CHAPTER - 7
RISK ASSESSMENT & DISASTER MANAGEMENT PLAN

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

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

7.1 RISK ASSESSMENT

7.1.1 INTRODUCTION

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

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

7.1.2 APPROACH TO THE STUDY

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

- Identification of potential hazard area;
- Identification of representative failure cases;

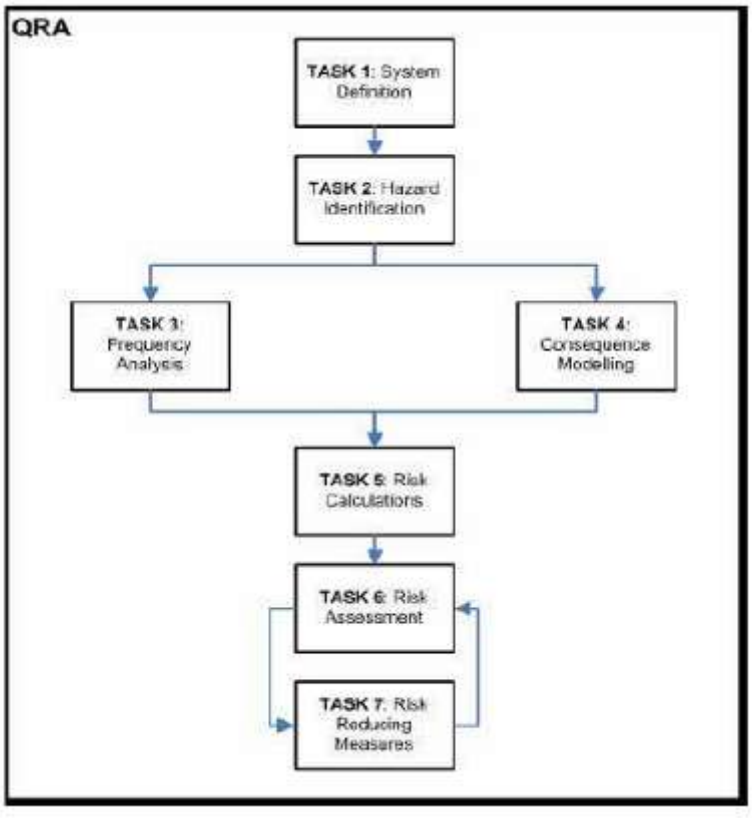
- Visualization of the resulting scenarios in terms of fire and explosion;
- Assess the overall damage potential of the identified hazardous events and the impact zones form the accidental scenarios;
- Furnish the recommendations on the minimization of the worst accident possibilities
- Preparation of Disaster Management Plan;
- Emergency Plan, which includes Occupational and Health Safety Plan;

