CHAPTER – 6

RISK ASSESSMENT

ADDITIONAL STUDIES

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

- Risk Assessment
- Onsite and Offsite Disaster (natural and manmade)Preparedness and Emergency Management Plan
- Occupational Health Programme

6.1 SCOPE OF THIS STUDY:

The QRA study in this report has been conducted considering the Terms of References (TORs) given by Expert Appraisal Committee of MoEF for Environment Clearance (EC).

The study has been carried out with a view to comply the following TOR points:

The study has been carried out with a view to comply the following TOR points:

TORS	TOR Description	Chapters in Report
47	Occupational health impacts on the workers and mitigation measures proposed to avoid the human health hazards along with the personal protective equipment to be provided to the workers.	Covered under section no.: 6.7 / 6.7.5/ 6.7.8 DETAILS OF OCCUPATIONAL HEALTH IMPACTS AND SAFETY HAZARDS.
	Plan for periodic medical examinations of the workers exposed	6.7.4 PLAN FOR PERIODIC MEDICAL CHECKUP /PERIODIC MEDICAL EXAMINATIONS
49	Risk assessment including prediction of the worst-case scenario and maximum credible accident scenario related to fire issues due to storage and use of fuel should be carried out. The worst-case scenario should take into account the maximum inventory of storage at site at any point in time. The risk	Covered under section no.: 6.3/ 6.3.

	contours should be plotted on the plant layout map clearly showing which of the activities would be affected in case of an accident taking place.	
	Based on the same, proposed safeguard measures including On-Site / Off-Site emergency plan should be provided.	Covered under section no.: 6.6
	Measures to guard against fire hazards including details of automatic fire detection and control system & detailed fire control plan showing hydrant pipeline network, provision of DG Sets, fire pumps, jockey pump, toxic gas detectors etc. should also be provided.	Covered under section no.: 6.5.3
53	Details of fire fighting system including provision for flame detectors, temperature actuated heat detectors with alarms, automatic sprinkler system, location of fire water tanks & capacity, separate power system for fire fighting, details of qualified and trained fire personnel & their job specifications, nearest fire station & time required to reach the proposed site.	Covered under section no.: 6.5.3 Other bifurcation is shown below
51	Details of hazardous characteristics and toxicity of raw materials and products to be handled and the control measures proposed to ensure safety and avoid the human health impacts.	Covered under section Table 6.2 B & 6.5.7
	This shall include the details of Antidotes also.	Covered under section 6.5.6.
50	Details of quantity of each hazardous chemical (including solvents) to be stored, Material of Construction of major	Covered under section Table 6.2 A& 6.5.

	hazardous chemical storage tanks, dyke details, threshold storage quantity as per schedules of the Manufacture, Storage & Import of Hazardous Chemicals Rules of major hazardous chemicals, size of the biggest storage tank to be provided for each raw material & product etc.	
55	Submit checklist in the form of Do's & Don'ts of preventive maintenance, strengthening of HSE, manufacturing utility staff for safety related measures.	Covered under section 6.5.5.

6.2 METHODOLOGY OF RISK ASSESSMENT

M/s. Suyog Life Science Pvt. Ltd., Ankleshwar handles various chemicals, some of which are hazardous in nature by virtue of their intrinsic chemical properties or their operating temperatures or pressures or a combination of them. Fire, explosion, toxic release or combinations of them are the hazards associated with industrial plants using hazardous chemicals. More comprehensive, systematic and sophisticated methods of Safety Engineering, such as, Hazard Identification and Qualitative/Quantitative Risk Assessment have been developed to improve upon the integrity, reliability and safety of industrial plants, the same has been discussed in detail under their respective headings.

6.2.1 OBJECTIVES OF RISK ASSESSMENT

Risk analysis follows an extensive hazard analysis. It involves the identification and assessment of risks the neighbouring 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 analysis is often confined to maximum credible accident studies.

Risk assessment is carried out with the following objectives:

1. To identify hazard and risk resulting from the hazards
2. To study and foresee the effects of such risks on the workers, public, property and environment and to find out necessary control measures to prevent or minimize risk.

3. To comply the legal requirement by various safety and environment laws of the country like…
    - The Factories Act, 1948
    - The Gujarat Factories Act, 1963
    - The Environment Protection Act and Rules, 1986
    - Hazardous waste (Management & Handling) Rules, 1989
    - Public Liability Insurance Act & Rules,1991
    - Chemical Accident, (Emergency, planning, preparedness and response) Rules,1996

To get the necessary information for Emergency planning and evacuation

6.2.2 DETAILS OF STORAGE FACILITIES

The storage facilities for **major hazardous chemicals** have been marked on the company layout given below:

FIGURE: 6.1

PLANT LAYOUT

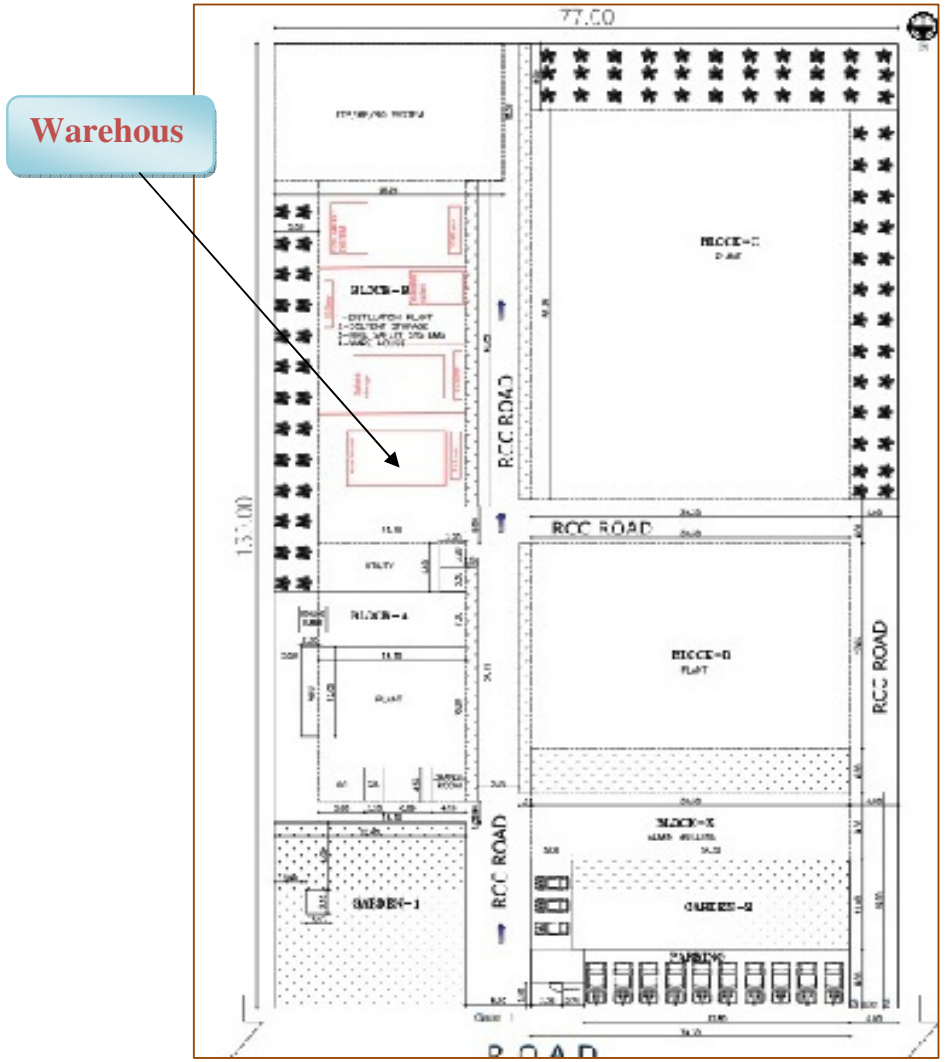


TABLE: 6.1

DETAILS OF HAZARDOUS RAW MATERIALS

Sr.	Name of Raw Material	Max. storage cap. at site	Mode of storage & Material of Construction	Storage Location	Hazards	Control Measures Provided
1	Diethyl Amine	5 MT	Drums	Warehouse	Flammable/ Toxic	• Proper storage area is provided. • PPEs like Splash goggles, Full suit, Vapor respirator or self contained breathing apparatus, Boots, Gloves etc, are provided and used while handling this chemical. • Impervious protective clothing and full face piece positive-pressure respirator are used. • Self contained breathing apparatus are used. • For detailed control measures & fire fighting facilities, refer section 6.5.
2	Dimethyl Sulphate	3 MT	Drums	Warehouse	Toxic	
4	Thionyl Chloride	2 MT	Drums	Warehouse	Toxic/ Corrosive	
5	Triethyl Amine	2 MT	Drums	Warehouse	Spill/ Fire	

TABLE 6.2

PROPERTIES OF HAZARDOUS CHEMICALS

Sr. no	Chemical	Physical State	FP °C	BP °C	SP. GR @ 20°C	Vap. Den. vs air	Vap. Pr. mm Hg @ 20°C	LEL %	UEL %	LD_{50} ORAL mg/kgs	LD_{50} DERMAL mg/kgs	LC_{50} mg/L	IDLH Value by ACGIH/ NIOSH	STEL by OSHA (PPM)	TLV-TWA by OSHA (PPM)
1	Diethyl Amine	Liq.	-18	55.5	0.71	2.5	195 mmHg	1.8	10.1	540	820	4000	200	25	10
2	Dimethyl Sulphate	Liq.	83.3	188	1.33	4.35	0.54	-	-	140		45 ppm 4 hour(s) [Rat]	7 ppm	-	0.1 (ppm)
3	Thionyl Chloride	Liq.	N.A	78.8	1.638	4.1	13.3 KPa	N.A	N.A	-	-	500 ppm 1 Hrs [Rat].	25 ppm	-	-
4	Triethyl Amine	Liq.	-8.3	89	0.73	3.48	54 mm of Hg	1.2	8	460 mg/kg [Rat].	570 mg/ kg [Rabbit]	LC_{lo}1000 ppm (mouse, 2 hrs)	200	3 ppm (ACGIH)	1 ppm (ACGIH)

6.3 RISK ASSESSMENT

Identification of hazards in the proposed project activity is of primary significance. Hazard states the characteristics of system/plant/process that presents potential for an accident. All the components of a system/plant/process needs 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.

HAZARDS IDENTIFICATION AND DETAILS OF PROPOSED SAFETY SYSTEMS

At M/s. Suyog Life Science Pvt. Ltd. Ankleshwar, major risks have been identified for the following areas:

- Warehouse (Storage Area)

As a conservative approach, we have analyzed the risk Qualitatively and Quantitatively both, as mentioned below.

In this study,

- The Storage & Handling of Diethyl amine, Dimethyl Sulphate, Thionyl Chloride & Triethyl Amine have been considered for Quantitative Risk Assessment (Consequence Analysis). Their storage location has been shown in Figure-6.2. Hazardous properties of these chemical have been summarized in Table 6.2 B.
- And, Storage & Handling of Solid Chemicals and Acids have been considered for Qualitative Risk Assessment.

