CHAPTER - 7
OCCUPATIONAL HEALTH, RISK ASSESSMENT AND DISASTER MANAGEMENT PLAN

7.1Introduction

M/s. Sri Krishna Pharmaceuticals limited proposed to establish a new unit at Plot. No. F-1, MIDC, Chincholi, Taluka- Mohol, Solapur District, Maharastra state.

7.2Site Location and Surroundings

M/s. Sri KrishnaPharmaceuticals Limited, F-1 is surrounded byMIDC Road and Tara Hydro laboratories in North, MIDC Road in south, Road followed by LR industries in east and Open land and Challa Chlorides on west direction.

The company is proposing the following blocks/Areas in the plant

- Production blocks
- Ware House
- QC/QA laboratory
- Utilities Block
- Boiler room
- Generator Room
- Bulk Storage area
- Effluent Treatment Plant
- Cooling towers
- Purified Water system
- Admin block

7.3 Objectives and Scope

The production of synthetic organic chemicals involves usage of many chemicals which are both hazardous and non-hazardous in nature. Risk analysis has been carried out to identify the hazardous materials and quantify the hazards to arrive at safe disaster management plan and emergency preparedness plan for storage and handling of the potentiality hazardous materials. Also the purpose of carrying out risk assessment study forM/S Sri Krishna Pharmaceuticals Limited, F-1is to obtain clearance from the Ministry of

Environment and forests (MOEF) which calls for a study on nature of hazards due to proposed location of process and storage units and also to study whether any accident,if occurs leads to any off-site disaster. In this endeavour, the study objectives are outlined here under.

i) Hazard identification and Visualization of Maximum CredibleAccident Scenarios.

- To identify major hazards relating to fire, explosion and toxicity due to chemicals, processes and storages of the proposed units.

ii) Hazard Analysis and Risk Assessment

- Hazard analysis is the process of determining the release probabilities and quantities, emission or release rates, the routes/pathways by which the released substances could reach the receptors, the fate of the substances in environmental media through which they are transported or moved and the characteristics of the receptors at risk.
- **Disaster Management** To provide guidelines for Disaster Management Plan(DMP) for on-site emergencies and EmergencyPreparedness Plan(EPP) for off-site emergency, based on above i) & ii) studies of proposed plant.

7.4 Production Details

The manufacturing capacities proposed are presented in **Table 7.1**

Table 7.1Production capacity proposed

S.No	Product Name	Production Capacity TPM	Product Description	Therapeutic Category
1A	Paracetamol(starting from PNCB- 4 stages)	400.0	Bulk Drug	Analgesic/Anti pyretic
1B	Paracetamol(starting from PAP- 2 stages)	1100.0	Bulk Drug	Analgesic/Anti pyretic
2	Ibuprofen	500.0	Bulk Drug	Anti inflammatory
3	Metformin	500.0	Bulk Drug	Anti diabetic
4	Domeperidone	15.0	Bulk Drug	Anti emetics
5	Dextromethorphan hydrobromide	20.0	Bulk Drug	Anti histamine

7	OMEGA 3(DocosaHexaenoic Acid (DHA))	10.0	Bulk Drug	Anti lipemic
	Total	**2545.0**		
	By Products			
1	Acetic acid	1788.0		
2	Soap	40.0		

7.4.1Process Description

The details of process are given in**Chapter 2**

7.5Hazard Analysis and Risk Assessment

7.5.1 Introduction

Hazard analysis is the process of determining the release probabilities and quantities, emission or release rates, the routes/pathways by which the released substances could reach the receptors, the fate of the substances in environmental media through which they are transported or moved and characteristics of the receptors at risk. The basis of risk estimation is to determine the dose-effect relationship between an indicator chemical and receptor. Estimation of risk follows only when the hazard analysis shows a frequency or occurrence, which is significant.

Risk evaluation is the process of identifying, whether the estimated level of risk is tolerable. Tolerable risk is not equated with acceptability; it refers to a willingness to live with a risk so as to secure certain risk benefits, and in the confidence that the risk is being properly controlled.

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

7.5.2 Common definitions

The common terms used in risk Assessment and Disaster Management are elaborated below:

"Risk" is defined as a likelihood of an undesired event (accident, injury or death)occurring within a specified period or under specified circumstances.This may be either a probability depending on the circumstances.

"Hazard" is defined as a physical situation, which may cause human injury, damage to property or the environment or some combination of these criteria.

"Hazardous substance" means any substance or preparation, which by reason of its chemical or physic chemical properties or handling is liable to cause harm to human beings, other living creatures,plants,micro-organisms,property or the environment.

"Hazardous process" is defined as any process or activity in relation to an industry which may cause impairment to the health of the persons engaged or connected therewith or which may result in pollution of their general environment.

"Disaster" is defined as a catastrophic situation that causes damage, economic disruptions, loss of human life and deterioration of health and health services on a scale sufficient to warrant an extraordinary response from outside the affected area are community. Disasters occasioned by man are factory fire explosions and release of toxic gases or chemical substances etc.

"Accident" is an unplanned event, which has a probability of causing personal injury or property damage or both.

"Emergency" is defined as a situation where the resources out pass the demand. This highlights the typical nature of emergency; it will be after experiences that enough is not enough in emergency situations. Situations of these kinds are avoidable but it is not possible to avoid them always.

In the sections below, the identification of various hazards, probable risks in a process industry manufacturing optical brighteners, maximum credible accident analysis, consequence analysis are addressed which gives a broad identification of risks involved in the plant.

7.5.3 Hazard Identification

Identification of hazards in the synthetic chemicals organic plant is of primary significance in the analysis, quantification and cost effective control of accidents involving flammable compounds. A classical definition of hazard states that hazard is not in fact the characteristic of system/plant/storage that presents potential for an accident. Hence, 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.

Typical schemes of predictive hazard evaluation and quantitative risk analysis suggest that hazard identification step plays a key role in estimation of probability of an unexpected event and its consequences from the basis of quantification of risk in terms of damage to property, environment or personal.Therefore thetype,quantity location and conditions of release of a toxic or flammable substance have to be identified in order to estimate its damaging effects, the area involved, and the possible precautionary measures required to be taken.

Some of the hazard identification procedures are as follows:

1. Fire Explosion and Toxicity Index(FETI) Approach;
2. HAZOP studies
3. Maximum Credible Accident and Consequence Analysis(MCACA);

7.5.3.1 Identification of Major Hazards from the unit

The Hazard identification process adopted is to identify hazardous chemicals as per the statutory requirements of Manufacture storage and import of Hazardous Chemical Rules,2016

The identified chemicals for the risk assessment are presented in the following**Table 7.2**

Table 7.2

List of Raw materials and Inventory

S.No	Name of the Raw Material	Quantity (Tons)	Physical Form	Nature of Storage	CAS NO.
1	Para Nitro Chloro Benzene	80.3	Solid	Bags	100-00-5
2	Mandelic acid	3.4	Solid	Bags	90-74-2
3	1- bromo-3-chloro-propane	1.7	Liquid	Drums	109-70-7
4	4- Methoxy phenyl acetic acid	4.3	Solid	Bags	104-01-8
5	40% Hydro bromic acid	2.2	Liquid	Drums	10035-10-7
7	Acetic Acid (20%)	34.5	Liquid	Tank form	74-19-7
7	Acetic anhydride	191.0	Liquid	Tank form	108-24-7
8	Acetone	218.8	Liquid	Tank form	77-74-1
9	Acetyl chloride	42.7	Liquid	Drums	75-37-5
10	Activated Corbon	5.2	Solid	Bags	7440-44-0
11	Alkali solution	3.3	Liquid	drums	-
12	Aluminum chloride	73.2	Solid	Bags	7447-70-0
13	Ammonia	8.8	Liquid	Drums	1337-21-7
14	Ammonia gas	0.4	Gas	Cylinder	1337-21-7
15	Ammonium chloride	2.9	Solid	Bags	12125-02-9
17	Caustic flakes	3.2	Solid	Bags	1310-73-2
17	Caustic Lye (48%)	125.7	Liquid	Tank form	1310-73-2
18	Conc. HCl 30 %	13.1	Liquid	Tank form	7747-01-0
19	Crude oil	7.7	Liquid	Drums	-
20	Dinitrochlorobenzene -DCNB	2.7	Solid	Bags	97-00-7
21	Dextrose	43.3	Solid	Bags	10/1/5997
22	Dicyanodiamide	44.3	Solid	Bags	471-58-5