7.1.3 METHODOLOGY

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

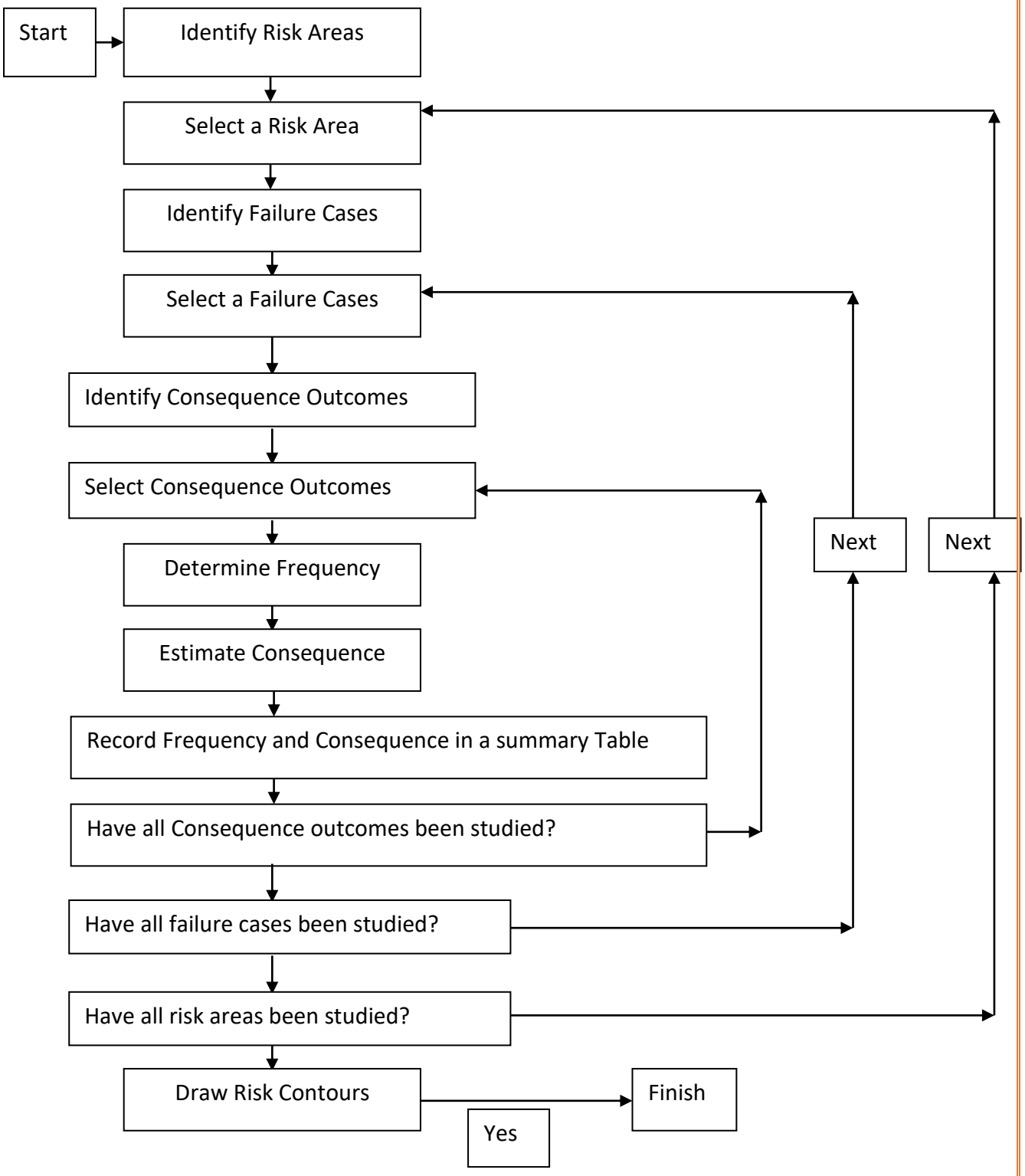
FIGURE – 7.1

QRA METHODOLOGY



FIGURE–7.2

FLOW CHART FOR QUANTITATIVE RISK ASSESSMENT



7.1.4 HAZARD IDENTIFICATION

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

7.1.4.1 IDENTIFICATION OF HAZARDOUS AREAS

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

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

7.1.4.2 IDENTIFICATION OF FAILURE CASES FOR HAZARDOUS AREAS

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

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

7.1.4.3 MAJOR HAZARDOUS AREAS AND SAFETY PRECAUTIONS

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

FIGURE-7.3

HAZARDOUS CHEMICAL STORAGE AREA

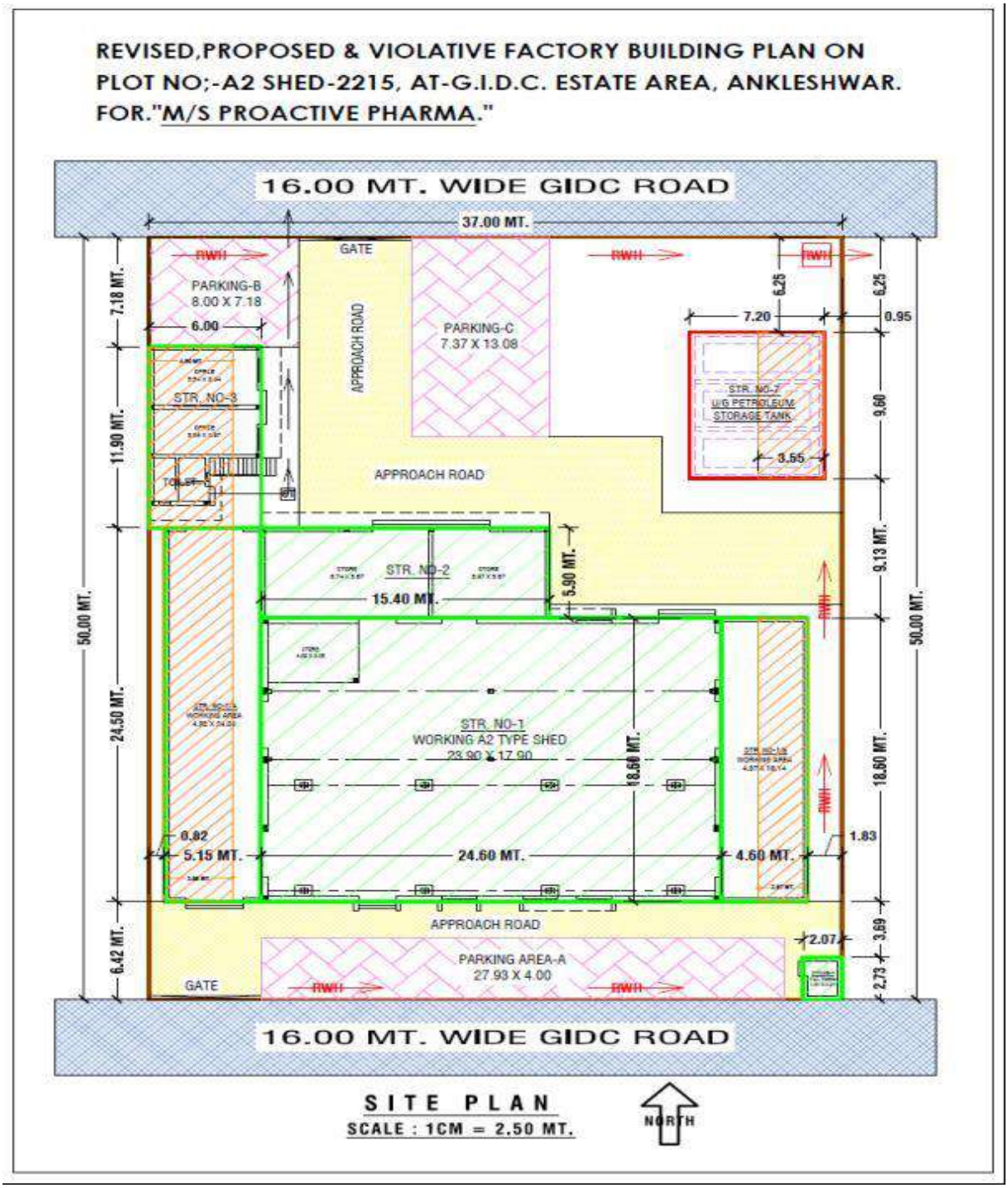


TABLE-7.1

STORAGE AND HANDLING DETAILS OF HAZARDOUS CHEMICALS

Sr. No.	Name Of Raw Material	State	Storage Mode	Capacity Of Single Container /Tank/Bag	Max. Storage Capacity At Site (After Expansion)	MOC
1	{2-[(2,6-Dichlorophenyl)Amino] Phenyl}Acetic Acid	Liquid	Drum	200 Lit	3.3	HDPE
2	10% Pd/C	Solid	Drum	200 Lit	0.3	HDPE
3	2-(Benzylamino)-1-(6-Fluoro-3,4-Dihydro-2H-Chromen-2yl)Ethanol	Liquid	Drum	200 Lit	10.3	HDPE
4	2, Chloro Benzoic Acid	Solid	Bag	25Kgs Or 50 Kgs	3.5	HDPE
5	2,4,5 Trichloro Nitro Benzene	Solid	Drum	200 Lit	4.0	HDPE
6	2,5-Di Chloro 4 Nitro Aniline	Solid	Drum	200 Lit	6.0	HDPE
7	2,5-Di Methyl Para Nitro Aniline	Solid	Drum	200 Lit	6.0	HDPE
8	2-Chloro-5 Methyl 4 Nitro Aniline	Liquid	Drum	200 Lit	6.0	HDPE
9	3-(Carbamoyl Methyl)-5-Methyl Hexanoic Acid	Solid	Bag	25Kgs Or 50 Kgs	4.0	HDPE
10	4-Fluoroaniline	Liquid	Drum	200 Lit	3.0	HDPE
11	6-Fluroro-3,4-Dihydro-2-Oxiranyl-2H--Benzopyran	Liquid	Drum	200 Lit	6.7	HDPE
12	Acetic Acid	Liquid	Drum	200 Lit	4.5	HDPE
13	Acetic Acid & Formic Acid	Liquid	Drum	200 Lit	52	HDPE
14	Acetonitrile	Liquid	Drum	200 Lit	6.7	HDPE
15	Alpha Phenyl Ethyl Amine	Liquid	Drum	200 Lit	2.7	HDPE
16	Ammonia	Liquid	Carbo	25Kgs Or 50 Kgs	1.3	HDPE
17	Bromine	Liquid	Bottle Glass	1 Lit	7.0	
18	Butanol	Liquid	Drum	200 Lit	1.0	HDPE
19	Catalyst	Solid/Liquid	Bag	25Kgs Or 50 Kgs	2.7	HDPE
20	Charcoal	Solid	Carbo	25Kgs Or 50 Kgs	0.0	HDPE
21	Chloro Acetyl Chloride	Liquid	Bag	200 Lit	3.8	HDPE
22	Chloroform	Liquid	Drum	200 Lit	2.0	HDPE
23	Chlorohexidine Base	Solid	Drum	200 Lit	8.0	HDPE
24	Cyanoacetamide	Solid	Fiber Drum	200 Lit	2.0	HDPE

25	Diclofenac Sodium	Solid	Fiber Drum	200 Lit	5.0	HDPE
26	DMF	Liquid	P.P. Drum	200 Lit	3.0	HDPE
27	DMS	Liquid	Drum	200 Lit	2.5	HDPE
28	Formic Acid	Liquid	Drum	200 Lit	8.7	HDPE
29	Glucona Delta Lactone	Solid	Drum	200 Lit	5.3	HDPE
30	H_2	Gas	Cylinder	900 Kgs	1.2	HDPE
31	H_2SO_4	Liquid	Drum	200 Lit	6.2	HDPE
32	HCl	Liquid	Carbo	25Kgs Or 50 Kgs	7.2	HDPE
33	Hexamethylene Diamine	Solid	Carbo	200 Lit	2.7	HDPE
34	HNO_3	Liquid	Drum	25Kgs Or 50 Kgs	2.0	HDPE
35	Iron Powder	Solid	Carbo	25Kgs Or 50 Kgs	0.5	HDPE
36	Iso Propyl Alcohol	Liquid	Bag	200 Lit	15.1	HDPE
37	Isovaleraldehyde	Liquid	Drum	200 Lit	5.3	HDPE
38	$KBro_3$	Solid	Fiber Drum	200 Lit	0.5	HDPE
39	Mesitylene	Liquid	Drum	200 Lit	3.5	HDPE
40	Methanol	Liquid	Drum	15 KL	29.7	HDPE
41	N Methyl Piperazine	Liquid	Tank	1KL	6.0	MS/SS
42	NaOCl	Liquid	Drum	200 Lit	2.7	HDPE
43	NaOH	Solid	Drum	25Kgs Or 50 Kgs	8.2	HDPE
44	Nash	Solid	Bag	200 Lit	34.0	HDPE
45	N-Butanol	Liquid	Drum	200 Lit	18.7	HDPE
46	NH_4OH	Liquid	Drum	200 Lit	5.0	HDPE
47	Ortho Toluidine	Liquid	Drum	200 Lit	6.5	HDPE
48	Para Toluidine	Solid	Drum	200 Lit	4.0	HDPE
49	P-Chloroaniline Hcl	Solid	Drum	25Kgs Or 50 Kgs	6.0	HDPE
50	Pyrrolidine	Liquid	Bag	200 Lit	1.3	HDPE
51	Sodium Dicynamide	Solid	Drum	200 Lit	3.3	HDPE
52	Sodium Methoxide	Solid	Fiber Drum	200 Lit	2.0	HDPE
53	Sodium Nitrite	Solid	Drum	25Kgs Or 50 Kgs	2.0	HDPE
54	Spent Solvent [I.E IPA, Ethyl	N.A	Drum	20 KL	40	HDPE