6.3.1 QUALITATIVE RISK ASSESSMENT

Many a times Risk involved in various processes / process equipments cannot be addressed completely by Consequence Analysis. As a conservative approach, these risks have been considered separately under this topic. The approach is to identify hazards associated in operation of equipments as well as in processes, assessing its impacts, ranking the risk posed by it and finally to propose remedial actions/mitigation measures such that the risk is minimized to tolerable level.

The **Risk Matrix** presented below should be referred in evaluating this assessment.

In **Qualitative Risk Assessment**, risk has been analyzed using methodology called HIRA-Hazards Identification & Risk Assessment. In HIRA, major manual activities carried out by plant personnel as well as contract labours have been considered.

For the following areas, Qualitative Risk Assessment has been carried out to identify the risk, ranking them as per their severity & probability, identifying the existing mitigation measures and finally to propose recommendations, if existing measures are not enough.

1. Storage & Handling of Solid Chemicals
2. Storage & Handling of Acids
3. Handling of Drums

TABLE: 6.3

RISK MATRIX FOR QUALITATIVE RISK ASSESSMENT

LIKEHOOD/ PROBABILITY		**SEVERITY**				
		Catastrophic (Death/System Loss)	Major/ Critical (Serious injury/ Illness)	Moderate (Less Serious Injury/ Illness)	Minor/ Marginal (Minor Injury/ Illness)	Insignificant/ Negligible (No injury/ Illness)
		1	2	3	4	5
Almost Certain	E	**H**	**H**	**H**	**M**	**M**
Likely	D	**H**	**H**	**M**	**M**	**L**
Possible	C	**H**	**M**	**M**	**M**	**L**
Unlikely	B	**M**	**M**	**M**	**L**	**L**
Impossible	A	**M**	**M**	**L**	**L**	**L**

TABLE: 6.4

RISK RANGE & ACCEPTABILITY CRITERIA

Risk Range	Risk Acceptability Criteria	Remarks
H	Unacceptable/ High	Management's Decision/Action Plan Required. Potential off-site Impact.
M	Medium	Generally Minor Impact. Acceptable with Management's Review. Specific monitoring or SOP to be followed.
L	Low	Acceptable without Review. Manage through Routine Procedure.

6.3.1.1 STORAGE AND HANDLING OF SOLID CHEMICALS

TABLE: 6.5

RISKS AND RECOMMENDATIONS

SR No	PROCESS OR ACTIVITY	ASSOCIATED HAZARDS	HEALTH & SAFETY IMPACT (RISK)	INITIAL RISK			EXISTING MEASURES	RESIDUAL RISK			ADDITIONAL RECOMMENDATIONS
				SEVERITY	LIKELIHOOD	RISK		SEVERITY	LIKELIHOOD	RISK	
1.	Handling Chemical bags	• Chemical dust Exposure	• Skin/Eye irritation.	4	C	**M**	• Chemicals are stored in isolated storage rooms having provision for natural & forced ventilation. • Certified Dust respirator is used. • Suitable protective clothing, gloves, respirator and other PPEs are used.	4	B	**L**	1. Operators/Workers to be trained for Safe Work Practices. 2. Chemical handling bags to be labeled and segregated properly.
2.	Cleaning of Chemical Spillage.	• Fumes Inhalation. • Dust Exposure.	• Severe irritation to eyes, skin. • Inhalation.	2	C	**M**	• Certified Dust respirator is used. • Suitable protective clothing, gloves, boots, etc. are used. • Spillage is cleaned or	4	B	**L**	

							neutralized with suitable media. • Cleaning activities are carried out under Strict vigilance. • Provision for natural & forced ventilation is available.				

6.3.1.2 STORAGE AND HANDLING OF ACIDS

TABLE: 6.6

RISKS AND RECOMMENDATIONS

SR. No.	PROCESS OR ACTIVITY	ASSOCIATED HAZARDS	HEALTH & SAFETY IMPACT (RISK)	INITIAL RISK			EXISTING MEASURES	RESIDUAL RISK			ADDITIONAL RECOMMENDATIONS
				SEVERITY	LIKELIHOOD	RISK		SEVERITY	LIKELIHOOD	RISK	
1.	Acids Loading & Unloading.	• Exposure to acidic fumes due to leakage in pipe/container / valves etc. • Spillage of acids.	• Skin/Eye irritation. • Toxic Vapor inhalation etc.	4	C	**M**	• Dyke Wall is available. • Loading & Unloading activity is carried out in well ventilated area. • Periodic Inspection of flanges/ferrule joints is carried out. • Neutralization media is made available in areas where acidsare stored/handled/used. • PPEs are used.	5	B	**L**	3. Operators/Workers to be trained for Safe Work Practices. 4. Allied facilities to be inspected on periodic basis. 5. Health check up of the concerned personnel to be carried as per the plan.
2.	Working in Storage Area.	• Exposure to HCl fumes.	• Severe irritation to eyes, skin. • Body burns.	4	C	**M**	• Storage area is well ventilated. • Acid proof flooring is available. • Neutralization is done	5	B	**L**	

							immediately with soda ash/lime or spill is absorbed in a sand or by suitable adsorbent. • PPEs like face mask, gloves etc. are worn by concerned person.				
3.	Tank overflow/leakage from joints etc.	• Exposure to HCl fumes.	• Severe irritation to eyes, skin.	3	C	**M**	• Level Indicator is provided. • Other relevant measures are same as above.	4	B	**L**	