23	Dimethyl formamide	58.5	Liquid	Drums	78-12-2
24	Dimethylamino hydrochloride	47.8	Solid	Bags	507-59-2
25	EDTA	0.3	Solid	Bags	139-33-3
27	Ethyl chloroformate	2.4	Liquid	Drums	541-41-3
27	Formaldehyde (40%)	0.3	Liquid	Drums	50-00-0
28	Formic acid	0.4	Liquid	Drums	74-18-7
29	Hydrogen	0.1	Gas	Cylinder	1333-74-0
30	Sodium hydro sulfite (Hydros)	0.5	solid	Bags	7775-14-7
31	Iron Powder	72.4	solid	Bags	7439-89-7
32	Iso propyl alcohol	250.9	liquid	Tank form	77-73-0
33	Isobutyl benzene	74.4	Liquid	Tank form	538-93-2
34	K2 CO3	1.5	Solid	Bags	584-08-7
35	Methanol	170.9	Liquid	Tank form	77-57-1
37	Methyl Aceto acetate(MAA)	1.5	Liquid	Drums	108-75-7.
37	Methyl formate	2.3	Liquid	Drums	107-31-3
38	MIBK	8.9	liquid	Tank form	108-10-1
39	Mono Chloro acetic acid	57.2	Solid	Bags	79-11-8
40	N- Hexane	113.4	Liquid	Drums	110-54-3
41	N- Methyl Piperidone	1.8	Liquid	Drums	1445-73-4
42	Orthophenylene di amine(OPDA)	1.4	Solid	Bags	95-54-5
43	O- Xylene	15.7	Liquid	Drums	95-47-7
44	PAP (1%) moisture)	147.1	Solid	Bags	123-30-8
45	Phosphoric acid	7.4	Liquid	Drums	7774-38-2
47	Phosphorous oxy chloride	5.1	Liquid	Drums	10025-87-3

47	Potassium carbonate	2.3	solid	Bags	584-08-7
48	Potassium hydroxide	2.0	solid	Bags	1310-58-3
49	Potassium chloride	0.8	Solid	Bags	7447-40-7
50	Raney Nickel	0.2	Solid	Drums	7440-02-0,7732-18-5,7429-90-5
51	Sodium Meta Bisulphite(SMBS)	0.5	Solid	Bags	7781-57-4
52	Sodium bi carbonate	4.1	solid	Bags	144-55-8
53	Sodium carbonate	2.0	solid	Bags	497-19-8
54	Sodium borohydride	1.0	solid	Bags	17940-77-2
55	Sodium dichromate	44.0	solid	Bags	7789-12-0
57	Sodium Hydro Sulphite(Hydros)	0.3	Solid	Bags	7775-14-7
57	Sodium metal	15.8	Solid	Bags	7440-23-5
58	Sulphuric Acid	131.9	Liquid	Tank form	7774-93-9
59	Toluene	118.5	liquid	Tank form	108-88-3
70	Urea	1.3	Solid	Drums	57-13-7
71	Xylene	7.0	Liquid	Tank form	1330-20-7

Table 7.3

List of hazardous chemicals(Listed in part II of schedule I of MSIHC Rules, 2016)

S.No	Raw material	Physical form	Type of hazard	Maximum Storage quantity(Tonns)	Threshold Quantity (Rule 5,7,9 and 13 &15	Threshold Quantity (Rule 10 to 12	Level of Hazard
1	Acetic anhydride	Liquid	Non-Flammable	191.0	Not specified	Not specified	Level 1 Hazard
2	Acetic acid	Liquid	Flammable	34.5	10000	10000	Level 1 Hazard
3	Acetone	Liquid	Flammable	218.8	7000T	7000T	Level 1 Hazard
4	Aluminium Chloride	Solid	Non-Flammable	73.2	Not specified	Not specified	Level 1 Hazard
5	Ammonia	Liquid	Flammable	8.8	50T	500T	Level 1 Hazard
7	Sulphuric acid	Liquid	Non-Flammable	131.9	Not specified	Not specified	Level 1 Hazard
7	HCl	Liquid	Non-Flammable	13.1	25T	250T	Level 1 Hazard
8	Hydrogen	Gas	Explosive	0.1	2 T	50T	Level 1 Hazard
9	Formaldehyde	Liquid	Flammable	0.3	5T	50T	Level 1 Hazard
10	Formic acid	Liquid	combustible	0.4	5000	50000	Level 1 Hazard
11	Iso Propyl alcohol	Liquid	Flammable	250.9	10000	10000	Level 1 Hazard
12	Methanol	Liquid	Flammable	170.9	10000	10000	Level 1 Hazard
13	o-Xylene	Liquid	Flammable	15.7	10000	10000	Level 1 Hazard
14	Phosphorous oxy chloride	Liquid	Flammable	5.1	Not specified	Not specified	Level 1 Hazard
15	Potassium hydroxide	Solid	Non-Flammable	2.0	Not specified	Not specified	Level 1 Hazard

17	Sodium Metal	Solid	Flammable	15.8	Not specified	Not specified	Level 1 Hazard
17	Sodium Hydroxide	Solid	Non-Flammable	3.2	Not specified	Not specified	Level 1 Hazard
18	Sulphuric acid	Liquid	Non-Flammable	131.9	Not specified	Not specified	Level 1 Hazard
19	Toluene	Liquid	Flammable	118.5	Not specified	Not specified	Level 1 Hazard

Note:

Level I Hazard: Chemical is listed in schedule of chemicals but threshold limit did not crossed 1st threshold or 2nd threshold limit as per the schedule I of MSIHC Rules 2016

The Physical properties of the key chemicals stored are presented in the following **Table 7.4**

Table 7.4
Physical properties & Hazard characteristics of Key Raw materials

S.No	Name of the Material	Boiling point °C	Flash Point in °C	Explosive Limits volume % in air	NFPA Rating		
					Health	Fire reactivity	Reactivity
1	Acetic acid	118.1	39	4-19.9	3	2	0
2	Acetic anhydride	139.9	49 49	2.7-10.3 2.7-10.3	2 2	1 2	1
3	Acetone	55.7	-17.8	2.5-12.8	2	3	0
4	Acetyl chloride	52	4.4	7.3	3	3	2
5	Ethylchloroformate	94	17	-	4	3	0
7	Isopropyl alcohol	82.5	11.7	2-12.7	2	3	0
7	Methanol	74.5	12	7.7-37	2	3	0
8	Methyl isobutyl ketone	115.9	14	1.4-7.5	2	3	0
9	n- hexane	78	-22.5	1.15-7.5	2	3	0
10	o-Xylene	144.4	17	0.9-7.7	2	3	0
11	Toluene	110.7	4.44	1.2-7.75	2	3	0

Following table gives the bulk storages of chemicals proposed

Table 7.5
Bulk Storages proposed

S.NO	Chemical Name	Storage Quantity	Tank dimensions	Above Ground/Below Ground	Area of tank
1	Acetic acid	4 X 25 KL	SS (R1.25M X H 5.0 M)	Above ground	24.54
2	Iso Butyl Acetophenone	20 KL	MS (5.0M dia X 2.25 M)	Below Ground	49.09
3	Acetone	20 KL	MS(5.0 M dia X 2.25 M)	Below Ground	49.09
4	Xylene	20 KL	MS(5.0 M dia X 2.25 M)	Below Ground	49.09
5	Toluene	2 X 20 KL	MS(5.0 M dia X 2.25 M)	Below Ground	49.09
7	Methanol	20 KL	MS(5.0 M dia X 2.25 M)	Below Ground	49.09
7	MIBK	20 KL	MS(5.0 M dia X 2.25 M)	Below Ground	49.09

7.6 Fire& Explosion Index (F&EI):

7.6.1 Methodology

Dow Chemical Company issued a guideline for hazard determination and protection. By this method a chemical process unit is rated numerically for hazards. The numerical value used is the Fire and Explosion Index (F&EI) which is most widely used for hazard evaluation in chemical process industries.The guide applies to process unit only and not to auxiliary units such as power generating stations, plant water systems, control rooms, fired heaters, structural requirements, corrosive nature of material handled and personal safety equipment. These are regarded as basic features that do not vary according to the magnitude of the fire and explosion hazard involved. The

guide also does not cover the processing and handling of explosives such as dynamite, TNT etc.

7.6.2 Computation of F&EI

The computation of fire and explosion index of each unit is based on the material factor. This is a measure of the intrinsic rate of potential energy release from fire explosion of most hazardous material or mixture of materials present in significant quantity, whether it is raw material, intermediate, product, solvent etc., by combustion or chemical reaction. "In significant quantity" here means such quantity that the hazard represented by the material actually exists. The Nationality Fire Protection Agency of USA (NFPA) have specified standard values for material factor which should be used for F&EI calculations and are available in DOW's hazard classification guidein case it is not readily available, it can be calculated using the heat of combustion, flammability indices etc.

General process hazard are factors that play a primary role in determining the magnitude of loss of incident. It takes into account the nature of the reaction, ventilation of the unit, accessibility of the unit, drainage facilities etc., special process hazards are factors that contribute primarily to the probability of a loss incident. They consist of specific process conditions that have shown themselves to be major causes of fire and explosion incidents. It takes into account toxicity of the material, operating pressure, operation near flammable range, quantity of material, joints and packing, use of hot oil exchange system etc., The F&EI calculated as a product of material factor, general process hazard factor, and special process hazard factor.