	Acetate, Toluene, Xylene, Methanol, Acetonitrile, Di Methyl Formamide, Tetra Hydro Furan, Mono/Di Ethylene Glycol, Methyl Acetate, Acetone, Butyl Alcohol, Dimethyl Sulfoxide, Xylene, Etc.]					
55	TCP [Tri Chloro Pyrimidine]	Liquid	Drum	200 Liter	6.5	SS/MS
56	Toluene	Liquid	Drum	50 Kg	5.0	HDPE
57	Triethylamine	Liquid	Drum	200 Liter	0.7	SS/MS

TABLE 7.2

OTHER HAZARDS AND CONTROL

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

TABLE 7.3

HAZARDOUS PROPERTIES OF THE CHEMICALS, COMPATIBILITIES, SPECIAL HAZARD AND ANTIDOTES

PRODUCTS												
Sr. No.	**Name of Products**	**Chemical Name**	**CAS No.**	**State**	**M.P /B.P^{0}C**	**F.P ^{0}C**	**LEL %**	**UEL %**	**TLV ppm or mg/m^3**	**LD50 Mg /Kg**	**Sp. Gravity (Water=1)**	**Vapour Density (Air =1)**
1	Distilled Solvent of different range 1) Pharma Grade 2) Technical Grade	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	All type of Thinner [i.e. Ink/Textile/Paint Thinner]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3	Purification of Acid (through distillation)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4	Pregabalin	Pregabalin	148553-50-8	Solid	NA	NA	NA	NA	NA	2000 mg/kg	NA	NA
5	Nebivolol HCl	Nebivolol (hydrochloride)	152520-56-4	Solid	NA	NA	NA	NA	NA	NA	NA	NA

6	Diclofenac Sodium	Diclofenac (sodium salt)	15307-79-6	Solid	NA	NA	NA	NA	NA	NA	NA	NA
7	Aceclofenac	:Aceclofenac	:89796-99-6	Solid	152°C/NA	NA	NA	NA	NA	NA	NA	NA
8	Chlorhexidine base	Chlorhexidine	55-56-1	Solid	NA	NA	NA	NA	NA	NA	NA	NA
9	Chlorhexidine Di Gluconate	Chlorhexidine Di Gluconate	18472-51-0	Liquid	NA/ 100°C	NA	NA	NA	NA	>2000 mg/kg	NA	NA
10	2,4,Di amino 6-Chloro Pyrimidine	2,4-Diamino-6-chloropyrimidine	156-83-2	Solid	197 - 200 °C/NA	NA	NA	NA	NA	NA	NA	NA
11	N,N-Dimethyl formamide dimethyl acetal	N,N-DIMETHYL FORMAMIDE DIMETHYL ACETAL	4637-24-5	liquid	102 - 103 °C/NA	5 °C	NA	NA	NA	> 5,000 mg/kg	NA	NA
12	hexanoic acid	Hexanoic acid 98%	142-62-1	Liquid	400 deg F/ 3.4 °C	102 °C	2.00 vol %	10.00 vol %	NA	NA	9270g /cm3	NA

13	5-Bromo 2-Chloro Benzoic Acid	5-Bromo-2-Chlorobenzoic Acid, 98%	21739-92-4	Solid	NA/154.00 - 156.00°C	NA	NA	NA	NA	NA	NA	NA
14	2 Bromo-4 Fluroacetanilide	2'-Bromo-4'-fluoroacetanilide	1009-22-9	Solid	114 - 118 °C/NA	NA	NA	NA	NA	NA	NA	NA
15	2,4,6 Trimethyle Benzoyl Chloride	2,4,6-Trimethyl benzoyl chloride	938-18-1	Liquid	NA/143 - 146 °C	NA	NA	NA	NA	NA	NA	NA
16	5 chloro 2,4 Dimethoxy Aniline	5-Chloro-2,4-dimethoxyaniline	97-50-7	Solid	NA	NA	NA	NA	NA	NA	NA	NA
17	2,5 Di Chloro PPD	NA	NA	Solid	NA	NA	NA	NA	NA	NA	NA	NA
18	2,5 Dimethyl PPD	NA	NA	Liquid	NA	NA	NA	NA	NA	NA	NA	NA

19	2 Chloro 5 Methyl PPD	NA	NA	Liquid	NA	NA	NA	NA	NA	NA	NA	NA
20	5-Nitro Ortho Toluidine	5-Nitro Ortho Toluidine	**99-55-**8	Liquid	NA	NA	NA	NA	NA	NA	NA	NA
21	2,5-Diamino Toluene Sulphate	2,5-Diaminotoluene sulfate, 97%	615-50-9	Solid	> 300 °C/NA	NA	NA	NA	NA	NA	NA	NA
22	4 Chloro 2,5-Dimethoxy Aniline	4-Chloro-2,5-dimethoxyaniline	6358-64-1	Solid	118 - 120 °C/NA	163 °C	NA	NA	NA	NA	NA	NA
23	1 Amino 4 Methyl Piperazine	1-Amino-4-methylpiperazine	6928-85-4	Liquid	NA/172 - 175 °C	62 °C	NA	NA	NA	NA	0.950	3.97
Raw Material												
Sr. No.	**Name of Raw Materials**	**Chemical Name**	**CAS No.**	**State**	**M.P /B.P^{0}C**	**F.P ^{0}C**	**LEL %**	**UEL %**	**TLV ppm or mg/m^3**	**LD50 mg/**	**Sp. Gravity (Water=**	**Vapour Density (Air =1)**
1	Acetic acid	Acetic acid	64-19-7	liquid	16.2 °C /117 - 118 °C	N.A	4 %(V)	19.9 %(V)	N.A	N.A	N.A	N.A

2	10% Pd/C	Palladium on carbon	NA	Solid	69 °C/2.963 °C	N.A	N.A	N.A	N.A	N.A	N.A	N.A
3	ethanol	Ethanol	64-17-5	liquid	-114 °C/78 °C	14.0 °C	: 3.3 %(V)	19 %(V)	N.A	10,470 mg/kg	N.A	N.A
4	2 Chloro Benzoic Acid	2-Chlorobenzoic acid	118-91-2	Solid	138 - 140 °C/NA	173 °C	N.A	N.A	N.A	N.A	N.A	N.A
5	2,4,5 Trichloro Nitro Benzene	1,2,3-Trichloro-4-nitrobenzene	17700-09-3	Solid	53 - 56 °C	113 °C	NA	NA	NA	NA	NA	NA
6	2,5-Di Chloro 4 nitro aniline	2,5-Dichloro-4-nitroaniline	6627-34-5	solid	154 - 158 °C	N.A	N.A	N.A	N.A	N.A	N.A	N.A
7	2,5-Dimethyl para nitro aniline	4,5-Dimethyl-2-nitroaniline	6972-71-0	solid	139 - 141 °C	NA	NA	NA	NA	NA	NA	NA
8	2-Chloro-5 Methyl 4 nitro aniline	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
9	3-(Carbamoyl methyl)-5-methyl hexanoic acid	3-(Carbamoylmethyl)-5-	181289-33-8	Solid	120-124°C/NA	NA	NA	NA	NA	NA	NA	NA

		methylhexanoic acid										
10	4-Fluoroaniline	4-Fluoroaniline	371-40-4	liquid	187 °C/NA	74 °C	N.A	N.A	N.A	N.A	N.A	N.A
11	6-Fluroro-3,4-dihydro-2-oxiranyl-2H--benzopyran	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
12	Acetic Acid	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13	Acetic Acid & Formic Acid	Formic acid	64-18-6	liquid	8.2 - 8.4 °C/100.8 °C	49.5 °C	18 %(V)	57 %(V)	N.A	N.A	N.A	1.59
14	Acetonitrile	Acetonitrile	75-05-8	liquid	-48 °C/81 - 82 °C	2.0 °C	3 %(V)	16 %(V)	N.A	N.A	N.A	1.42
15	Alpha Phenyl ethyl amine	Alpha Phenyl ethyl amine	3886-69-9	Liquid	-10°C/187-189°C	N.A	N.A	N.A	N.A	N.A	N.A	N.A
16	Ammonia					N.A	N.A	N.A	N.A	N.A	N.A	N.A
17	Bromine	Bromine	7726-95-6	liquid	-7.2 °C/58.8 °C	N.A	N.A	N.A	N.A	N.A	N.A	5.52
18	Butanol	n-Butanol	71-36-3	liquid	-90 °C/116 - 118 °C	35 °C	11.2 %(V)	1.4 %(V)				2.56
19	Catalyst	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
20	Charcoal	Activated	7440-44-	solid	3.550	N.A	N.A	N.A	N.A	N.A	N.A	N.A