6.3.1.3 STORAGE AND HANDLING OF DRUMS

TABLE: 6.7

RISKS AND RECOMMENDATIONS

SR No	PROCESS OR ACTIVITY	ASSOCIATED HAZARDS	HEALTH & SAFETY IMPACT (RISK)	INITIAL RISK			EXISTING MEASURES	RESIDUAL RISK			ADDITIONAL RECOMMENDATIONS
				SEVERITY	LIKELIHOOD	RISK		SEVERITY	LIKELIHOOD	RISK	
1.	Unloading of chemical drums from truck.	• Drum rupture • Fall of drums	• Toxic Vapor inhalation etc. • Fire	3	C	**M**	• Loading & Unloading activity is carried out in well ventilated area. • Pellets are used for handling of drums. • Trained workers • PPEs	5	B	**L**	
2.	Handling of Drums (during storage and usage)	• Exposure to fumes due to leakage in drums. • Spillage of chemicals.	• Skin/Eye irritation. • Toxic Vapor inhalation etc.	4	C	**M**	• Storage and handling of drums is carried out in well ventilated area. • PPEs are used.	4	B	**L**	6. Allied facilities to be inspected on periodic basis. 7. Neutralization media is made available in areas where acids are stored/handled/used.

3.	Unloading/Emptying of chemical from drums	• Exposure to chemical fumes.	• Severe irritation to eyes, skin. • Body burns.	3	C	**M**	• Storage area is well ventilated. • Acid proof flooring is available. • Neutralization is done immediately with soda ash/lime or spill is absorbed in a sand or by suitable adsorbent. • PPEs like face mask, gloves etc. are worn by concerned person.	5	C	**L**	
4.	Transfer of chemicals from drums to plant/reactor	• Exposure to chemical fumes.	• Skin/Eye irritation.	3	C	**M**	• PPEs like face mask	5	C	**L**	
5.	Cleaning of empty drums	• Exposure to chemical fumes.	• Toxic Vapor inhalation etc.	4	C	**M**	• PPEs like face mask	5	C	**L**	

6.3.2 QUANTITATIVE RISK ASSESSMENT

Quantitative Risk Assessment (QRA) is a structured approach to identifying and understanding the risks associated with Storage and Handling of flammable/toxic chemicals. The assessment starts by taking into account an inventory of hazardous chemicals stored, likelihood of leakage/spillage associated with it and selecting the worst case scenario for consequence estimation.

Finally, suggesting the measures to minimize or mitigate risks to meet appropriate acceptability criteria. The planning for emergency evacuation shall be borne in mind whilst interpreting the results.

6.3.2.1 CONSEQUENCE ANALYSIS

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

6.3.2.2 DAMAGE CRITERIA

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 as per the Guidelines for QRA – Phast (Micro) Software (DNV) & Purple Book for QRA released by Centre for Chemical Process Safety (CCPS).

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).

TABLE: 6.8

EFFECTS DUE TO INCIDENT RADIATION INTENSITY

INCIDENT RADIATION – kW/m^2	TYPE OF DAMAGE
37.5	Immediate ignition of wood (without flame Contact). 100 % fatal.
25	Minimum Energy required for igniting wood (Without flame contact). 100 % fatal in 1 min. Significant injury in 10 sec.
12.5	Minimum heat required to ignite wood (With flame contact). 1 % fatal in 1 min. First degree burn in 10 sec.
4	Pain after 20 sec. Blistering unlikely.
2	No discomfort for long exposure.

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.

TABLE: 6.9

DAMAGE DUE TO OVERPRESSURES

Peak Overpressure	Damage Type
0.40 bar	Ear Drum Rupture to humans 50 % probability of fatality inside 15% probability of fatality in open
0.21 bar	Structural Damage to buildings 20% probability of fatality to personnel inside 0% probability of fatality in the open
0.13 bar	Minor Structural Damage to nearby structures

	10% probability of fatality to personnel inside 0% probability of fatality in the open
0.02 bar	Glass Damage
0.01 bar	Minor Damage

Intoxication

In this report, LC_{50} concentration and IDLH concentrations have been considered for Consequence Analysis.

6.3.2.3 ASSUMPTIONS FOR CONSEQUENCE ANALYSIS

For Consequence Analysis, assumptions regarding Meteorological, Pasquil Stability Classes, Wind velocity, Ambient Temperature, Relative Humidity, Inventory, Ground Roughness, Model used etc. are very important. In this report, the following assumptions have been considered.

i. Meteorological Paste other tables

- Atmospheric Conditions: No Inversion
- Ambient Temperature: 35^0C has been considered.
- Relative Humidity: As the site is not in rainy zone RH of 50% has been considered.

ii. Pasquil Stability Classes

- Pasquil Stability category D/F is considered as conservative approach.

iii. Other assumptions:

- Ground Roughness: Ground Roughness has been considered as 0.3 M.
- Dispersion model of both Heavy Model and also Gaussian distribution have been used as applicable/appropriate.
- Inventory: Release of 100% of the inventory has been considered. For this, failure of the container has been considered from the bottom.
- Storage conditions: Storage conditions have been considered as they are practically stored at site.

Following Weather data has been used for the study:

TABLE :6.10

WEATHER DATA USED FOR THE STUDY

WIND SPEED (M/S)	PASQUILLSTABILITY
1.5	F
1.5	D
5	D

6.3.2.4 SOFTWARE USED FOR CALCULATIONS

1. PHAST MICRO
2. ALOHA

6.3.2.5 SCENARIOS CONSIDERED FOR CONSEQUENCE ANALYSIS

1. In this study, the scenarios for consequence analysis have been selected considering:

- The physical and chemical properties of hazardous materials.
- Storage conditions & Modes of Storage (Barrels & Carboys).
- Hazards ranking by NFPA.
- Guidelines by OSHA (29 CFR).
- Operating and Storage Conditions for handling and storage of hazardous chemical.