7.6.3 Hazard Ranking

The hazard ranking based on F&EI value is as follows

Table 7.6
Degree of Hazard for F&EI

F&EI Index Range	Degrees of Hazard
1-70	Light
71-97	Moderate
97-127	Intermediate

128-158	Heavy
159 & above	Severe

7.6.4 Results of FEI for Storage Units

Detailed computation of Fire and Explosion Index (FEI) for the major inventories of storage tanks& Drums for all liquid & gaseous raw materials at the SKPL tank farm is carried out. The values of FEI& TI are given in **Table7.7**

TABLE 7.7 -LIST OF LIQUID RAW MATERIALS USED IN SKPL-SOLAPUR –F-1 UNIT (Stored in Drums)

S.No	Name of the raw material.	Physical status	Nature of Hazard	Mode of storage (in closed shed)	Storage Quantity (Tons)		NFPA Hazard classification			F & EI				Category
						MF	Nh	Nf	Nr	GPH	SPH	F&EI	TI	
1	Acetyl chloride	Liquid	Flammable	Drums	25	24	3	3	2	0.5	1.7	97.2	3.2	Severe
2	Aldehyde	Liquid	Flammable	Drums	48	21	2	4	0	0.5	1.8	57.7	7.48	Light
3	N-hexane	Liquid	Flammable	Drums	20	17	1	3	0	0.5	1.95	70.8	3.45	Moderate
4	Mono Methyl Aceto Acetate	Liquid	Toxic, combustible	Drums	0.9	17	1	3	0	0.3	1.7	57.17	7.0	Light
5	BCP(1-Bromo-3-chloropropane)	Liquid	Toxic	Drums	1.0	21	2	1	0	0.3	1.07	27	7.11	Light
7	NMP (N-methylpyrrolidone)	Liquid	Flammable	Drums	1.0	21	2	3	2	0.3	1.7	73.71	7.0	Moderate
7	Ethyl chloroformate	Liquid	Flammable	Drums	1.4	17	0	3	1	0.7	1.9	74.2	7.0	Moderate
8	2-[1-cyclohexenyl ethylamine	Liquid	Flammable &Toxic	Drums	2.35	21	3	2	0	0.3	1.7	73.71	4.5	Moderate
9	4-Methoxy Phenyl Acetic Acid	Solid	Toxic	Carboys	2.5	17	2	1	0	0.3	1.4	47.41	4.5	Light
10	Phosphorus Oxy chloride	Liquid	Toxic	Carboys	3.0	21	4	0	2	0.5	1.1	77.15	9.0	Moderate
11	Methyl formate	Liquid	Flammable & Toxic	Carboys	1.3	21	2	4	0	0.3	1.7	73.71	7.5	Moderate
12	Dextrose	Liquid	--	Drums	27	4	1	1	0	0.15	0.2	5.52	4.05	Light

Table 7.8 LIST OF LIQUID RAW MATERIALS USED IN SKPL-SOLAPUR –F-1 UNIT

BULK STORAGES
(STORED IN ABOVE GROUND TANKS)

S.No	Name of the raw material	Physical status	Nature of Hazard	Mode of storage	MOC & Dimension	No Of Tanks	Storage Quantity		NFPA Hazard classification			FE& I				Category
								MF	Nh	Nf	Nr	GPH	SP H	F&EI	TI	
1	Caustic Lye (48%)	Liquid	Corrosive	Above Ground	M S (R1.25MXH5.0M)	2	50KL	21	3	0	1	0.5	0	31.5	2.1	Light
2	Sulphuric Acid	Liquid	Reactive	Above Ground	M S (R1.25MXH5.0M)	1	25KL	21	3	0	2	0.5	1.05	33.05	2.3	Light
3	Acetic anhydride	Liquid	Flammable	Above Ground	AL (R1.25MXH5.0M)	4	100KL	24	3	2	1	0.5	0.2	74.8	3.2	Moderate
4	HCl	Liquid	corrosive	Above Ground	PPFRP (R1.25MXH5.0M)	2	50KL	21	3	0	0	0.15	1.75	1.38	4.05	Light
5	Liquor ammonia 25%	Liquid	Toxic, corrosive	Above Ground	M S (R1.25MXH5.0M)	1	25KL	4	3	1	0	0.7	0.2	17.28	7.05	Moderate
7	Acetic acid	Liquid	Flammable	Above Ground	SS (R1.25MXH5.0M)	4	100KL	14	2	2	1	0.15	1.75	44.27	4.05	Light
7	Ammonia -LIQ	Liquid	Toxic, corrosive	Above Ground	M S (R1.25MXH5.0M)	1	25KL	4	3	1	0	0.7	1.75	17.28	7.05	Moderate
8	Ammonia gas	Gas	Toxic	50kgs cylinders	--	50 X 50 Kg Cylinders	2.5 T	4	3	1	0	0.7	1.75	17.28	7.05	Moderate
9	Hydrogen	Gas	Explosive	Cylinder	--	--	04nos	21	0	4	0	0.5	2.9	122.8	4.4	Severe

Table 7.9 LIST OF LIQUID RAW MATERIALS USED IN SKPL-SOLAPUR –B14/1 UNIT
BULK STORAGES
(STORED IN BELOW GROUND TANKS)

S. No	Name of the raw material.	Physical status	Nature of Hazard	Mode of storage	MOC	No Of Tanks	Storage Quantity		NFPA Hazard classification			F&EI				CATAGORY
								MF	Nh	Nf	Nr	GPH	SPH	F&EI	TI	
1	Isopropyl alcohol	Liquid	Flammable	Below Ground	MS (5.0MdiaX 2.25M)	1	20KL	17	1	3	0	1	1.8	89.7	7.5	Moderate
2	Isobutyl Benzene	Liquid	Toxic, Flammable	Below Ground	MS (5.0MdiaX 2.25M)	1	20KL	17	1	2	0	0.5	1.55	71.2	7.1	Moderate
3	Isobutyl Acetophenone	Liquid	Combustible	Below Ground	MS (5.0MdiaX 2.25M)	1	20KL	17	1	2	0	0.7	1.3	58.88	9.0	Moderate
4	Isopropyl chloro acetate	Liquid	Flammable	Below ground	MS (5.0MdiaX 2.25M)	1	20KL	17	1	2	0	0.5	1.81	77.44	3.3	Moderate
5	Acetone	Liquid	Flammable	Below Ground	MS (5.0MdiaX 2.25M)	1	20KL	17	1	3	0	0.7	1.75	42.24	4.3	Light
7	O-Xylene	Liquid	Flammable	Below Ground	MS (5.0MdiaX 2.25M)	1	20KL	18	2	3	0	0.5	1.72	78.4	7.57	Moderate
7	Toluene	Liquid	Flammable	Below Ground	MS (5.0MdiaX 2.25M)	2	40KL	17	2	3	0	0.5	1.74	79.7	7.48	Moderate
8	Methanol	Liquid	Flammable	Below Ground	MS (5.0MdiaX 2.25M)	1	20KL	17	1	3	0	1	1.75	88	7.5	Moderate
9	MIBK	Liquid	Flammable	Below Ground	MS (5.0MdiaX 2.25M)	1	20KL	17	2	3	0	0.8	1.75	79.2	7.8	Moderate

7.6.4.1 Maximum Credible Accident Analysis and Its Mitigation Measures

A Maximum Credible Accident (MCA) can be characterized as the worst credible accident. In other words: an accident in an activity, resulting in the maximum consequence distance that is still believed to be possible. A MCA-analysis does notinclude a quantification of the probability of occurrence of the accident. Another aspect,in which the pessimistic approach of MCA studies appears, is the atmospheric conditionthat is used for dispersion calculations.

The Consequence Analysis has been done for selected scenarios by ALOHA (version 5.4.7) of EPA. The details of software used for MCA analysis are described below.

- A computer based version ALOHA 5.4.7 is used to calculate toxic and explosive effect of the accidental release of liquid chemicals within the plant area.
- ALOHA (Areal Locations of Hazardous Atmosphere) is a computer program designed especially for use by people responding to chemical release as well as for emergency planning and training.
- ALOHA was jointly developed by the National Oceanic and Atmospheric Administration (NOAA) and the Environment Protection Agency (EPA).
- The mathematical model is based on the Emergency Response Planning Guidelines (ERPGs) which gives Toxic Levels of Concern (LOCs) to predict the area where a toxic liquid concentration might be high enough to harm people.
- ALOHA models key hazards-toxicity, flammability, thermal radiation (Heat), and over pressure (expansion blast force)-related to chemical releases that result in toxic gas dispersion, fire and/or explosion

7.6.4.2 Heat Radiation & Vapour cloud Fire distances of Hazardous Storages

Based on FEI and TI calculated only two storages have high severity. One is Acetyl Chloride which is stored in drums and another one is Hydrogen Cylinders. Only two hydrogen cylinders will be handled at any point of time. All other chemicals came under Light or Moderate Hazards. A Representative MCA analysis is done for the following chemicals and effects are documented

Table: 7.10

Failure Modes & Consequences

S. No.	Failure Type & Failure Mode	Consequence
1	Acetyl Chloride – Thermal Radiation – Total amount burned 200 kilograms	Poolfire& Vapour cloud
2	Acetic anhydride - Leak from hole in horizontal cylindrical tank – Flammable chemical escaping from tank (not burning) – Amount Released: 10.2 kilograms	Toxic Threat Zone
3	Ammonia : Leak from hole in vertical cylindrical tank - Flammable chemical escaping from tank (not burning)- Chemical Mass in Tank: 11,858 kilograms	Toxic Threat Zone
4	Hexane : Leak from hole in container vessel -	Flammable Area of Vapour Cloud & Toxic Threat Zone
5	ETHYL CHLOROFORMATE: Pool Fire Puddle Diameter: 2 meters Puddle Mass: 50 kilograms	Thermal Radiation from pool fire
6	Hydrogen – Over Pressure	Blast from Vapour Cloud Explosion, Blast force from over pressure
7	ISOPROPANOL –Leak from hole in vertical cylindrical tank- Flammable chemical escaping from tank	Poolfire Threat Zone
8	METHANOL –Leak from hole in vertical cylindrical tank- Flammable chemical escaping from tank	Poolfire Threat Zone
9	N-METHYL-2-PYRROLIDONE –50 kg - Heavy Gas - Flammable Area of Vapor Cloud –	Vapour Cloud & Threat Zone