		charcoal	0		°C/NA							
21	Chloro Acetyl chloride	Chloroacetyl chloride	79-04-9	liquid	-22 °C/105 - 106 °C	100 °C	N.A	N.A	N.A	220 mg/kg	N.A	N.A
22	Chloroform	Chloroform	67-66-3	liquid	-62,99 °C/61 °C	N.A	N.A	N.A	N.A	20.000 mg/kg	N.A	213,3 hPa
23	Chlorohexidine Base	Chlorhexidine	55-56-1	solid	134 - 136 °C	N.A	N.A	N.A	N.A	2,515 mg/kg	N.A	N.A
24	Cyanoacetamide	Cyanoacetamide	107-91-5	solid	119 - 121 °C	215 °C	N.A	N.A	N.A	1,680 mg/kg	N.A	N.A
25	Diclofenac Sodium	Diclofenac sodium salt	15307-79-6	solid	275 - 277 °C	N.A	N.A	N.A	N.A	N.A	N.A	N.A
26	DMF	Dimethylformamide	68-12-2	liquid	-61 °C/153 °C	58 °C	2,2 %(V)	15,2 %(V)	N.A	3.010 mg/kg	N.A	2.52
27	DMS	Dimethyl sulfide	75-18-3	liquid	-98 °C/38 °C	-30 °C	2,2 %(V)	19,7 %(V)	N.A	2.000 mg/kg	N.A	N.A
28	Formic Acid	Formic acid	64-18-6	liquid	8.2 - 8.4 °C/100 - 101 °C	49.5 °C	18 %(V)	57 %(V)	N.A	730 mg/kg	N.A	1.59
29	Glucona delta lactone	Gluconic acid δ-lactone	90-80-2	solid	160 °C/NA	N.A	2 %(V)	27,5 %(V)	N.A	N.A	N.A	N.A
30	H_2	Hydrogen	1333-74-0	gas	-259.2 °C/-252.8 °C	< -149.99 °C	4 %(V)	74.2 %(V)	N.A	N.A	N.A	0.08
31	H_2SO_4	Sulfuric	7664-93-	liquid	3 °C/290	N.A	N.A	N.A	N.A	2,140	N.A	3.39

		acid	9		°C					mg/kg		
32	HCl	Hydrochloric acid	7647-01-0	liquid	-30 °C/> 100 °C	N.A	N.A	N.A	N.A	N.A	N.A	N.A
33	Hexamethylene diamine	Hexamethylenediamine	124-09-4	solid	42 - 45 °C/204 - 205 °C	80 °C	0.7 %(V)	6.3 %(V)	N.A	750 mg/kg	N.A	4.01
34	HNO_3	Nitric Acid	7697-37-2	liquid	NA/100 °C	N.A	N.A	N.A	N.A	N.A	N.A	N.A
35	Iron Powder	Iron	7439-89-6	Solid	1,535 °C/2,750 °C	N.A	N.A	N.A	N.A	N.A	N.A	N.A
36	Iso Propyl alcohol	Propan-2-ol	67-63-0	Liquid	-89.5 °C/ 81 - 83 °C	12 °C	2 Vol%	12 Vol%	N.A	N.A	0.785	2.1
37	Isovaleraldehyde	Isovaleraldehyde	590-86-3	liquid	< -89.99 °C/90 °C	-4.99 °C	N.A	N.A	N.A	N.A	N.A	2.97
38	$KBrO_3$	Potassium bromate	7758-01-2	solid	42 - 48 °C/NA	N.A	N.A	N.A	N.A	N.A	N.A	N.A
39	Mesitylene	Mesitylene	108-67-8	liquid	-45 °C /163 - 166 °C	53.0 °C	0.88 %(V)	N.A	N.A	7,000 mg/kg	N.A	N.A
40	Methanol	Methanol	67-56-1	liquid	-98 °C/64.7 °C	9.7 °C	5.5 %(V)	36.5 %(V)	N.A	1.187 - 2.769 mg/kg	N.A	1.11
41	N methyl Piperazine	1-Methylpiperazine	109-01-3	liquid	138 °C/NA	39 °C	N.A	N.A	N.A	N.A	N.A	3.46
42	NaOCl	Sodium	7681-52-	liquid	-28.9	N.A	N.A	N.A	N.A	N.A	N.A	N.A

		hypochlorite solution	9		°C/111 °C							
43	NaOH	Sodium Hydroxide Pellets	1310-73-2	solid	318 °C/1.390 °C	N.A	N.A	N.A	N.A	N.A	N.A	1.38
44	NaSH	Sodium hydrosulfide hydrate	207683-19-0	solid	52 - 54 °C/NA	90 °C	N.A	N.A	N.A	105 mg/kg	N.A	N.A
45	N-Butanol	1-Butanol	71-36-3	liquid	-90 °C/117.7 °C	35 °C	1.4 %(V)	11.2 %(V)	N.A	790 mg/kg	N.A	2.56
46	NH4OH	Ammonium hydroxide solution	1336-21-6	liquid	-60 °C/38 - 100 °C	N.A	N.A	N.A	N.A	N.A	N.A	1.21
47	Ortho Toluidine	OToluidine	95-53-4	liquid	-27.99 °C/99 - 200 °C	85 °C	1.5 %(V)	N.A	N.A	670 mg/kg	N.A	3.7
48	Para Toluidine	P-Toluidine	106-49-0	Solid	41 - 46 °C/200 °C	87 °C	1.1 %(V)	6.6 %(V)	N.A	N.A	N.A	N.A
49	P-Chloroaniline HCl	4-Chloroaniline Hydrochloride	N.A	solid	N.A	N.A	N.A	N.A	N.A	N.A	N.A	N.A

50	Pyrrolidine	Pyrrolidine	123-75-1	liquid	< -60 °C/87 - 88 °C	3 °C	1.6 %(V)	10.6 %(V)	N.A	433 mg/kg	N.A	2.46
51	Sodium Dicynamide	Sodium dicyanamide	1934-75-4	solid	N.A	N.A	N.A	N.A	N.A	N.A	N.A	N.A
52	Sodium Methoxide	Sodium methoxide	124-41-4	solid	N.A	33 °C	7.3 %(V)	36 %(V)	N.A	1,687 mg/kg	N.A	1.87
53	Sodium Nitrite	Sodium nitrite	7632-00-0	solid	271 °C/320 °C	N.A	N.A	N.A	N.A	N.A	N.A	N.A
54	Spent Solvent [i.e IPA, Ethyl Acetate, Toluene, Xylene, Methanol, Acetonitrile, Di methyl formamide, Tetra hydro furan, Mono/Di ethylene glycol, Methyl Acetate, Acetone, Butyl Alcohol, Dimethyl Sulfoxide, Xylene, etc.]	N.A	N.A	N.A	N.A	N.A	N.A	N.A	N.A	N.A	N.A	N.A

55	TCP[Tri Chloro Pyrimidine]	2,4,5-Trichloropyrimidine	5750-76-5	liquid	N.A	> 109,9 °C	N.A	N.A	N.A	N.A	N.A	N.A
56	Toluene	Toluene	108-88-3	liquid	-93 °C/110 - 111 °C	4.0 °C	1.2 %(V)	7 %(V)	N.A	5.580 mg/kg	N.A	N.A
57	Triethylamine	Triethylamine	121-44-8	liquid	-115 °C/88.8 °C	-14.99 °C	N.A	N.A	N.A	730 mg/kg	N.A	3.49

7.2 SAFETY PRECAUTIONS

7.2.1 Control measures provided for Solvent storage Area:

1. Construction & Installation of solvent storage facility is provided as per explosive act, (License & local rules / regulation followed).
2. Flame proof electrical fitting & intrinsically safe instruments are installed.
3. Flame arrestor installed on vent pipe with breather valve & emergency vent valve provided.
4. Earth fault relay trip installed for solvent tanker unloading system (Solvent pump having interlock with grounding of the tanker to make 100% grounding.).
5. Grounding (double earthing) & Jumper for flange joint provided for all installation & it is monitored periodically.
6. Road Tanker grounded before unloading.
7. Check list is followed for loading & unloadin

   g.
8. Leakage collection bund with foam system is provided.
9. Combustible Gas Detection system, Fire (Foam / Powder) extinguisher, Foam monitors is provided.
10. F-30 coating provided for solvent storage tanks.
11. Nitrogen blanketing system is provided.
12. Closed handling system is provided.
13. Smoke detector system installed at Hydrogen Peroxide storage room.
14. Cooling system provided for Hydrogen Peroxide storage room.
15. In case of High temperature of Hydrogen Peroxide Storage Room, High temp. indication provided & connected centralized DCS system.

