisting fire brigades ensures safety of their crew members involved in emergency operation.

6.42 EMERGENCY RESPONSE

Concept of operations deals with the possible steps associated with an emergency response assuming the most severe emergency scenario. This includes:

- Accident initiation and rising of alarm
- Accident evaluation and emergency declaration
- Off site and external agency notification
- Implementation of onsite response actions

- Implementation of protective actions and evacuations
- Co-ordination of response action with external agencies
- Management of emergency resources
- Recovery and facilitate re-entry procedures

6.43 EMERGENCY CAPABILITIES

The primary emergency response facilities comprise with emergency control center upon declaration of emergency, the main security gate office will become the emergency control center [ECC].The ECC is located in a low /minimal risk zone of the plant. It is manned round

6.43.1 EMERGENCY HANDLING PROCEDURES

Action plan:

- On hearing emergency declaration siren and announcement on public address system, all key persons will rush to their nominated location and start actions.
- The main controller will continuously assess the situation by taking feedback from the incident controller. He will consult the advisory team members to get essential information if required but if does not required to take help from advisory team; he can assign other jobs to advisory team.
- Once the emergency is brought under control, Main Controller will inform to security to give **"ALL CLEAR"** siren and announce on Public Address System about termination of emergency.

In the case the emergency assumes off site dimensions and cannot be controlled, then if the chief controller with his advisory team decides to evacuate the plant, he will instruct the security to sound "**EVACUATION SIREN"**

Procedure in case emergency tends to have off site implications

- As per the sire plan and wind direction at the time of emergency, the likely affected area will be identified and population within will estimated.
- The police will be informed so that in-coming traffic on highway can be controlled from both the ends. The police force will be helpful in evacuation of villages, factories or other public places in the vicinity

- The fire brigade will be informed and ambulance will be called and kept ready to meet any eventuality.
- Neighboring factories will be communicated for sending help.
- Statutory authorities such as factory inspector, district collector and others concerned to be intimated.

Procedure for salvage operations

- The salvage operation will be carried out under the guidance of the main controller, his advisory team and incident controller.

They will conduct accident investigation; assess the damages-the clock by security supervisors.

During emergency, the main controller and his advisory-team will confirm

- Master plan of facility and 5kms surrounding area-displayed on wall
- Layout of facility, equipment and storages, displayed on table and wall
- Availability and location of personal protective equipment
- Self-contained breathing apparatus sets and the spare cylinders
- External telephone with direct dialing and STD facilities
- Internal telephone
- List of important internal and external telephone numbers displayed on table and wall.
- Transport facility
- Extra copies of plant layout for marking during emergency
- Telephone directory both local and surrounding district
- General stationary like paper, pencil etc.
- Nominal roll and address of all employees with contract telephone no's and blood group
- List of first aiders and emergency squad members
- Details of all contractors and their employees.
- Details of meteorological information during different seasons such as wind speed, direction, temperature, humidity etc.

The location of ECC, Assembly points, availability of first aid boxes, fire extinguishers, PPE should be marked onsite.

6.44 MITIGATION OF ENVIRONMENTAL IMPACT DURING FIRE EMERGENCY

- In case of fire, cut of contact of fire with flammable material or prevent of fire by other means
- Use water or suitable fire extinguisher to extinguish fire
- Contain the contaminated water or any other liquid to prevent it going to soil or drain and divert it to ETP storage tank. If required treat it before sending to ETP tank.
- Any solid waste generated should be collected, stored and send to TSDF site.
- During fire emergency use necessary PPE.
- Bottom valve failure: mitigation of environment impact during failure of between valves or tank failure.
- In case of material coming out of the bottom valve shall be contained inside the dyke wall and will be transferred to HDPE plastic drum by help of pump/piping.
- In case of acid spillage after pumping shall be neutralized and waste shall be cleaned with help of water and send the water to ETP.
- The failed bottom valve shall be replaced or repaired and restart. After tank is empty valve will be repaired, or replaced. In case of leakage form tank body tank will be repaired.
- Preventions of failure: preventive maintenance of bottom value shall be carried out as per schedule. To prevent any leakage from tank body, thickness checking shall be same as per schedule.
- In case of bottom value failure or heavy leakages from tank body material from caustic of aniline in the tank shall be transferred to the HDPE drums, by running the pump.
- Preventions of failure: preventive maintenance of bottom valve shall be carried out as per schedule. To prevent any leakage from tank body, thickness checking shall be same as per schedule.
- In case of any material leaching the soil it shall be neutralized and washed with water.

TABLE-6.5: KEY PERSONNEL

KEY PERSONS							ALTERNATIVE			
S. No	Department	Name, Address & Design.	Qualification	Place Of Availability			Name, Address & Design.	Place Of Availability		
				Factory	Residence	Telephone no. Factory		Factory	Residence	Telephone no. Factory

EXTERNAL AND INTERNAL EMERGENCY TELEPHONE NOS.TABLE

TABLE 6.6: EXTERNAL EMERGENCY TELEPHONE NOS.