10	TOLUENE – Leak from hole in vertical cylindrical tank - Flammable chemical escaping from tank	Vapour Cloud &Toxic Threat Zone
11	Methyl Formate – Leakage from Drum(50 Kg)	Toxic threat, Flammability threat and vapour cloud explosion
12	Phosphorous Oxy Chloride- Leakage from Drum (50 KG)	Toxic threat zone
13	Cyclohexylamine – Leakage 50 Kg	Flammable/Toxic/vapour Explosion

The maximum credible loss Scenarios (MCLS)& Damage distance identified from mathematical modelling for storage areas are given in the table below

Table 7.11

MCA scenarios and damage distances

S. No.	Failure Type & Failure Mode	Consequence	Category	Damage Distance
1	Acetyl Chloride – Thermal Radiation – Total amount burned 200 kilograms	Thermal Radiation	Red	< 10 Meters
		Flammable area	Red(70% LEL) Yellow (10%LEL)	23 Meters 71 Meters
2	Acetic anhydride - Leak from hole in horizontal cylindrical tank – Toxic chemical escaping from tank (not burning) –	Toxic Threat Zone	Red (100PPM) Orange(15 PPM)	10M

	Amount Released: 10.2 kilograms		Yellow (0.5 PPM)	28M 177 Meters
3	Ammonia : Leak from hole in vertical cylindrical tank – Toxic chemical escaping from tank (not burning)- Chemical Mass in Tank: 11,858 kilograms	Toxic Threat Zone	Red (>1100 PPM) Orange(>170 PPM) Yellow (30 - 170 PPM)	42 Meters 114 Meters 277 meters
4	N-Hexane : Leak from hole in container vessel -	Toxic Threat Zone	Red(>8700PPM) Orange (>2900 PPM)	45 Meters 80 Meters
		Flammable Area of Vapour Cloud	Red (70% LEL) Yellow(10% LEL)	49 Meters 127 Meters
5	ETHYL CHLOROFORMATE: Pool Fire Puddle Diameter: 2 meters Puddle Mass: 50 kilograms	Thermal Radiation from pool fire	Red	<10 Meters
7	Hydrogen – Over Pressure	Blast from Vapour Cloud Explosion, Blast force from over pressure	Red (> 8 PSI) Orange(3.5 PSI)	18 Meters 20 meters

			Yellow (1 PSI)	31 Meters
7	ISOPROPANOL –Leak from hole in vertical cylindrical tank- Flammable chemical escaping from tank	Poolfire Threat Zone	Red	<10 meters
8	METHANOL –Leak from hole in vertical cylindrical tank- Flammable chemical escaping from tank	Poolfire Threat Zone	Red	<10 meters
9	N-METHYL-2-PYRROLIDONE –50 kg -Heavy Gas - Flammable Area of Vapor Cloud –	Vapour Cloud & Threat Zone	Red (70 % LEL) Yellow (10 % LEL)	29 Meters 77 Meters
10	TOLUENE – Leak from hole in vertical cylindrical tank - Flammable& Toxic chemical escaping from tank	Vapour Cloud	Red	<10 meters
		Toxic Threat Zone	Red Yellow	10 Meters 11 Meters

7.7 Recommendations and Risk mitigation measures

Based on the risk analysis results and discussions above the following conclusions can be drawn:

1. The probability of tank failures is very rare and quantity of chemicals handled is very less. As it is proposed to build Ware house for storage of drums and bulk storages in one place, the chances of consequential

damage are high. In view of this, it is suggested to isolate the bulk storage tank form area from main ware house area

2. All the tank forms for the above ground tanks shall be provided with Dyke walls as per the guidelines of Factory Rules of Maharastra and Explosive guidelines
3. Non essential personnel should be located away from plant area. These include office staff, plant management personnel, technical services, library maintenance (planning/inspection), administration, accounts, etc.
4. The wind direction plays a major role in case of chemical releases. Hence adequate wind socks are to be provided at strategic locations so the people can notice take appropriate action in case of emergency.
5. It is recommended to provide adequate gas detectors at Ammonia storage area to give alarm sufficiently in advance in case of leakage.
6. Ammonia Cylinders storage area shall be provided with caustic pit and emergency scrubber for handling any leakage scenario from cylinders
7. It is recommended to provide on line VOC analysers to detect any solvent leakages during storage and handling
8. The study is based on assumptions that the storages are designed, constructed and operated in accordance with the safe Engineering practices and standards is recommended that strict adherence to the standards and accepted practices are followed not only during the installation of the plant but also throughout the life of the plant.
9. Maintenance plays a vital role in proper upkeep of the plant. One important function is monitoring of health of equipment, pipeline and machines. Adoptions of the systems like thickness survey (including support), maintenance history cards, and preventive maintenance practices will improve plant performance and safety. It should be pointed out that the failure rates of equipment and pipes are influenced by the maintenance practice followed so when the plant starts ageing. It is suggested that due attention is given to this aspect when formulating maintenance strategy.

10. The storage areas shall be re-designed keeping in view of the damage distances predicted in such a way that damage and toxic concentrations are within the premises of the company

Based on the damage distance criteria and probability of failure of different storage tanks, it is concluded that the damage distances for different liquid chemicals are following within the plant boundary. Thus no villages surrounding the tank farm are affected due to the leakage of toxic chemicals release as site is in notified industrial area

7.8 Hazard and Operability Study (HAZOP)

Safety and reliability of modern processing plant can be improved by using procedures that recognize and eliminate potential problems in the design stage. This is especially important because of the increasing need to operate the different units, for economic reasons, more closely to known risk situations. Hence, it requires refined methods like HAZOP study technique for identifying hazardous situations and problems and eliminating them at the design stage.Based on process reactions, a list of process reactions were identified for taking additional care precautions and presented in **Table 7.12**

Table 7.12
Hazardous processes and precautions suggested

Unit Process	Chemicals Involved	Equipment & Utilities	Temp/Pressure	Emission	Safety Measures
Product: Paracetamol					
Stage-I:Hydrolysis	1.PNCB, 2.C.S.LYE, 3.Sulphuric acid	Reactors, vessels, (RE-107,RE-104, V-105,V-107)	35-170°C, 4.4 kg/cm^2	No process emissions .Vents connected to scrubber	Scrubber
Stage-II: Reduction	1.PNP, 2.Ironpowder, 3. Acetic acid (20%), 4.C.S.Lye, 5.Hydros,	Reactors, vessels (RE-217, RE-217, RE-218, V-219, PC-201)	35-102°C		Scrubber (with C.S.Lye solution)

	7.SMBS.				
Stage-III: Acetylation	1. PAP, 2.Acetic anhydride, 3.EDTA, 4.Hydros, 5. SMBS	Reactors, vessels(RE-301, RE-302, RE-303, V-315, PC-301)	25-100°C	Acetic acid	Scrubber (with C.S.Lye solution)
Stage-IV: Purification (Pharma)	1.Technical Paracetamol, 2.C.S flakes/Soda ash/Sodium-bi-carbonate, 3.Activated carbon, 4.Hydros, 5.SMBS	Reactors, Agitated nutch filters (RE-304, RE-305, RE-401, RE-402, RE-403, RE-404, ANF-403, ANF-404)	45-105°C		NIL

7.8.1HAZOP WORK SHEETS

Typical hazop study for the proposed products is presented in the table below.

Table 7.13

HAZOP Study for Paracetamol (Starting from PAP)

S.No	Deviation	Causes	Consequences	Actions to be taken
1	More Charging of Acetic anhydride	1) Valve seating corroded or struck up in 'open' position 2) Faster addition	1) More Acetic acid is produced	1) Valve is to be serviced/ replaced
2	No Charging of Acetic Anhydride	1) No Acetic anhydride in M.T 2) Wrong indication of level indicator 3) Bottom valve struck up in closed	1) Without addition of RM running of agitator, waste of power and time 2) If level shows less the yield will be less If level shows	1) Charging of Acetic anhydride from storage tank to day tank 2) Level indicator bottom & top valves rectification 3) Bottom valve

		position	more, waste of Raw material and more by product formation 3) No material loss, but waste of time	servicing or replacement
3	Less Charging of Acetic anhydride	1) Pipe is partially closed 2) Valve is not properly opened 3) Damaged gasket coming in the way	1) Delay in the reaction 2) Waste of power	1) Choke to be removed 2) Valve to be serviced or replaced 3) Gasket replacement

7.9 Occupational Safety and Health

The Bulk drugs industry involves handling of various chemicals. The manufacturing process may generate fugitiveemissions, which will pose hazards in the production area to the employees. The occupational safety and health plan shall follow the guidelines based on Factories Act 1948 and shall be finalized in consultation with the local factories inspectorate.

The occupational safety and health plan is prepared to identify the hazards due to the operations and process, with the mitigation measures. The mitigation measures are mainly engineering controls, production area conditions, personal protective equipment and training and education.