7.2.2 Control measures provided for Warehouse:

1. Fixed electrical fitting is provided. Lighting is installed between racks above the gangways & away from material storage to avoid heating to storage goods.
2. Electrical fitting tested periodically (i.e. electrical load thermo graphic temperature measurement, mechanical integrity of cables, physical condition of cable & other electrical appliances / installation.)
3. BT reach truck battery charging station is provided outside of ware house.
4. Appropriate passage, gangways provided.
5. Fire detection system (Beam Detector) provided.
6. Adequate portable fire extinguishers installed at noticeable position & kept easily accessible.
7. Fire hydrant system provided.
8. Auto sprinkler system provided on individual racks compartments at Ware House: this system is independent system having Separate Pumps with separate piping from Pump House to Ware House, it consists of automatic operated sprinkler on 59°C.
9. Fire Alarm System: Automatic fire detection & alarm system consists of Fire Detectors, Addressable Manual Call Points (MCP) & Hooters Beam Detectors (Ware House) are placed at strategic locations and connected by cable to central control panel at ECC with repeater panel at DCS Control Room.

10. Emergency exit provided.
11. A warehouse is used exclusively for storage activities. Loose chemical handling not allowed.
12. Chemical segregation is done based on reactivity.
13. In case of maintenance work, Ignition sources controlled by hot work permit system.
14. Natural & Eco ventilator is provided.
15. Proper drainage system is provided for used fire water.

7.3 PRECAUTIONS DURING STORAGE AND TRANSPORTATION OF HAZARDOUS CHEMICALS LIQUIDS

- Vendor will be asked to provide MSDS to Driver.
- Truck will have clearly marked identification of material being contained with mentioning Safety Card.
- Driver to have concerned Safety Officer's contact details to contact him in case of emergency.
- Provide muffler on exhaust while entering tanker within premises.
- Ensure Earthing Boss connection before starting any transferring.
- SOP to cover routine checking of Solvent storage area to be carried out for checking any spillage / leakage.
- Readings of Temperature & Pressure will be noted, recorded & reported immediately for abnormality.
- Safety instruments like rupture disc, safety valves will be checked at defined duration for intakeness.
- Barrels to be checked for proper fixing of bungs before sending it outside the premises.
- Barrels to be monitored physically daily for developing any pressure or vacuum within it on long storage.
- Concerned persons will be trained properly to use spill kit in case of observing any spillage inside warehouse.

SOLIDS

- Vendor will be asked to provide MSDS to Truck Driver.
- Driver to have concerned Safety Officer's contact details to contact him in case of emergency.
- Provide muffler on exhaust while entering truck within premises.
- SOP to cover routine checking of Bags & Containers for checking any damage.
- Containers to be tested for safe racking & transportation.
- Proper PPE to be used while handling the material & concerned persons to be trained for usage of the same.
- Concerned persons will be trained properly to use spill kit in case of observing any spillage inside warehouse.

7.4 Hazard Identification

In the storage of chemical & manufacturing operation various flammable / toxic / corrosive material, compressed gases are utilized &also the stock of the combustible material is maintained. These items have potential to lead to an accident (explosion / fires etc).

The major industrial hazards can be divided into following different categories.

1. FIRE HAZARD.
2. EXPLOSION HAZARD.
3. TOXIC HAZARD.
4. Electrical Hazard
5. Mechanical Hazard

Above hazard should be taken into consideration because some of the chemical used, stored are having inflammable / flammable, toxic, corrosive and explosion properties.

FIRE HAZARD

The fire may take place because of any one or more of the following reasons,

- Naked Flame
- Hot Surface
- Electric Spark
- Static Electricity
- Rise in Temperature & Pressure beyond permissible limits.

To prevent the fire hazards, following actions have been taken.

- Naked flame, hot surface and other ignition sources are eliminated from the areas where flammable substances are stored and handled.
- Storage and process area are posted with "No Smoking" sign.
- An earthing terminal for use during transfer operation.
- Flame proof electrical wiring wherever needed is installed at plant and stores building.
- Pump body, drive motor and associated electrical switchgear are earthed properly.

To control the fire hazards, following provisions made available.

- **FIRE DETECTION SYSTEM: -**

The fire alarm gets activated by automatic detection devices, like Smoke, Heat and Optical detectors installed at various potential fire prone places at site.

At certain place (MCP) Manual call points are also provided. This system can be activated on that particular point in case, fire is observed. The copy of the drawing is attached in part 2ND.

PORTABLE FIRE EXTINGUISHERS & SAND BUCKETS: -

There are many fire extinguishers and sand buckets installed in various buildings in the premises. No. of extinguishers installed in the plant area based on the location of hazardous chemical and process carried out. All the fire extinguishers have name of the manufacture and ISI mark on it. Storage near extinguisher is avoided for easy approach and the service contract is provided for servicing the fire extinguishers on monthly basis.

Table-FFA (Proposed)									
Type of Fire Extinguishers	**Number of Fire extinguishers**	**Fire Water Reservoir Capacity**	**Fire Pump Capacity**	**Hydrant Pressure**	**Tanks covered by Sprinklers**	**Details deluge valve arrangements**	**Fire tenders available**	**Foam Type and quantity**	**Other relevant details**
Foam	4	9 ltr	--	15BAR	--	--	--	--	--
CO_2 Powder	2	100 KL	56MTR	5.0 Kg/cm^2	NA	NA	--	--	--
Dry Chemical Powder	4	6 kg	--	15 bar	--	--	--	--	--
ABC	1								

LIST OF PERSONEL PROTECTIVE EQUIPMENT

1) Safety Helmet: - Individual
2) Safety Shoes: - Individual
3) Hand Gloves: - Individual
4) Nose Mask: - Individual
5) Safety Goggles: - Individual

DETAILS OF FIRE FIGHTING ARRANGEMENTS

Sr No	AREA OF INSTALLATION	NO. OF CO2 Fire Extinguisher Installed	NO.OF DCP Fire Extinguisher Installed	Sand Bucket Installed
1	Process Plant Area		8 NOS	
2	Electric Panel Room	2 NOS		
3	Ware House			
4	Tank Farm	MOBILE FOAM UNIT 150LTR		1 SET (4 BUCKET 1 STAND)
5	Office	1 NOS		
6	Utility			
7	Process Area			

FIRE HYDRANT SYSTEM:

Fire hydrant system is provided to protect entire plant and non-plant area. It consists of external (Yard) Hydrants, internal hydrants, fire escape hydrants and water / foam monitors. And sufficient amount of water in underground tanks are available. In the pump house six pumps are installed. (One diesel driven pump, two electrical operated pumps & three jockey pump.) The jockey pump is always in auto system to maintain the pressure in the hydrant system.

FIXED FOAM SYSTEM:

The fixed foam system is provided for solvent tank farm area & foam system for protection of bund area of solvent tank farm is provided.

Floor wise auto operated spot foam protection system is provided for selected reactors / vessels in production building.

SPRINKLER SYSTEM:

Auto operated sprinkler system is provided for raw material & finish goods warehouse. The sprinkler system is independent system having separate pumps with separate piping from pump house to warehouse.

FIRE WATER STORAGE:

Separate concrete fire water storage tank is provided. The tank is constructed in two compartments with baffle wall in between not going right down to the base of the tank. This arrangement ensures proper circulation of the fire water and prevents stagnation.

Fire Water retention:

Separate concrete fire water retention tank is provided. The tank capacity is 1000 M^3& working capacity is 750 M^3 (It is equivalent to fire water storage tank)

Explosion hazard

The second major hazards after fire in industry are explosion. Explosion hazard is normally more dangerous than the fire hazard as it causes greater damage and loss to property. The explosion may take place because of any one or more of the following reasons,

- With exposure to spark / flame.
- Explosion due to vapor in flammable concentration.
- Due to inherent oxygen.
- Static electricity or open flame.

To prevent the explosion hazards, following actions have been taken.

- ❖ Temperature indicator, Alarm system & interlocking system are provided on the basis of risk analysis on necessary equipment.

To control the explosion hazards, following actions have been taken.

- ❖ Rupture Disc & Safety Valve provided as per necessity on equipment.