S. No.	Name	Place	Office

TABLE-6.7: INTERNAL TELEPHONE NOS.

S. No.	Name & Location of the plant, Department or Area	Telephone Numbers (Internal)

6.45 ESSENTIAL WORKERS

A task force of essential trained workers [expert's team] is available to get the work done by the incident controller and the site main controller. Such work will include:

- Fire fighting and spill control till a fire brigade takes the charge.
- To help the fire brigade and mutual aid teams, if it is so required.
- Shutting down plant and making it safe.
- Emergency engineering work e.g. isolating equipment, material process, providing temporary by-pass lines, safe transfer of materials, urgent repairing or replacement, electrical work, etc.
- Provision of emergency power, water, lighting, instruments, equipments, materials, etc.
- Movement of equipment, special vehicle and transport to or from the scene of the accident.
- Search, evacuation, rescue and welfare.
- The injured is given first aid.
- Moving tankers or other vehicles from area of risk.
- Carrying out atmospheric test and pollution control.
- Manning of assembly points to record the arrival of evacuated personnel. Manning for outside shelters and welfare of evacuated persons there.
- Assistance at causalities reception areas to record details of causalities.

- Assistance at communication centers to handle outgoing and incoming calls and to act as messengers if necessary.
- Manning of works entrances in liaison with the police to direct emergency vehicles entering the work, to control traffic leaving the works and to turn away or make alternative safe arrangements for visitors, contractors and other traffic arriving at the works.
- Informing surrounding factories and the public as well as directed by the site main controller.
- Any special help required.

TABLE 6.8: ESSENTIAL WORKERS

S. No.	Name	Designation	Residence address	Trained for work

6.46 ASSEMBLY POINTS

At the time of emergency, on-essential workers, casual workers, visitors and others are to be replaced to assembly points and separate in charge are nominated.

TABLE 6.9: LIST OF ASSEMBLY POINTS

S. No	Location	Accommodation capacity	At the time of Emergency			Nearest Tel. No.
			Person in-charge	Place of availability	Telephone No.	
				Factory	Office	

6.47 EMERGENCY CONTROL CENTRE

ECC means the place from where the emergency may be controlled by ECC controller and other key personnel. Location of the centre **SECURITY CABIN.**

TABLE 6.10: FIRE AND TOXICITY CONTROL ARRANGEMENTS

S. No	Item to be kept in the center	Quantity	Persons who will handle or operate this item	Its period of operation	Notes
1	Safety Helmet		Plant employees including security personnel are trained in the use &upkeep of all the personal protective equipments available in the factory. They will operate &use these equipments &tackle emergency situation	The equipments kept in ECC are being used regularly & all the time kept in ready to use condition. Whenever they are being used if required they are being cleaned /maintained or being replenished immediately.	The safety equipments kept in the ECC have 24 hrs.access to all employees. Outside aid agency likes fire brigade, medical etc. will go to the factory premises via the emergency control centre Besides at plant/shop floor level various types of personal protective equipments are kept for the use of plant employees in emergency Plant employees are being trained on the use & upkeep of all safety Equipments.
2	Safety Hand Gloves PVC Rubber Cotton Cum Leather Asbestos				
3	Safety Goggles Spectacle Type Panoramic Type				
4	Face Shield				
5	Aprons PVC Cotton				
6	PVC Suits				
7	Safety Gum Boots				
8	Self Contained				

	Breathing Apparatus				
9	Gas mask with canister				
10	Safety emergency				
11	Fire extinguishers DCP[10kg.capacity] Co2[3.2kg.capacity] Soda acid[9lit.capacity] Foam [10lit.capacity]				
12	Fire hoses with branches				
13	Explosive meter				
14	Gas detection devices				
15	Resuscitator				
16	Portable mike				
17	Telephone- P&T intercom				
18	Emergency siren switch				
19	First aid box				

Separate persons are trained for fire and toxic gas control. They are also trained personnel protective equipment.

TABLE6.11: FIRE & LEAKAGE OF TOXIC/CORROSIVE CHEMICAL CONTROL ARRANGEMENT

For flammable & toxic substance storage										
For key personnel & essential workers										
Fire water : 100 KL of reservoirs, Bore-well–one										
Other source & capacity	No. of hydrant points	No. of fire pumps, type & capacity	No. of hose reals & total length	No. of fire tenders & capacity	No. of sprinklers/monitors				Alternative power arrangement	No.CO_2 Extinguis-hers
					Fixed		Portable			
					Lifting height	Pressure	Lifting height	pressure		

Dry powder type	Foam type	Water jet product	Other extinguisher	Personal protective equipment

Type of powder & total quantity	No. of portable		Type of foam &Total quantity	No. of portable		No.& size of blankets	Other jet product quantity	Type	No. or quantity	Respiratory		Non-respiratory	
	Extinguishers	Tonners		Extinguishers	Tonners					Type	No.	Type	No.