7.9.1 Health Surveillance Plan

The health surveillance plan consists of medical checkup on recruitment to ascertain the health status of the employees. The data to be obtained includes;

Baseline health data such as height, weight and Vital statistics, A detailed history of previous diseases and occupational exposures. The focus will be on previous lung problems and precious exposure to lung toxins such as silica, asbestos, irritant gases etc., A history of personal hobbies or activities that might involve exposures to potential toxicants, particularly those that might affect target organs of concern of metal species, Past history of any allergies, including asthma. Identification of personal habits (smoking, hygiene, alcohol consumption, fingernail biting) that may be relevant to work. Histories will be sufficiently detailed, complete physical examination with special attention to respiratory, the appropriate respiratory equipment (if any) that may be worn. X-ray, Blood tests and urine tests.

Annual health check up for all employees who are working in production areas and stores areas, including casual workers, is done through the hospital. It is suggested to including general health checkup, lung function test, Liver function tests, urine and blood examinations & Records are maintained. It is suggested to maintain Antidotes as suggested for toxic gas hazards in the referral hospital always to meet any emergencies

7.9.2 First Aid centre

Sri Krishna Pharmaceuticals Limited proposed to establish occupational health center with the following emergency handling facilities

- Stretcher
- Bed
- Self-breathing equipment
- First aid boxes
- Ambulance is on call
- One company vehicle will be made available in day and night shifts

7.9.3 Tie up with Local Hospitals:

Government Hospitals and Private nursing homes are available in Chincholi and Sholapur. It is suggested to have tie up with the local hospitals for treating any emergency accident case of workers with the hospitals

7.10 Disaster Management Plan

This Disaster Management Plan (DMP) has been designed based on the range, scales and effects of "Major Generic Hazards" described in the Risk Assessment Report just mentioned and on their typical behaviours predicted therein. The DMP addresses the range of thermal and mechanical impacts of these major hazards so that potential harm to people onsite and off-site, plant and environment can be reduced to a practicable minimum. The scenarios of loss of containment are credible worst cases to which this DMP is linked.

The project is in its formative stage and detail engineering is yet to be done, so the elements of the DMP are based on concepts.

The emergency plan envisaged will be designed to intercept full range of hazards specific to Pharmaceutical industry. In particular, the DMP will be designed and conducted to mitigate those losses of containment situations, which have potentials to escalate into major perils.

Emergency medical aids to those who might be affected by chemical spills and toxic exposure will be inherent in the basic capabilities. The most important capability of this DMP will be the required speed of response to intercept a developing emergency in good time so that disasters such as explosion, major fire etc. are never allowed to happen.

7.10.1 Disaster Control Philosophy

The emergency control philosophy of the plant is in line with its normal operational controls. The emergency control room will be the plant's Central Control Room, which will employ Distributed Control System (DCS). All emergency operations, which may involve shutdown of the plant, will be

controlled from the Central Control Room by the same operator(s) using dedicated "Shut-Down Consoles". The consoles will send commands to initiate the shutdown procedure. Plant shutdown system will be performed by DCS.

The principal strategy of DMP of the plant is "Prevention" of identified major hazards. The "Identification" of the hazards will employ one or more of the techniques [e.g. Hazard and Operability Study (HAZOP), accident consequence analysis etc.]. Since these hazards can occur only in the event of loss of containment one of the key objectives of technology selection, project engineering, construction, commissioning and operation is "Total and Consistent Quality Assurance". The Project Authority will be committed to this strategy right from the conceptual stage of the plant so that the objective of prevention can have ample opportunities to mature and be realised in practice

The DMP or Emergency Preparedness Plan (EPP) will consist of:

A. On-site Emergency Plan

B. Off-site Emergency Plan

Disaster Management Plan preparation under the headlines of On-site Emergency Plan and Off-site Emergency Plan is in consonance with the guidelines laid by the Ministry of Environment and Forests (MOEF), Govt of India."Occupier" of the facility is responsible for the development of the On-site Emergency Plan as per the guidelines given by the Government. The Off-site Emergency Plan should be developed by the Government (District Authorities).

7.10.2 ONSITE EMERGENCY PLAN

Objectives of Emergency Management Plan (On-Site)

A quick and effective response during emergency can have tremendous significance on whether the situation is controlled with little loss or it turns into a major emergency therefore, the objectives of this onsite emergency plan (ONSEP)

During Emergency: is to provide basic guidance to the personnel for effectively combating such situations to minimize loss of life, damage to property and loss of property.

- To Locate emergency and if possible to eliminate
- To minimize loss to personnel and property, in quickest time possible
- Firefightingequipment's and safety Appliances should be made available, in readily usable condition, in the event of emergency
- To decide for shutdown of the plant in case of emergency
- To localize the hazard/ accident
- To fix responsibilities to the persons in the plant in case of emergencies
- To arrange rescue operations and treatment to the persons affected
- To provide safety to other persons present in the plant at the time of hazard
- To contain the hazard within the plant
- To get assistance from neighbouring industries under Mutual Aid, fire Station, Hospitals etc.
- To alert the statutory authorities concerned for further action in case the hazard is likely to extend to the outside area of the plant

During Normal Time:

- To keep the required emergency equipment in stock at right places and ensure their working condition;
- To provide proper guidelines to all personnel for emergency operations and escape
- Preserve relevant records and evidence for the emergency case and subsequent enquiry
- Investigation and remedial measures to avoid reoccurrence of the hazard

7.10.3 Elements of onsite Emergency Plan

- Important elements considered in this plan are:
- Identification of emergencies
- Emergency organization
- Emergency facilities

- Emergency procedure
- Communications during emergency
- Rescue, Transport and Rehabilitation
- Roles and responsibilities of key personnel and essential employees
- Mutual aid

7.10.4 Emergencies Identified

Following are the potential emergencies anticipated from Sri Krishna Pharmaceuticals Limited F-1

- Fire accidents at Bulk solvent storage & HSD areas
- Fire accidents at Boiler area, DG area
- Fire accidents in drier area
- Toxic gas release from storage of chemicals
- Major Spillage of solvents & other chemicals
- Fire/Explosion/Toxic gas release from cylinders

7.10.5 Emergency Organization

The responsibilities of key personnel for emergencies are clearly defined as follows

An emergency control room as the focal point has been earmarked. The control room flashes information to various agencies as shown in the chart. This is located in an area of minimum risk and close to road. Security and Time office room is the emergency control point.

7.10.6 Emergency Facilities

a) Emergency Control Centre (ECC)

It is a location where all key personnel like Site Controller, Emergency Coordinators can take stock of situation or can assemble and monitor aspects related to emergency and take decisions related to emergency.

The following information and facilities would be maintained at the ECC Plant control room: Latest copy of Onsite Emergency Plan and Off Site Emergency Plan (as provided by District Emergency Authority)

- Intercom Telephone
- P&T Telephone

- Telephone Directories (internal and P&T)
- Factory Layout, Site Plan
- Electrical cable rooting plan, locations of hazardous inventories, sources of safety equipment, hydrant layout, location of pump house, road plan, assembly by points, vulnerable zones, escape routes;
- Emergency shutdown procedures for generators and fuel supply system;
- Nominal roll of employees;
- List and addresses of key personnel;
- List and addresses of first aid providers;
- List and addresses of employees trained in fire fighting;
- List and addresses of qualified trained persons;
- Material safety data sheets of raw materials;
- Duties of key personnel;
- Important addresses and telephone numbers including those of fuel supplying company, government agencies, neighbouring industries and other sources of help, outside experts;

The following emergency equipment shall be made available at alternate ECC (Security point):

- Fire proximity suit/Gloves/Helmets;
- Hand tools suitable for pipelines (non sparking type);
- Teflon tape;
- Flame proof torches/batteries;
- Manila rope;
- Spark arrestor;
- First aid box;
- Public address megaphone, hand bell, emergency torch.

b) Assembly Points

Assembly points are those locations where the persons who are not connected with emergency operations can await either for further instructions or for rescue transport and rehabilitation. Assembly point is located opposite to Security and Time Office room which is located far away from production area.

a) Emergency control systems proposed

The following emergency control systems are proposed in M/s. Sri Krishna Pharmaceuticals Limited F-1

1. Wind sock
2. Lightening protection for all buildings and high raised chimneys.
3. Double Earthing& Bonding for electrostatic hazards for all reactors
4. Mobile earthing for drums while charging material
5. Closed arrangement for solvent transferring.
6. Pressure Relief system & Rupture Discs for reactors
7. Earth Rite system for road tanker loading and unloading.
8. Dust collection system with proper measures for electro static hazards.
9. Closed circuit powder transferring system for Granulation/blending/ milling equipment's
10. Laminar air flow booths for raw materials dispensing and weighing operations
11. FLP fittings at Flammable materials handling areas.
12. Alarm system in the plant for emergency notification
13. Product containment booth at raw material sifting.
    - Addressable fire detection system.
    - Fire detectors
    - Smoke detectors
14. Fire protection systems :
    - Portable Fire Extinguishers

15 Fire Hydrant system covering all blocks

17Occupational Health Centre.