TOXIC HAZARD: -

A chemical can find entry into human body through various routes such as injection, inhalation or skin contact.

To prevent the toxic hazards, following actions have been taken.

Exposure Control Arrangement: All bulk critical materials are handled in closed system. Solid handling is done through charging hopper having dust extraction hood. Vents are connected to the scrubber system to prevent human exposure.

- ❖ Efficient exhaust system is provided wherever necessary in the plant.
- ❖ Scrubber system is also provided to the reactors in the plant to scrub the vapors of the chemical.

To control the toxic hazards, following provisions made available.

- ❖ To avoid chemicals, contact with body, suitable respiratory / non respiratory personal protective equipment's are provided.
- ❖ Spillage of any chemical will be avoided to the maximum extent by closed circuit system i.e. day tanks are provided with an overflow line having bigger diameter than that of inlet of the pipe diameter. Standard operating procedures are available to handle spillage and leakage.
- ❖ Suitable posters & short work procedure showing dangerous properties of the chemical are also displayed in the working area.
- ❖ Arrangement for combating spills of these chemicals such as wash water / sand / neutralizing agents / absorbents for covering up made available nearby.
- ❖ The Personnel are also suitably trained in the use of the chemicals before giving responsibility.

- Periodic medical check-up of employees & contract Personnel is being carried out. If any worker shows any indication of exposure due to chemical, suitable preventive measures are being takes place.
- In case of major toxic release all employee will be assembled at admin building and then transfer to safer shelter (Company Guest House) by transport.

7.5 CONSEQUENCE ANALYSIS

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

Operating Parameters

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

Inventory

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

Loss of Containment

Plant inventory can get discharged to Environment due to Loss of Containment. Certain features of materials to be handled at the plant need to the clearly understood to firstly list out all significant release cases and then to short list release scenarios for a detailed examination. Liquid release can

be either instantaneous or continuous. Failure of a vessel leading to an instantaneous outflow assumes the sudden appearance of such a major crack that practically all of the contents above the crack shall be released in a very short time. The more likely event is the case of liquid release from a hole in a pipe connected to the vessel. The flow rate is depending on the size of the hole as well as on the pressure, which was present, in front of the hole, prior to the accident. Such pressure is basically dependent on the pressure in the vessel. The vaporisation of released liquid depends on the vapour pressure and weather conditions. Such consideration and others have been kept in mind both during the initial listing as well as during the short-listing procedure. In the study, Maximum Credible Loss accident methodology is to be used, therefore, the largest potential hazard inventories have been considered for consequence estimation.

7.5.1 DAMAGE CRITERIA

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

a) Determination of the source strength parameters;

b) Determination of the consequential effects;

c) Determination of the damage or damage distances.

The basic physical effect models consist of the following.

Source strength parameters

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

Consequential effects

* Dispersion of gaseous material in the atmosphere as a function of source strength, relative density of the gas, weather conditions and topographical situation of the surrounding area.

* Intensity of heat radiation [in kW/ m^2] due to a fire or a BLEVE, as a function of the distance to the source.
* Energy of vapour cloud explosions [in N/m^2], as a function of the distance to the distance of the exploding cloud.
* Concentration of gaseous material in the atmosphere, due to the dispersion of evaporated chemical. The latter can be either explosive or toxic.

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

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

Selection of Damage Criteria

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

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

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

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

Heat Radiation

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

- The radiation energy onto the human body [kW/m^2];
- The exposure duration [sec];
- The protection of the skin tissue (clothed or naked body).

- The limits for 1% of the exposed people to be killed due to heat radiation, and for second-degree burns are given in the table herein:

Damages to Human Life Due to Heat Radiation

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

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

Effects Due To Incident Radiation Intensity

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

Explosion

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

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

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

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

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

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

Damage Due To Overpressures

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

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

Intoxication

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

This dose D is basically determined by:

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

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

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

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

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

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

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

$D = \int C^n.dt$

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

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

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

Pr = 2.67 means 1% of the population;

Pr = 5.00 means 50% of the population;

a and b material dependent numbers;

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

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

7.5.2 MAXIMUM CREDIBLE LOSS ACCIDENT SCENARIOS

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

The Maximum Credible Loss (MCL) scenarios have been developed for the Facility. The MCL cases considered, attempt to include the worst "Credible" incidents- what constitutes a credible incident is always subjective. Nevertheless, guidelines have evolved over the years and based on basic engineering judgement, the cases have been found to be credible and modelling for assessing vulnerability zones is prepared accordingly. Only catastrophic cases have been considered and not partial or small failures (as is the case in Quantitative Risk Assessment where contributions from low frequency - high outcome effect as well as high frequency - low outcome events are distinguished). Emergency planning is the objective of the study, 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.

7.5.2.1 CONSEQUENCE ANALYSIS CALCULATIONS

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

7.5.2.2 SOFTWARE USED FOR CALCULATIONS

PHAST MICRO: Phast is the most comprehensive software available for performing Process Hazard Analysis (PHA), Quantitative Risk Assessment (QRA) and Financial Risk Analysis (FRA). Our extensively validated software for consequence and risk assessment is used by governments and industry helping them to comply with local safety regulation and their own corporate best practice.

Phast contains all the discharge, dispersion, effects and risk models you will need to accurately assess all your major hazards and associated risks. Phast Consequence provides you with comprehensive hazard analysis facilities to examine the progress of a potential incident from the initial release to its far-field effects.

TOXIC AND FLAMMABLE IMPACT

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

DISCHARGE

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

DISPERSION

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

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

FLAMMABLE EFFECTS

For releases of flammable material Phast calculates

- Radiation profiles and contours from a range of fire scenarios including pool fires, flash fires, jet fires and fire balls, including cross-wind effects on a jet fire
- Vapor Cloud Explosion modeling using industry standards models including the TNO Multi-energy, Baker Strehlow Tang and TNT Equivalence models
- Overpressure contours from Boiling Liquid Expanding Vapour Explosions

TOXIC EFFECTS

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

PHAST RISK

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

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

A key benefit of Phast Risk is the ability to identify major risk contributors and differentiate these from incidents with worst case consequences which might otherwise dominate the safety reviews. Whilst medium scale incidents have lesser consequences, they may have a higher frequency,

which, when combined with their hazardous effects, generate a higher level of risk. Time and effort directed to mitigating high consequence but often low frequency events may not be well spent. Phast Risk helps you direct this effort more effectively.

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

Benefits

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

Table 7.4 POSSIBLE ACCIDENT SCENARIOS

Scenario	MCL Scenario	Pressure & Temp.	Quantity in MT
1	Release of Drum	NTP	50

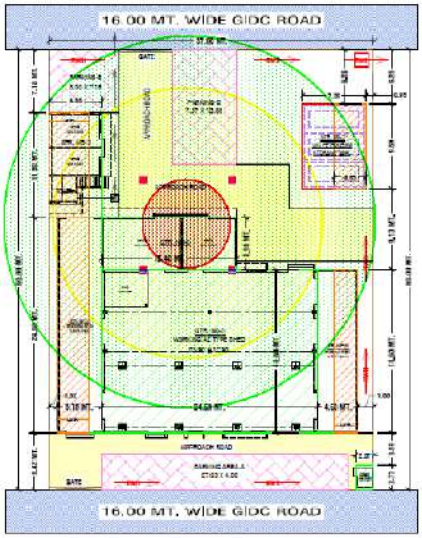
SCENARIO -1 UNCONFINED POOL FIRE SIMULATIONS FOR DRUM STORAGE AREA

Catastrophic Rupture		
Input Data		
Stored quantity - 50 MT		
Wind speed - 2.00 m/s		
Density (Air) – 0.867 g/cm^3		
Results indicate		
Pool Fire Scenario		
Radiation Level (KW/n	Distance in mete	**Effect if IHR at Height of simulation**
4	50.625	This level is sufficient to cause personnel if unable to reach cover within 20s; however blistering of the skin (second degree burn) is likely; 0: lethality
12.5	25.77	This level will cause extreme pain within 20 seconds and movement to a safer place is instinctive. This level indicates around 6% fatality for 20 seconds exposure.
37.5	12.39	This level of radiation is assumed to give 100% fatality as outlined above.