TABLE 6.12: FIRE & LEAKAGE OF TOXIC/CORROSIVE CHEMICAL CONTROL ARRANGEMENT

FIRE WATER:		**NO.OF RESERVORIES:**			**TOTAL QUALITY:**				
Other sources & capacity	No. of hydrants	No. of fire pumps type and capacity	No. of hose reels & total length	No. of fire tenders and capacity	No. of sprinkles/Monitors Portable Lifting height	Alternate power arrangements	No. of CO2 Exiting.	Dry powder type	
								Type of powder & total quantity	No. of portable Exiting

6.48 RAISING THE ALARM

- Emergency alarm should be raised in the event of an emergency.
- Any person noticing an unusual occurrence, fire, chlorine leakage, toxic or corrosive substance leakage etc. should inform the concerned department/section head/shift in charge immediately and try to control/contain the incident.
- Departmental head/shift in charge will immediately go to the site of incident, assess the situation and initiate the action to "blow the emergency Alarm" by telephoning the main gate to security officer/Asst, security officer/Security supervisor.
- In case of telephone failure a messenger should be sent running to main gate to inform.

Details of siren are given below

Siren codes

- Declaration of emergency:-A long short wailing siren for one minute will mean that there is an emergency within the premises.
- All clear siren: - A long siren for one minute will mean that the emergency declared is under control, i.e. all clear. This siren code will mean All clear, normal condition.
- Evacuation siren:-A long short wailing siren for 3 [three] minutes, will mean that emergency declared cannot be controlled. Hence all persons in the premises will evacuate as per the plan.
-

TABLE6.13: DETAILS OF ALARMS AND SIRENS

S. No	Type of emergency	Type of siren/alarm	Duration of sounding	Type of sound
1	Fire & explosion	Electrical operated siren	1 Minute	Continuous

6.49 DECLARING MAJOR EMERGENCY

Major emergency may be declared after sufficient thought because it activates many agencies. The nominated persons to declare major emergencies are given.

TABLE6.14: NOMINATED PERSONS TO DECLARE MAJOR EMERGENCY

S. No.	Name of plant/Dept./Location	Name & Designation of the persons nominated to declare the emergency	Duty or designation given under the on-site/off-site emergency plan	Telephone no.	Residence Address and Telephone No.

6.50 TRANSPORT AND EVACUATION ARRANGEMENTS

Following arrangements shall be made for the transport and evacuation of persons in case of any emergency situation arises in the factory.

Those employees who have own vehicles will make arrangements to shift the injured.

TABLE6.15: TRANSPORT AND EVACUATION ARRANGEMENTS

Name & Location	Telephone No.	In charge person		Own vehicles		
		Name & designation	Residence address & Telephone Nos.	Type & Nos.	Capacity	Driver's name &address

6.50.1TELEPHONE MESSAGES

Telephone operator has to pay vital role in case of emergency. After hearing the siren/hooter, he/she should inform to all key personnel immediately on phone. He/she should receiving be very sharp, precise, attentive and quick in & noticing the message.

FORMAT TO RECORD EMERGENCY CALL

Part A : Essential Information
Details Of Call As Reported
Caller's Name & Designation Date: Time: Phone No.
Purpose: Of Call Is Any Particular Advice Required Immediately?
Name Of Chemicals To Be Spelt Out Clearly Brief Description Of Incident. Fire/Explosive/Liquid Spill/Gas Release Quantity Involved Packing/Storing/Handling/Using Details Location Of Incident Cause, If Known, In Brief

Part B : Information To Be Obtained If Readily Available
Has Any One Been Injured? Yes/No If Yes, How Many? Affected By Chemicals? Yes/No If Yes, How What First-Aid Has Been Given? Yes/No If Yes, Address Of The Hospital. Is The Road Blocked? Yes/No Closed To Traffic? Yes/No Who Owns The Chemicals? Has The Owner Been Informed? Yes/No
IF CAUSED BY VEHICLE VEHICLE NUMBER_____AND NAME & ADDRESS OF THE OWNER_____ HAS THE OWNER BEEN INFORMED YES/NO TO WHOM WAS THE LOAD CONSIGNED

6.51 MUTUAL AID

In emergency situations, resources over and above those available at the works may be needed. Emergency Coordinator would be contacting neighboring factories for help. A survey of industries who can come to help and also the help, they can extend is done as mentioned below.

- The help would be in the form of technical manpower, medical aid, transport for rescue and Rehabilitation, fire fighting, additional special protective wear or any other help as the case may be.

- Manager – Safety who is Emergency Coordinator is assigned with this responsibility and he would maintain liaison during non-emergency period and ensure co-operation
- Similarly, the help required from civil administration, in respect of medical aid, transport, law and order, rehabilitation etc. are identified and liaison is established with Mandan Revenue Officer and Police Officials.

6.52 MOCK DRILL

Mock Drills would be organized once in six months to evaluate the Preparedness and functioning of OSEP.

- It is also planned to undertake few informed and uniformed mock drills [or rehearsals] for meeting emergencies.
- Such rehearsals would be carefully analyzed and shortcomings would be identified and necessary corrections would be taken up.
- Site Controller is responsible for planning and execution and evaluation of mock drills. Also information would be given to statutory authorities.