17.ambulance (round the clock)

18. Self-breathing masks, Chemical resistance suits, Gum boots, chemical masks

19. Emergency lights in strategic areas

20. Safe handling procedures

21. Spill control kits

Location of First Aid Boxes

The first aid boxes will be located at the following places production blocks, administrative office, time office, and will be under the charge of EHS in-charge.

e) Fire protection system

The API Manufacturing plant will be provided with reliable fire protection system, which will be efficient and effective. Fire protection system will cover following:

- Hydrant system to cover the total plant area
- Medium velocity spray water (MVSW) system for storage tanks
- Portable foam, CO2 and dry type fire extinguisher at strategic locations for emergency situations
- Foam system for flammable solvents
- SM 200 system in MCC and control rooms

7.10.7 Fire Protection System-Portable Fire Extinguishers

SKPL proposes to provide foam, carbon dioxide, dry chemical powder (DCP) and other types of portable extinguishers at various locations depending on their compatibility and as per the rules laid down by Tariff Advisory Committee (TAC).

Fires have been classified in to five categories, A, B, C, D and E by TAC. Type of extinguishers that will be provided at all the installations are as per the following table:

Class	Description	Suitable type of extinguishers
B	Fires in flammable liquids	Foam, carbon dioxide, dry chemical powder and sand buckets
E	Fires in Electrical Equipment	Carbon dioxide and dry chemical powder

Portable fire extinguishers are generally used for extinguishing fires in their initial stages immediately after their detection. These extinguishers are designed for this purpose but their effective use depends on correct selection of

extinguisher, proper location and availability of a person who is well trained to make effective use of the extinguisher.

In accordance with the above table and anticipated class of fire, suitable type of extinguishers will be provided at various locations in the installations. The distribution extinguishers will be in compliance with Indian standards IS: 2190-1992.

Control room can be considered as Class E fire zone. Hence CO_2 extinguishers will be installed at appropriate locations.

Portable extinguishers will be provided at convenient locations in order to ensure ready access. The maximum running distance to locate an extinguisher will not exceed 15 m. the effective use of these extinguishers in controlling the fires would largely depend on their easy accessibility and availability to a person who is well-trained in operating the extinguisher and is also ware of their compatibility depending on the class of fire. The extinguishers will be mounted at a height with a red rectangle or band above them. This would enable the employees to locate the extinguishers from a distance.

7.10.8 Fire Hydrant System

SKPL fire hydrant system will be designed as per proper code and the network will cover the various installations and buildings.

The fire water pressure system may be designed for a minimum residual pressure of 7 kg/cm^2 g at the hydraulically remotest point of application.

Motor driven pumps will supply firewater to hydrant system as well as MVW system. There will be two jockey pumps. 50% pumps will be diesel engine driven. The number of pumps will be calculated as per the fire manual of TAC and OISD guidelines. In addition to above, different types of fire fighting cylinders such as foam, CO2 and dry chemical powder and other necessary auxiliaries will also be provided. Fire alarm and detection systems comprising of control and monitoring station, remote terminal unit and applicable sensors will also be provided.

It is proposed provide fire water sumps with a capacity 1157M3 in 3 numbers of ground tanks to meet any exigency. This is apart from the MIDC supply line which is available 24 hours day

It is proposed to provide foam storage of 2M3 based on fire load calculations outlined in previous chapters

The SKPL plant will be located at MIDC and there are few chemical and pharmaceutical units in the MIDC area. Sholapur town is about 15 kms from the project site and in the event of any emergency the local authorities has to reach the site from the town. As the project site is by the side of Mumbai- Sholapur High way, the communication and transport system available will be of highest order, the road networks is very good and fire tenders and other emergency equipment can reach the site within very short time.

There is one fire tender and one ambulance service available in MIDC area within 1 KM distance of the proposed site

The Photographs of MIDC emergency centre is given **figure 7.1**

Figure 7.1 MIDC Emergency Centre

h) Emergency Escapes

Emergency escapes in the plant area and floor wise emergency are conspicuously marked.

7.10.9EMERGENCY ORGANIZATION-ROLES AND RESPONSIBILITIES

Adequate man power with training would be allotted for emergency team. A total of 20 emergency Response team members would be trained and made available in all working shifts. A full-fledged emergency control room would be established with the following facilities and information which will control the emergency operations

Functions of Site Controller

Site Controller is the one who will retain overall responsibility for the factory and its personnel. As soon as he is informed of the emergency, shall rush to the emergency control Centre based on the situation and in touch with incident controller accordingly. The duties of the site controller will be

- Site main Controller is who will retain overall responsibility for the factory and its personnel.
- As soon as he is informed of the emergency, he will rush to the control room based on the situation and in touch with incident controller and other team members.
- He will arrange for messengers if any other mode of communication is not available.
- He will assess the magnitude of the emergency and decide the total course of action including the help from outside. He will arrange for necessary supply of firefighting materials, manpower, neutralizing materials, ambulance, first aiders etc. to incident controller.
- He will give instructions for shutting down of other plants and operations after assessing the situation from time to time.
- He ensures effective evacuation of all people and proper attention to the casualties.

- He ensures effective head count of all the people present on the site.
- He continuously reviews and assesses the situation.
- When emergency is over he asks security to give all clear siren.
- He communicates the emergency details to senior management and statutory authorities if necessary.
- He chairs the meeting after the emergency is called off and prepare report on the incident and the details of action initiated.

Functions of Incident Controller

The person who identifies incident is called "Incident Identifier". He has to take following actions immediately:

a. Sound "Fire! Fire! or Leak! Leak!

b. Inform area shift in charge. The area shift in charge will assess the situation and inform to emergency control centre by dialling 100 to declare emergency. In case of worst scenario the identifier himself is authorized to inform emergency control centre to declare emergency then inform to area shift in charge.

c. Information to be given:

i. Name and Emp.Code.
ii. Location and Area.
iii. Nature of incident.

Role of Emergency Response Team

Unit Head is the Emergency main controller. After receiving information either by alarm or through phone, he will immediately arrive to the Emergency Control Centre (Main Security Gate) and takes full charge. He directs all the efforts at the site. The main responsibilities during an emergency are:

- Assess the situation, decide and activate the emergency procedure
- Takes actions for controlling the incident, securing the safety of personnel and minimizing damage to environment, plant and material through incident controller.

- Direct the rescue and firefighting operations at site
- Search for causalities and arrange for proper first aid for them
- Ensure treatment of causalities and accounting of personnel
- Evacuate non-essential persons from site to safe location
- Direct shutting down of plants and evacuation of personnel
- Ensure good communication with emergency control centre
- Ensure proper communication to inside and outside emergency services
- Take direct operational control of works area not affected by the incident
- Preserve evidence for enquiry.

To perform the entire above responsibilities emergency main controller is assisted by Dy. Emergency controller.

Team Functions

Shut – down Team

Leader : Production Officer

Member : Chemist, Maintenance Charge man

To shut down the unit/section of the plant as directed by the site controller or as situation demands, as per emergency shutdown procedure.

* If approach is difficult take help of ERT members.
* Co-ordinates all actions of the control room to control emergency

Control Team – MAINTENANCE

Leader : Executive – Maintenance

Members : Fitters and Electricians.

- To identify source of leak and arrest it.
- To neutralize spillages/leaks.
- Attend to all repair jobs, which are needed for emergency control operations eg. Changing gaskets, replacing pipe sections, repairing of motors, pumps, valves, etc.

- To install additional pumps, blowers or other equipment for decanting, evacuating and draining as needed.
- To give temporary electrical connections as needed.
- To minimize damage to plant & environment and loss of material by segregation, covering, salvaging, diverting/stoppage of fire water by canal gate closing etc.,
- To retrieve and protect plant records (log books, indicator charts, drawings, manuals, inventory documents etc.) form destruction / damage during emergency control operation.
- Inform the message to in-charge (Safety Dept./Security in-charge) of fire hydrant pumps and operation.
- Arrange for shut down of non-essential utilities as per instruction of incident controller
- In consultation with incident controller, arrange power supply cut-off to the affected area. Ensure that emergency power and water supply is on.
- Consult incident controller and with the help of maintenance supervisor and emergency squad, execute leakage control operations

Fire Fighting & Rescue Team

Leader : EHS Head/Safety officer

Member : Emergency Response Team Members

- To rush to the incident spot and start fire-fighting operations by wearing appropriate PPE.
- To attend fire pumps and maintain adequate water pressure in the hydrant system.
- To maintain supply of fire extinguishing media and equipment as necessary.
- To guide outside firefighting agencies.
- To rescue the injured personnel.
- To transport injured personnel to first-aid post or safe places.

- To guide employees to reach Assembly point.
- To search for missing personnel.

Male Nurse/Ambulance Driver/First aid members

- To render first aid.
- To administer O2 in case of toxic gas inhalation.
- To arrange stretchers to the FF & Rescue team.
- To arrange for sending theinjured person to Hospital. On the advice of these Hospitals, arrange for, if necessary, transportation of patients to any of the specialty hospitals as needed.
- Arrange for anti-dotes to all effected people

Team – Admin

- Contacting other industries for help.
- Notifying the emergency to civil/local authorities as per the advice of the emergency controller/site controller.
- Giving necessary details to statutory bodies regarding emergency and keeping them abreast of the development.
- Informing kith and kin of injured
- Arranging alternate transportation in case of breakdown of transport vehicles, ambulance, etc.
- Arranging for relievers and catering facilities.
- Arranging transportation of injured to hospitals.
- Contacting medical centers/ hospitals identified for mutual aid.
- Arranging transportation (I) for persons connected with emergency functions including relieving staff if emergency prolongs (ii) transportation of materials / equipment needed from outside.