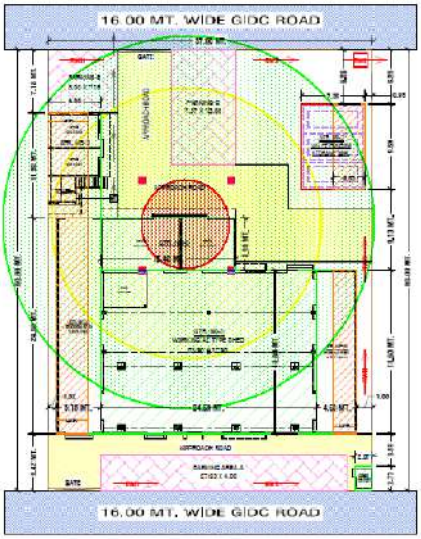
Fire Ball Scenario

Radiation Level (KW/m^2)	Distance in meter	Injury Type
4	55.05	Pain after 20secs.
12.5	32.6	1st degree Burn
37.50	12.57	100% Fatal

SCENARIO OF POOL FIRE



SCENARIO OF FIRE BALL



Measures to be taken to prevent such accident:

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

Following precautions will be adopted during unloading

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

Following precautions will be adopted Storage of such chemicals

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

RISK ASSESSMENT SUMMARY

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

Induction safety course to be prepared and trained all new employees before starting duties in plant.

7.6 LEAK DETECTION AND REPAIR (LDAR) PROGRAM

Spillage / Leakage Control Procedure

1. Purpose

1.1 To provide the guidelines for effective control and disposal of Spillage of materials.

2. Scope

2.1 This Procedure is applicable for control and disposal of spilled liquid and solid materials.

3. Responsibility

3.1 Stores Assistant/ Stores Officer/ Warehouse Executive/ Engineering Department Personnel/ QA/QC department personnel/ Production Executive and officers/ EHS departments.

3.2 Manager/ Asst./Manager / Executive – from all departments.

4. Accountability

4.1 Sr. Executive –EHS/ Unit Head

5. Procedure

5.1 Spill Control for Solid Materials (Acid Or Alkali)

5.1.1 In case of spill of the solid refer the MSDS of the material for safety related guidance. Inform QA and EHS department for getting their advice. Immediately plug the source of leak if possible.

5.1.2 Use appropriate personnel protective equipments to prevent the breathing in /inhaling the solid, as per the guidance given in the MSDS.

5.1.3 Collect the spilled solids material.

5.1.4 Do not use water before dry swiping. The dry swipage do not mix with earlier collected material.

5.1.5 After collection of spilled material clean the area by using the water. Collected water drain in the effluent.

5.1.6 Check the analysis of collected material if it is found ok recycle the material in processes.

5.1.7 If, the material found not reusable to discarded it along with the hazardous waste..

5.1.8 Send the collected spilled solid material along with the ETP primary sludge to **Bharuch Enviro Infrastructure limited-Ankleshwar** for further treatment of landfill.

5.2 SPILLAGE / LEAKAGE OF ACID / ALKALI DUE TO DRUM / TANK FAILURE.

5.2.1 Nature of hazard during the spillage / leakage of Acid / Alkali.

- Highly Corrosive.
- In case of acids like H2SO4, in contact with water violent heat released.

- Fire may produce irritating or poisonous gases.

5.2.2 Action to be taken during the spillage / leakage of acid / alkali.

5.2.3 In case of spillage / leakage of the liquid material refer the MSDS of the spilled material for safety precautions and use PVC suit, Hand gloves, Safety shoes etc in case of leakage/spillage.

5.2.4 Self-contained breathing apparatus (SCBA) may be used.

5.2.5 In case the spillage or leakage observed, first pour the china clay (vermiculate) on material and collect the contaminated china clay (vermiculate) and send to ETP.

5.2.6 In case the spillage or leakage is large, Do not use water, as the reaction is highly exothermic

5.2.7 Cover the spillage with sand / china clay (vermiculate) by using full PVC suit, PVC hand gloves, suitable footwear, self-contained breathing apparatus etc. and collect the socked material in the separate drums/bags after collection wash the area with water.

5.2.8 Inform the effluent treatment plant about additional load.

5.2.9 Keep unwanted persons at a safe distance, away from the spillage & isolate the area

5.2.10 Do not clean the spillage with cotton rags or sawdust, which may result in fire.

5.2.11 In case of the spillage / leakage in outside area (other than classified) use dry sand or China clay (vermiculate) to soak the liquid. Collect this soaked sand or china clay (vermiculate) in a poly bag. Seal the bag and put the label on the bag detailing the Name of the material, Qty. Weight of the soaked sand or china clay, any special precaution, if any, to be taken care of at the time of disposal of the material. Immediately plug the source of spill / leak.

5.2.12 Send the collected spilled material for the disposal to along with the ETP sludge.

5.3 SPILLAGE / LEAKAGE OF FLAMABLE LIQUIDS.

5.3.1 Nature of hazard during the spillage / leakage of chemicals

5.3.2 In case the small spillage or leakage observed, first pour the china clay (vermiculate) on material and collect the contaminated china clay (vermiculate) and send to ETP.

5.3.3 If the spillage is of inflammable liquid, switch off all the power supply in the area to prevent Electric Spark.

5.3.4 Do not use any vacuum cleaner or floor cleaning machine to collect the spilled material as the vapors of the spilled material may explode due to electrical circuits and rotating parts of these machine.

5.3.5 Send the spilled material along with the ETP sludge to **BEIL-Ankleshwar.**

6. Formats

Not Applicable

7. Abbreviations

SOP	:	Standard Operating Procedure
EHS	:	Environment, Health & Safety
QA	:	Quality Assurance
QC	:	Quality Control
ETP	:	Effluent Treatment Plant
MSDS	:	Material Safety Data Sheet
PVC	:	Poly Vinyl Chloride
SCBA	:	Self-contained breathing apparatus

7.7 Submit checklist in the form of Do's & Don'ts of preventive maintenance, strengthening of HSE, manufacturing utility staff for safety related measures.

Do's:

- Store used oil at proper place as per plant guidelines.
- Use lubricating oil carefully to avoid spillage on ground.
- Use lubricating oil as per requirement.
- Use minimum amount of water wherever it is required as per plant guidelines.
- Waste disposal system for all plants should be separate.
- Avoid spillage of liquid, hand gloves, cotton waste on road, which will cause pollution. Recycle or dispose that material.
- Use cleaning equipment carefully. (i.e. cotton waste, oil & chemicals)
- Place all the equipments (i.e. Fire Hose, Rubber Pipe and Chisel) at proper place.
- Handling of chemicals should be as per plant guidelines to avoid undesired chemical reaction.
- Safety training and correct use of PPE's must for all the employees.
- Environment guidelines should follow during cleaning of vessels, Tank, channels etc.
- Follow shift in charge's instructions during loading or unloading of chemicals.
- In case of fire or any accident, immediately inform responsible person.
- In case of emergency, inform operator as well as control room.
- Area of work during excavation, radiography, sand blasting shall be cordoned with warning tags of "work in progress", "no entry", "radiography" in progress' etc.
- Switch off lights and computers when not in use.
- Shut the water cock properly when not in use.
- Always follow safety rule during the plant operation.

Do's during shut down:

- All equipment, vessels, lines where hot work is envisaged shall be purged, flushed thoroughly and positively isolated. Similar precautions should be taken for vessel entry also.
- Back flow of materials from sewers, drains should be avoided by proper isolations.
- In case of confined space entry and other cleaning jobs etc. which are to be carried out by the process department, vessel entry permit should be issued to immediate supervising officer/operator by shift in charge. This permit should be renewed by incoming shift in charge during every shift.
- Hoist, Platform, cages used for lifting persons or to send persons inside vessels by such means must be of sound construction with wire ropes slings, etc. to avoid failure.
- All steam, condensate, hot water connections should be made tight with clamps.
- Nitrogen hazard should be kept in mind. All nitrogen sources should be positively isolated from vessels/confined spaces to avoid oxygen deficiency where vessel entry is required.
- All nitrogen hoses used for purging before vessel entry should be removed from source/utility point.
- All underground sewers shall be flushed, protected from sparks.
- Full PPEs like PVC suits, gum boots, face shield & other required shall be used while draining, flushing and other reclaiming activities to avoid burn, poisoning etc.
- Wet asbestos cloth/metallic plate should be used to collect flying sparks.
- Water, steam flushing, nitrogen blanketing shall be continued where spontaneous combustion takes place. Precautions should be taken for pyrophoric nature of material.
- Temporary electrical connections, cords, boards and other electrical fixtures should be of sound material to prevent electrical shock.
- Oil spillage in the pit of oil slope tank should be cleaned with water/sand.
- Proper approach like aluminum ladder should be provided to reach to the platforms of scaffolding and ladder must be tied.
- All clumps of scaffolding should be tightened properly and planks should be tied at both ends and supported at proper distances along span to avoid sagging and failure.
- Always use safety belt while working at height of more than 2 meters and ensure tieing the life line of safety belt with firm support.