2. This report considers the worst case scenario which is possible during any set of operation variable and production methodologies. The objective of the study is emergency planning, hence only holistic & conservative assumptions are used for obvious reasons. Hence though the outcomes may look pessimistic, the planning for emergency concept should be borne in mind whilst interpreting the results.

In this regard, **the failure cases which may lead to release of hazardous chemicals are as under, put of which the worst case relevant scenario shall be considered::**

- Failure of unloading arm of the ISO tanker during unloading of solvents.
- Leakage from Flange joints.

3. The results of consequence analysis shall be used for;

a. Emergency Planning

b. Deciding Evacuation Routes

c. Deciding Location of Assembly Points and ECC

d. Resource Allocation for mitigation

6.3.2.6 SCENARIOS IDENTIFIED FOR CONSEQUENCE ANALYSIS

Scenarios	Description of Scenario	Storage Pressure & Temp.	Scenarios considered
FIRE SCENARIOS			
1	Release of Triethyl Amine	Ambient	Flash Fire, UVCE, Late Pool Fire
2	Release of Diethyl Amine	Ambient	Dispersion, Flash Fire, Late Pool Fire
TOXIC GAS RELEASE SCENARIOS			
3	Release of Dimethyl Sulphate	Ambient	Dispersion
4	Release of Thionyl Chloride	Ambient	Dispersion

Considerations Made:

- In Case of **Diethyl Amine & Triethyl Amine** we have considered the maximum worst case scenario as **Release of Inventory due to 2" leakage from Drum**.

- In **Case of Dispersion for Diethyl Amine,** we have considered the following scenarios:
  - ✓ Leak from 50 mm hole size for 10 min for LC_{50} (4000 ppm) concentration.
  - ✓ Leak from 50 mm hole size for 10 min for IDLH (200 ppm) concentration

- In **Case of Dispersion for Dimethyl Sulphate,** we have considered the following scenarios:
  - ✓ Leak from 50 mm hole size for LC_{50} (45 ppm) concentration.
  - ✓ Leak from 50 mm hole size for IDLH (7 ppm) concentration

- In **Case of Dispersion for Triethyl Amine,** we have considered the following scenarios:
  - ✓ Leak from 50 mm hole size for LC50 (1000 ppm) concentration.
  - ✓ Leak from 50 mm hole size for IDLH (200 ppm) concentration

Note: Release of above chemicals from process equipments like Reactor is not possible as these chemicals will be in diluted/intermediate form in all process equipments and not in pure form.

Selection Criteria of Scenarios:

- As per the relevant guidelines for consequence analysis, we have considered the **maximum credible scenarios** for all the above mentioned chemicals, for a period of 600 secs leakage duration, which is the representative of all kinds of minor/major leakages.
- Modeling has been carried out for dispersion up to LC_{50} concentration and IDLH concentration, in case of toxic chemical. Evacuation should be carried out in less than 30 min from the area covered under IDLH in case of relevant leakage scenario. The purpose is to avoid irreversible health effects to persons inside the area of IDLH concentration.
- Based on the above considerations and the input parameters considered for worst case scenarios, the risk contours are plotted on the plant layout map clearly showing which of the facilities would be affected in case of an accident taking place. Based on the same the safety measures/recommendations are proposed and On-Site & off-Site emergency plan is prepared as mentioned under the section 6.6.

TABLE: 6.11

SCENARIO#1 – RELEASE OF DIETHYL AMINE

Basis: Release/Leakage of Xylene due to failure of : • Full Bore Rupture of Unloading Pipeline (2")					
Input Data:					
Leak Size Considered	50 mm				
Release rate	2079.20 gms/sec				
Drum gets empty in	38.23 sec				
Pressure	Ambient				
Temperature	35 deg C				
Weather Condition	1.5/F, 1.5/D, 5/D				
LFL	28000 ppm				
UFL	144000 ppm				
CASE:1 FLASH FIRE					
			Distance (m)		
			Category 1.5/F	Category 1.5/D	Category 5/D
Furthest Extent	14000	ppm	5.70468	5.67424	4.80139
Furthest Extent	28000	ppm	3.42671	3.41761	2.83192
CASE:2 VAPOR CLOUD EXPLOSION (UVCE – Overpressure Results)					
NOT REACHED					
CASE:3 JET FIRE (Jet Fire - Effects of Radiation Level)					
			Distance (m)		
			Category 1.5/F	Category 1.5/D	Category 5/D
Radiation Level	4	kW/m2	7.17124	7.17124	7.68604
Radiation Level	12.5	kW/m2	Not Reached	Not Reached	Not Reached
Radiation Level	25	kW/m2	Not Reached	Not Reached	Not Reached
Radiation Level	37.5	kW/m2	Not Reached	Not Reached	Not Reached

Result:

SR. No.	Concentration	Downwind Distance (meters)		
		Category 1.5/F	Category 1.5/D	Category 5/D
1	LC_{50} (4000ppm)	10.53	4.03	No Hazard
2	IDLH(200 ppm)	28.09	27.68	2.98