Security Officer

- On receiving the information blow the main siren after getting approval from site controller.

- Communicate location of the incident, Safe Escape Routes, wind direction & assemble location by mega phone with the help of incident controller.
- Depute required number of security guards to close the main gate to bar the entry of unauthorized persons.
- Ensure transport of injured and ensure transport for additional injuries in absence of Admin personnel.
- Keeps security guards at the gate and move to the emergency area.
- Ensure all the security guards (near main gate, other designated places) are reporting to Incident controller/site controller.
- Permit minimum delay in the entry of authorized personnel and outside agencies, vehicles, etc., who have come to help.
- If needed on the advice of incident controller, he rushes to emergency control center and reports to site controller, with the attendance record of employees, list of contract workmen and visitors.
- To direct all drivers of vehicles / tankers which are waiting outside the main gate for entry into the plant to remove the vehicles away from the factory.
- After arrival of all statutory bodies, co-ordinate with them for permitting entry/exit of vehicles related to emergency. Collect work permits issued on the day from Safety Dept. to identify possible locations of deployment of contract laborers for the purpose of reconciling any missing employees.
- After the mitigating emergency situation on the advice of site controller/incident controller all clear siren will be blown for two minutes on which the normalcy will be restored.

7.10.10 Duties of Employees other than KEY Personnel

- On hearing the emergency siren, contact the shift supervisor for necessary action.

- Alert other employees in concern section.
- If he/she is not an employee of affected area, close down operations safely before leaving to assembly point.
- If he/she is not an employee of the adjacent location of the mishap area, should close down operations/ plant / equipment.
- Be ready to go to nearby assembly point. Those who are not involved directly in the plant operations should assemble at assembly point.
- If he/she is present in an area, which is not your regular work place, inform the shift supervisor of that area about your presence and follow his advice.
- Pending advice from shift supervisor, if you hear announcement over megaphone, act according to such announcement especially in respect of evacuation and escape route.
- If you do not get any directions from shift supervisor or by megaphone and if you happen to get affected at any stage by the spreading toxic vapor or fire, act as indicated. Position yourself upwind side of source of leakage and if you don't get any directions over the megaphone, leave the place in cross wind direction and proceed to the assembly point located in that direction.
- Warn nearby employees, if possible by shouting.

Duties of Section in charges/Engineers/supervisors General approach:

- As soon as the emergency siren is heard, alert the visitors in your area of jurisdiction and ask them to stand by for further instructions from you. Do not permit them to move out of your area.
- Await directions over megaphone with the help of security regarding emergency shut-down of your unit/section or regarding evacuation.
- Meantime, select two of your plant operators and instruct them to be ready for shutdown if necessary.

- If evacuation is announced over megaphone or otherwise, or pending announcement of evacuation if you observe spread of toxic vapor or fire so as to affect persons in your unit, direct and guide them to the assembly point.
- If escape routes are not announced, guide the persons to follow the routes not involved in the wind direction.
- Permit members of Control Team, FF & Rescue Team to report to the respective team leaders.
- If the emergency occurs in your area or jurisdiction
- Immediately direct your trained employees to put out fire and arrange to report to Site Controller /EC.
- Note: If toxic materials are involved in fire, do not allow employees to fight fire without use of SCBA.

EHS HEAD/SAFETY IN CHARGE:

- As soon as he hears about the emergency, he rushes to the incident site.
- He advises incident controller and site controller for managing on site emergency
- Fire extinguishers, hoses, nozzles, mechanical foam compound located in various points shall be provided to ERT members.
- Be drawn and arranged for firefighting.
- Coordinate with fire brigade group and help them.

DRIVER- AMBULANCE:

- Upon hearing the warning signal, he should observe wind direction proceed to the vicinity of spot and reverse the vehicle.
- Keep engine in running condition
- Open the back door of ambulance
- Go back to the seat

- Take the injured to first aid center / nearest hospital(as directed by emergency coordinator- first aid & medical)

EMERGENCY COORDINATOR (FIRST AID & MEDICAL) /MALE NURSE:

- Available at / Rush to first aid center.
- Stay on alert for first aid and medical treatment for chemical poisoning and other injuries.
- Receive the injured, examine and quickly assess the condition and treat.
- Report to the hospitals and make arrangements for likely more cases of injuries.
- Shift the injured to the nearest hospital.
- Stay put in first aid center for subsequent injury cases if any.
- Gather feedback from hospital and communicate to site controller.

HEAD COUNT SUPERVISOR:

- At assembly point, take the head count and compare with the attendance
- Records of the day/ shift. In case of missing people, informs site controller.
- Hold on till all clear signal is received or act as per instructions of site controller

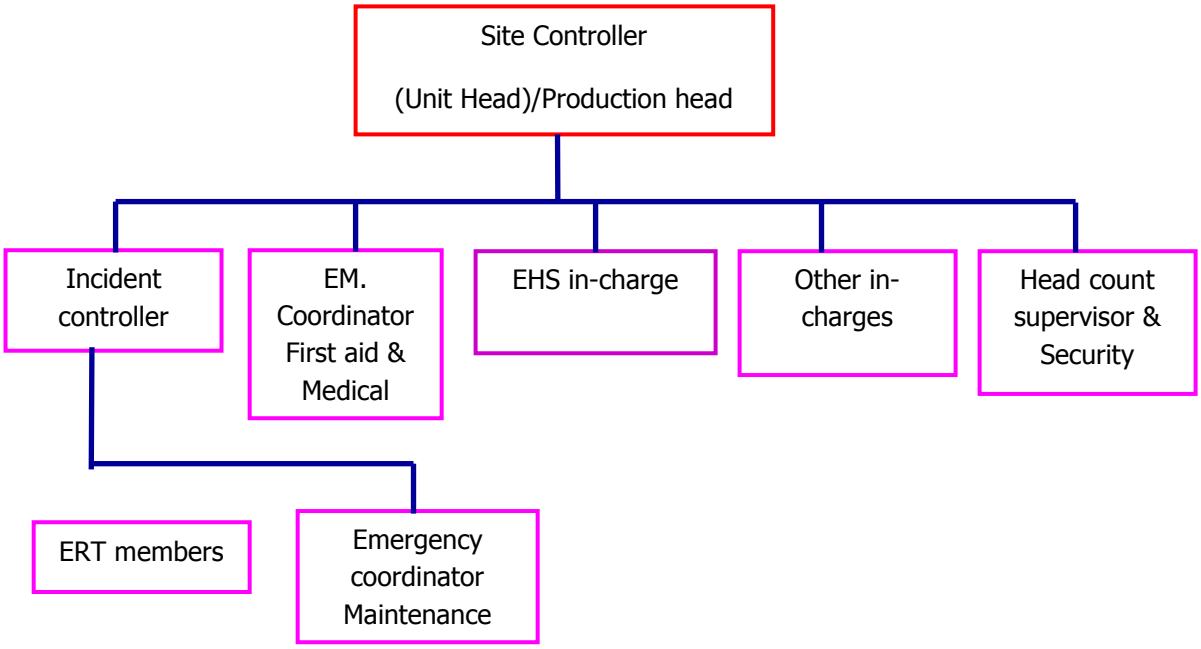
The task summary includes:

- Assessment of potential impact based on systematic risk identification program for both fire & exposure hazardous substances.
- Assessment of potential impact on harm to the environment by spill or release of harmful vapor/material.
- Essential need for evacuation
- Areas to be evacuated

- Information sharing
- Alert communication mode
- Transportation/Medicare/Safe Sheltering and Security aspects with concerned authorities.

Post Emergency Procedures should include:

- Incident review.
- Identification of remedial measures and implementation.
- Information dissemination within the Site to prevent recurrence.
- Reporting to Statutory authorities as applicable.



7.10.11Communication

This will involve the channels of communication so that the site is isolated and proper persons take the change to fight the disaster and minimise its effects. SriKrishna Pharmaceuticals Limited will make plan in this connection. Also if there is any minor or major emergency, Emergency alarm can be activated by any person who saw the emergency first.

Jot line will be there between Sri Krishna PharmaceuticalsLimited and Mutual Aid members in the MIDC and also with the MIDC officials local area representatives.

An effective communication system is proposed to be provided in the API complex. The various types of communication equipment's proposed to be provided at all important employees placed in the complex to achieve 100% reliability. This includes the following:

i. Intercom telephone system
ii. Mobile Phones
iii. Public Address System
iv. Hot lines connections are selected places, to mobilize to mutual aid in case of emergency
v. Warning Sirens
vi. Mobile vehicles and public address equipment to warm neighbouring population, if emergency is likely to affect the population outside the premises

INFORMATION TO RELATIVES OF INJURED

The relatives of injured will be informed by emergency coordinator (security/transport). The employees residential address file is available at emergency control center and also in the residence of emergency coordinator (security/transport). The communication to the relatives of injured will be passed on through telecom or by a messenger with car. The clear address of the injured person (Local residential address/address of hospital if hospitalized) will be communicated to the relatives.

INFORMATION TO LOCAL AUTHORITIES

i. In case of onsite emergency, the Dy. Chief inspector of factories and inspector of factories will be informed immediately. The information will be passed on over telecom, telegram or through a messenger deputed by Emergency Controller.

ii. After consulting Dy. Chief Inspector of factories and inspector of factories, the information will be sent to Chief inspector of factories also. The company will implement the advice of local authorities in improving the safety in dealing with the event.

iii. State Pollution Control Board authorities will be informed in case of accidents like toxic gas release, spillage of hazardous chemicals.