- Ensure area cordoning for hot work, X-ray, excavation, hazard material temporary storage.
- Ensure proper tagging of valves, switches etc to prevent its use.
- Ensure proper guidance to workman and make him aware about local area hazards before start of the job.
- All welding machines should be provided with power isolation switch of suitable rating.
- Portable electrical appliances/tools earthing should be in good working condition. Insulation portion should be free from damages.
- All electrical cables should be joints free and connection taken by using three pin plugs.
- While inserting fuse all care should be taken so that no one touches conductor to avoid the shock to the persons.
- During hydro jetting work workers should wear hand gloves, safety helmet goggles and PVC suit.

Don'ts:

- Do not use fire hydrant water for washing/bath purpose.
- Do not use water for cleaning purpose, use broomstick if possible.
- Do not wash or clean trolley, tractor or trucks which are used for chemical/fertilizer's transportation. Wash them at proper place.
- Smoking & carrying matchbox, cigarettes, lighter, bidis etc. are prohibited.
- Photography & carrying cameras/Mobile phones are strictly prohibited in all areas.
- Do not spill liquid or chemicals in open atmosphere.
- The use of Radio Active Source within the plant shall not be allowed without obtaining valid permission/work permit and intimation in the form of a circular to all plant persons shall be given in advance.
- Unauthorized entry into any battery limit of plant is strictly prohibited.
- Sitting or walking on rail tracks, crossing between wagons, taking rest under stabled wagons, crossing the rail through the openings underneath the stationary wagons are strictly prohibited.

Don'ts during shut down:

- Do not use gasket or other blinds as it can fail during job. All blinds should be metallic.
- No toxic/corrosive/irritating materials should remain plants or sections where hot work is to be carried out.
- No hot work should be permitted in battery limits near sewers till areas have been cleaned flushed properly.
- No hot work irrespective of place of area shall be done without valid permit.
- No combustible material shall be there in flare line for taking up of flare line job. Isolations shall be ensured.

7.8 Details on various SOP to be prepared.

The following SOPs will be prepared for the safe & smooth functioning of operations –

a) SOP - for safety training.

b) SOP-Induction of new employees.

c) SOP- Safe Production operations.

d) SOP-Safe unloading and storage of raw materials.

e) SOP-Safe Loading of Finished Goods.

f) SOP- Inspection of Transport vehicles.

g) SOP-Quality control of Raw Materials and Finished Goods.

h) SOP-Work permits system.

All the above SOPs will have following basic contents –

a) Safe preparedness of system to start.

b) Safe Shut down procedure of system.

c) Safe handling of system.

d) PPE required to handle the system.

e) Trouble shooting of the system.

f) Operational control procedures.

7.9 PROCESS SAFETY

- Safety measures will be adopted from the design stage.
- Safety Valve and pressure gauge will be provided on reactor and its jacket (if jacket is provided).
- Utility like Chilling, cooling, vacuum, steaming and its alternative will be provided to control reaction parameters in a safe manner.
- Free Fall of any flammable material in the vessel will be avoided.
- Static earthing provision will be made at design stage to all solvent handling equipments, reactors, vessels & powder handling equipments.
- Any reaction upsets will be confined to the reaction vessel itself.
- All emergency valves and switches and emergency handling facilities will be easily assessable.
- Further all the vessels will be examined periodically by a recognized competent person under the Gujarat Factory Rules.
- All the vessels and equipments will be earthed appropriately and protected against Static Electricity. Also for draining in drums proper earthing facilities will be provided.
- Materials will be transferred by pumping through pipeline or by vacuum from drums.
- All solvents and flammable material storage tanks will be stored away from the process plant and required quantity of material will be charge in reactor by pump.
- Jumpers will be provided on all solvent handling pipeline flanges.
- Caution note, safety posters, stickers, periodic training & Updation in safety and emergency preparedness plan will be displayed and conducted.
- Flame proof light fittings will be installed in the plant.
- All the Plant Personnel will be provided with Personal Protection
- Equipments to protect against any adverse health effect during operations, leakage, spillages or splash. PPE like Helmets, Safety Shoes, Safety
- Glasses, Acid-Alkali Proof Gloves etc. will be provided to the employees.
- All employees will be given and updated in Safety aspects through periodic training in safety.
- Material Safety Data Sheets of Raw Materials & Products will be readily available that the shop floor.

7.9.1 FOR DRUM/CARBOY STORAGE AREA

Some chemicals will be received at plant in drums/Carboys by closed containers and stored in a drum/Carboy storage area.

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

7.9.2 TRANSPORTATION

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

7.10 DISASTER MANAGEMENT PLAN

Company shall develop the emergency management system to tackle the emergency situation, apart from its emergency management system. The detail of disaster management system is discussed in the following section.

7.10.1 DEFINING THE NATURE OF EMERGENCY

7.10.1.1 LEVEL OF EMERGENCY CAN BE CLASSIFIED IN THREE CATEGORIES.

LEVEL - 1:
The leakage or emergency, which is confinable within the plant, premises. It may be due to -

a) Small fire in the plant

b) Low toxic gas release for short duration.

c) Collapsing of equipment that do not affect outside premises.

LEVEL - 2:

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

a) Major fire inside the factory premises.

b) Medium scale explosion confined to the factory premises.

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

LEVEL - 3:

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

a) Explosion of high magnitude affecting the adjacent area

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

7.10.2 OBJECTIVES OF EMERGENCY MANAGEMENT SYSTEM

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

- To identify and assess types of emergencies due to different types of hazards.
- To work out plan with all provisions to handle emergencies and safeguard employees and people in the vicinity of the factory.
- To provide for emergency preparedness and the periodical rehearsal of the plan.
- To plan mode of proper communication and actions to be followed in the event of emergency.

- To keep all necessary information with respect to hazard/accident control and emergency contacts in one document for easy and speedy reference.
- To inform employees, general public and the authorities about the hazards/risk if any and the role to be played by them in the event of emergency.
- To control and contain the accident.
- To effect rescue and treatment of casualties.
- To inform and help relatives of casualties.

7.10.2 STRUCTURE OF EMERGENCY MANAGEMENT SYSTEM

The management structure at M/s. Pro Active Pharma includes the following personnel's;

- Chief Emergency Controller
- Incident Controllers and Deputy Incident Controllers
- Site Main Controllers
- Key Personnel's
- Essential Workers
- Assembly points

7.11 OCCUPTIONAL HEALTH AND HAZARD AND SAFETY MESUARES

General Safety Precautions:

A brief description of the measures taken site:

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

7.11.1 OPERATION AND MAINTENANCE

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

- Industrial Safety Helmet

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

7.11.2 FACTORY MEDICAL OFFICER (FMO)

A qualified doctor will be appointed as FMO on retainer ship basis. Doctor will visit once in a week.

7.11.3 AMBULANCE VAN

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

7.11.4 FIRST AID BOX

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

7.11.5 PERIODIC MEDICAL EXAMINATION

It is proposed that client will ensure that…

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

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

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

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

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

1. It is proposed to formulate and implement an EMP for Occupational Safety and Health with following aims…
    - To keep air-borne concentration of toxic and hazardous chemicals below PEL and TLV.
    - Protect general health of workers likely to be exposed to such chemicals.
    - Providing training, guidelines, resources and facilities to concerned department for occupational health hazards.
2. It is proposed that this EMP be formulated on the guidelines issued by Bureau of Indian Standards on OH&S Management Systems: IS 18001:2000 Occupational Health and Safety Management Systems.
3. Workplace Monitoring Plan
    - It is proposed that a Workplace Monitoring Plan to be prepared & implemented in consultation with FMO and industrial hygienists.

- Each workplace must be evaluated to identify potential hazards from toxic substances or harmful physical agents. Air-borne concentration of toxic chemicals will be measured and record will be kept.

4. Health Evaluation of Workers

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

7.11.7 MEDICAL SURVEILLANCE PROGRAM

Pre-employment Medical Check Up

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

Periodical Medical Check up

1. Lung Function test
2. Cardiogram
3. Audiometry
4. Hematological Examination
5. Urine examination