INFORMATION TO DISTRICT AUTHORITIES

vii. The Emergency controller/site controller/Head HR on advise of Emergency controller is authorized to inform the police. The inspector of Police local police station will be informed for the control of law and order situation at the Plant or in vicinity or at hospital where injured are under treatment.

viii. Police department will be requested for protecting the lives of employees and property of the company, evacuation of personnel outside the Plant. District Collector, Dist. Medical Officer and Superintendent of Police, of the area will be informed by Site controller if required.

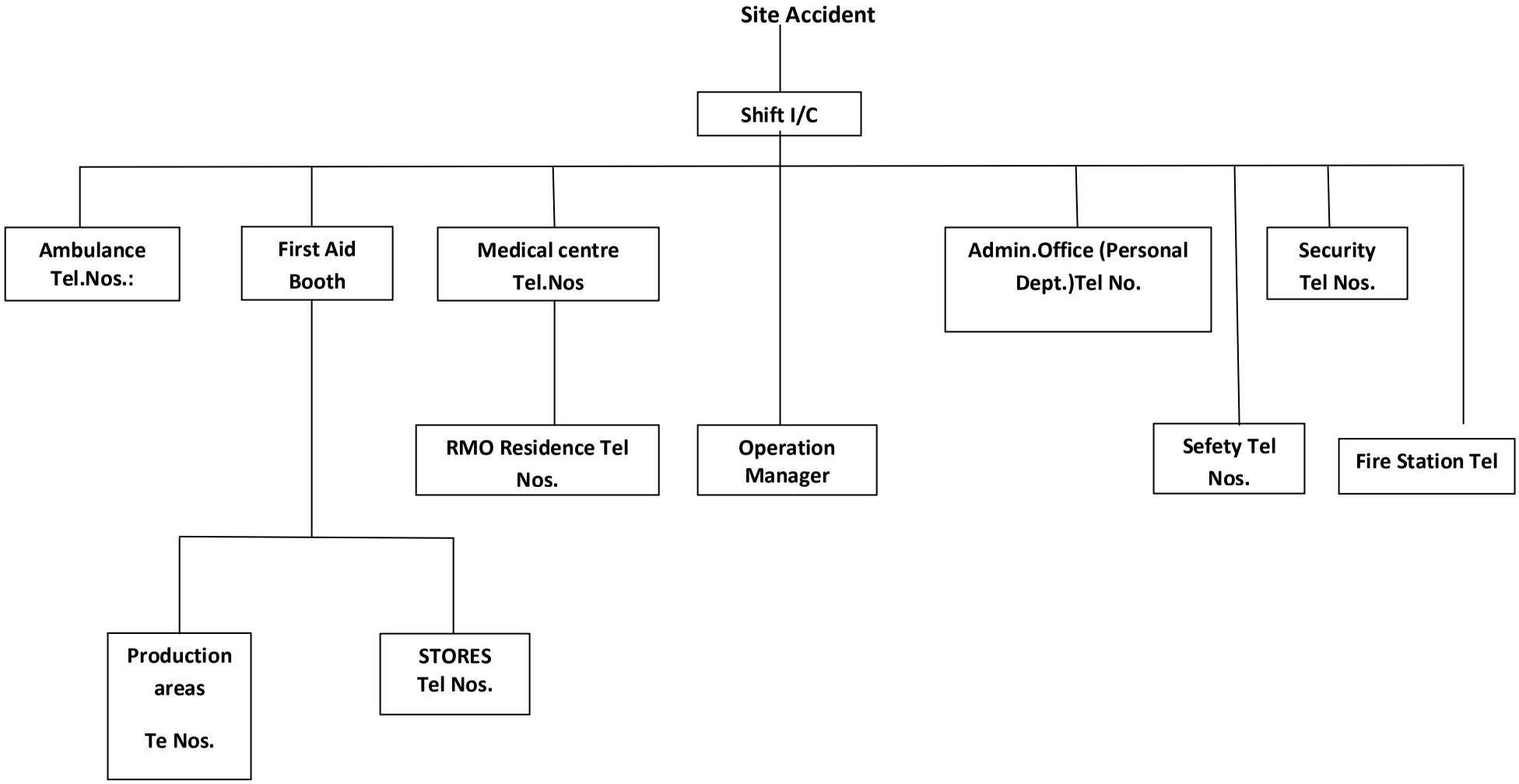
7.10.12 First Aid &Medical Facilities

First few hours after an accident are very important for the injured person to avoid facilities. A well-equipped medical centre can handle emergency resuscitation and treatment to stabilise the patient before transferring to a referral hospital, identified for the purpose. For smooth operational emergency and accident handling and treatment system, SKPL is proposing to first air room with all basic facilities to provide. After first aid, the patients would be shifted to Civil Hospitals located in Sholapur area .Stand by vehicle would be kept in the premises for 24 hours for emergency and ambulance facility is available in MIDC and local hospital with which SKPL would have tie up.

Shower booths and eye wash equipment will be installed at each plant and first aid kit will be available in Emergency control room. The flow of medical

information system will be shown in**Figure 7.2**. The medical centre will also diagnose any occupational disease acquired by any personnel from their profession/occupation (If any).

Fig. 7.2 Medical Emergency Information System (General)



7.10.13 Training Programme for Employees

Training programmes in safety and accident prevention will be organised for all levels of employees with a view to familiarise them with the general safety rules and procedures to be followed in various operational activities and to update their knowledge in safety and accident prevention, industrial hygiene, emergency procedures, first aid and use of various safety appliances. These training programmes shall be conducted periodically in a planned manner to refresh their knowledge in safety and accident prevention, industrial hygiene, emergency procedures, First aid and use of various safety appliances. These training programmes shall be conducted periodically in a planned manner to refresh their knowledge.

Methodology:

Training programme shall be conducted using audio-visual aids, practical demonstration, etc. to make it more effective and interesting. These programmes will be supplemented with case studies, group discussions. The course material will be selected as per the requirements and need of each level of employees.

Mode of Training:

i. Class room training
ii. Practical demonstration
iii. Video film and slides
iv. Mock drills
v. Practical training in the use of breathing apparatus, gas mask etc.
vi. Practical training in the use of gas testing techniques

7.10.14Public Awareness Programmes

Public awareness programmes are necessary for taking timely actions by the neighbouring populations/inhabitants in the vent of major emergencies which might affect them.The awareness programmes will be made in close co-ordination with civic authorities and local area representatives to make it effective and practical. The programmes will include printed pamphlets, film show etc.

Training of Drivers Transporting Hazardous Materials

Trucks and road tankers will be deployed for transporting raw materials and finished products to and from the complex. Some of the raw materials may be hazardous in nature. A paper training programme for all truck/tanker driver is being planned for safe loading /unloading of materials, safe parking and safe transportation.

First Aid Training

First aid training programme will be conducted for all employees with the help of qualified medical and para-medical staff at medical centre/hospital. This programme will be conducted in batches. The programme includes basic first-aid techniques and procedure for artificial respiration. This programme will be repeated periodically to refresh knowledge.

Training in Industrial Hygiene

Training in industrial hygiene practices will be imparted to all employees.

The training will include the following:

i. Preventive measures
ii. Protective measures
iii. Curative measures in case of acute exposures

7.11 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 non formed mock drills (or rehearsals) for meeting emergencies. Such rehearsals would be carefully analysed 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. It is proposed to at-least conduct two mock drills in a year and over a period of time all the sections in all the shifts would be covered. When truck drivers carrying product are in the plant, they also would be trained regarding transportation emergencies and how to react to minimize the damage or effect on people.

7.12Review of Onsite Emergency Plan

1. Onsite Emergency Plan would be reviewed whenever there is a change in product, or product route of manufacture, or addition of new equipment or change in Site Controller.
2. Site Controller is responsible for such update and making available latest copy or Onsite Emergency Plan to all concerned in the organization as will as to the Statutory Authorities.

7.13 Incident recording and revision of Disaster Management Plan

Every incident/accident in Sri Krishna Pharmaceuticals Limited shall be recorded by safety & environmental officer. Root cause analysis and corrective actions shall be taken by responsible I/C of area and shall be reviewed by top management in safety committee meeting once in two months' time

The Disaster Management Plan would be periodically revised based on accident/incidents and experienced gained from the mock drills.

7.14 Off site Emergency Plan:

This is a green field pharmaceutical unit. There are 14 chemicals which come under Manufacture, Storage and Import of hazardous Chemicals (MSIHC) Rules, 2016. No chemicals crossed the 1^{st} or 2^{nd} threshold limits prescribed in MSIHC Rules. Modelling data on potential hazards indicates that the impacts will be limited to plant premises. 5 Toxic chemicals are stored in liquid condition. Information on quantities of chemicals stored, emergency centre and mitigation will be submitted to Authorities under MSIHC Rules and chemical Accidents (Emergency Planning preparedness and response) Rules. The unit will also participate in mutual aid program with other units in the area to get help from other units and also to help other units in case of emergency situations. Accessibility to all bulk storages will be maintained without any obstructions and all chemical storages will be provided with dyke walls to contain any accidental spills or leaks. Unit will coordinate with MIDC Authorities and District Administration to give information to public in case of any emergency situation.