- **51 meters in downwind direction is considered as evacuation area.**

FIGURE: 6.2

RISK CONTOURS FOR FLASH FIRE

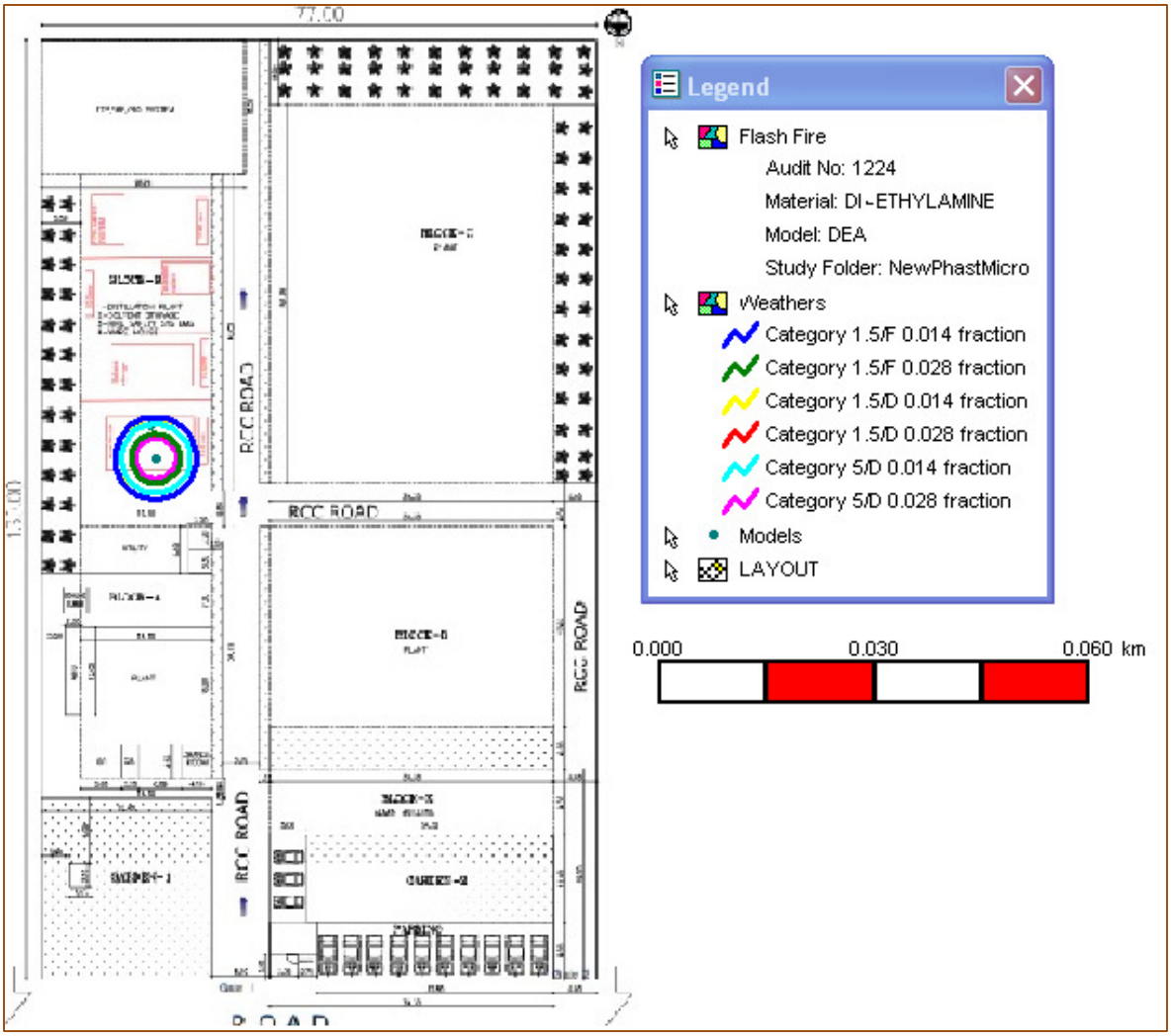


FIGURE: 6.3

RISK CONTOURS FOR JET FIRE:

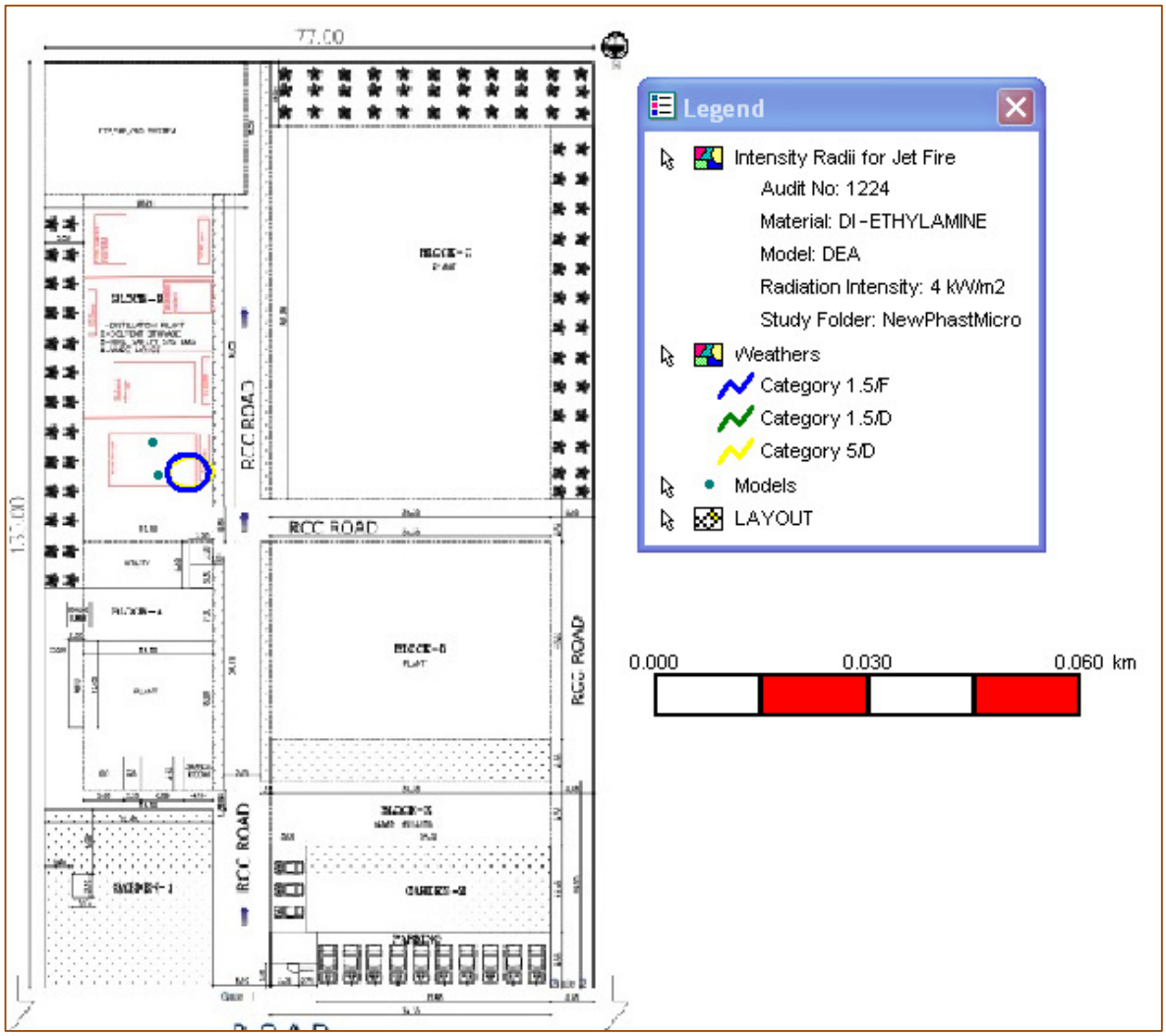


FIGURE: 6.4

RISK CONTOURS FOR IDLH CONCENTRATION:

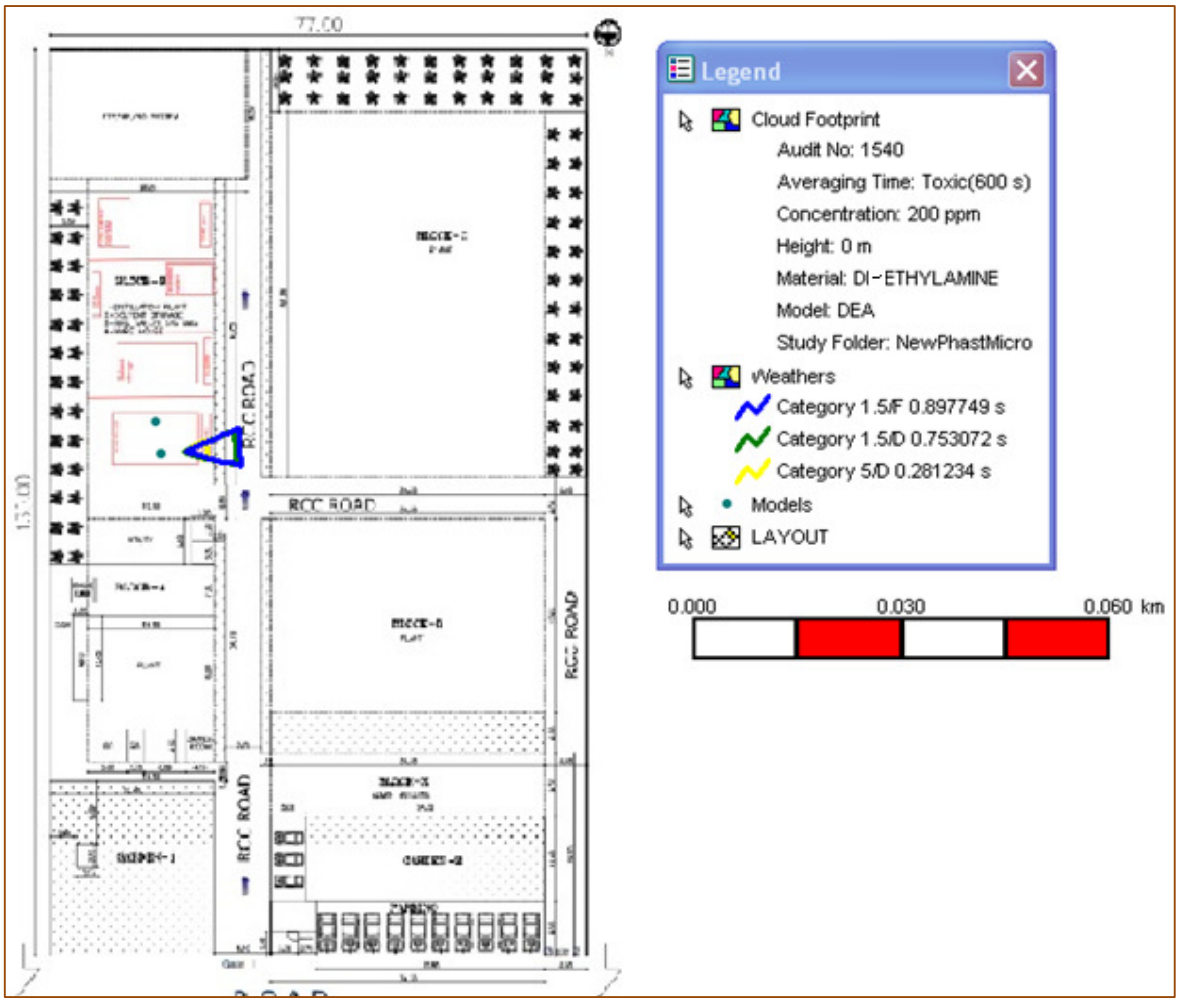


FIGURE: 6.5

RISK CONTOURS FOR LC_{50} CONCENTRATION:

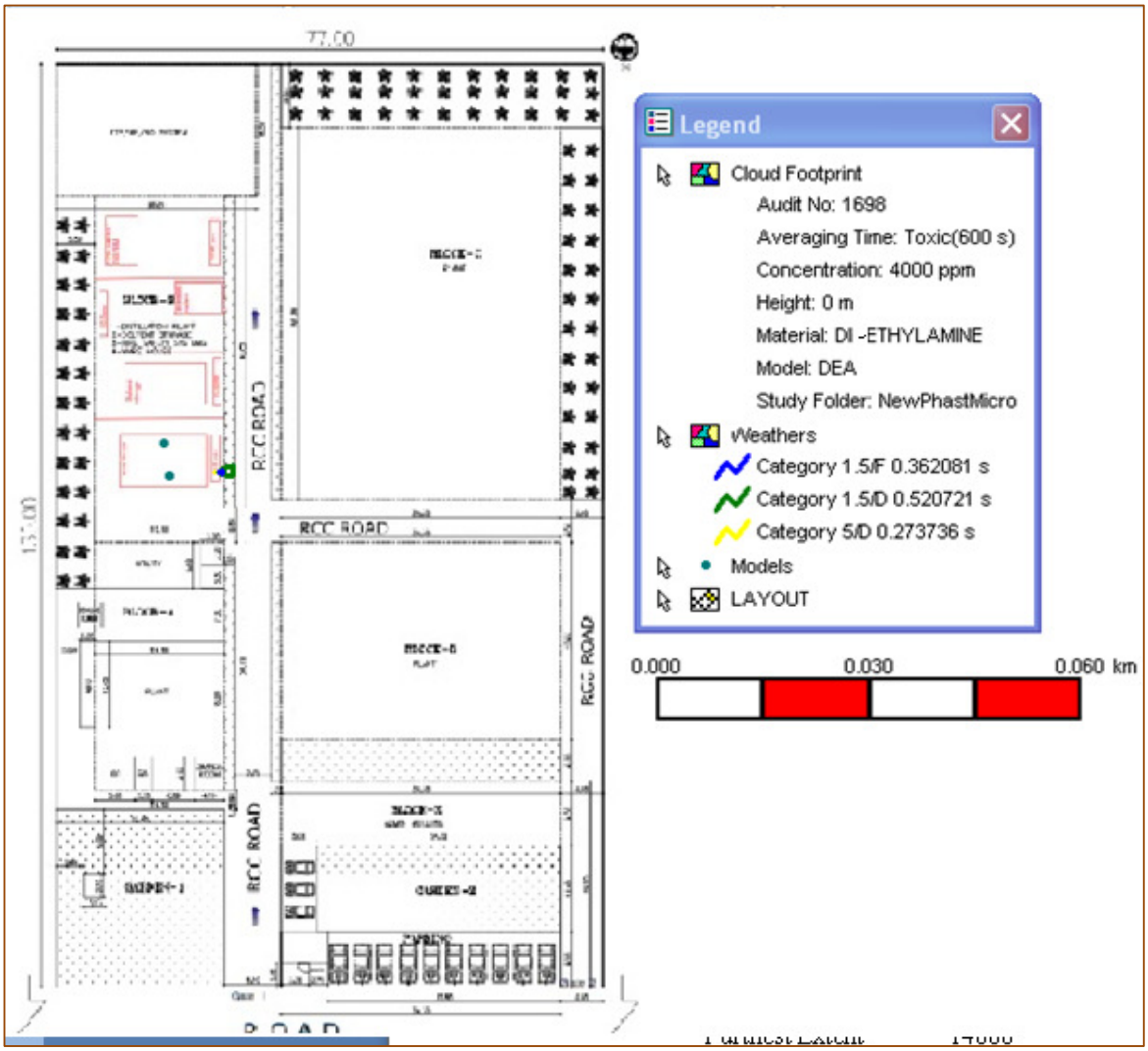


TABLE: 6.12

SCENARIO # 2 – RELEASE OF DIMETHYL SULPHATE

Basis: Possible Release/Leakage due to 2" damage to drum or tilting of drum with open lid.	
Input Data	
Release rate	91.5 Grams/min
Leak Size Considered	50 mm
Drum gets empty in	10 mins
Temperature Considered	35 deg C
Pressure Considered	Ambient
Weather Condition	1.5/F
IDLH	7 ppm
LC_{50}	45 ppm 4 hours [Rat].

RESULTS:

Sr. No.	**Concentration**	**Down wind Direction (meters)**
1	IDLH : 7 ppm (Red)	87
2	LC_{50} : 45 ppm (Orange)	25 (Contour not Drawn)

- **87 meters in downwind direction is considered as evacuation area**

FIGURE: 6.6

RISK CONTOURS FOR IDLH & LC_{50} CONCENTRATION

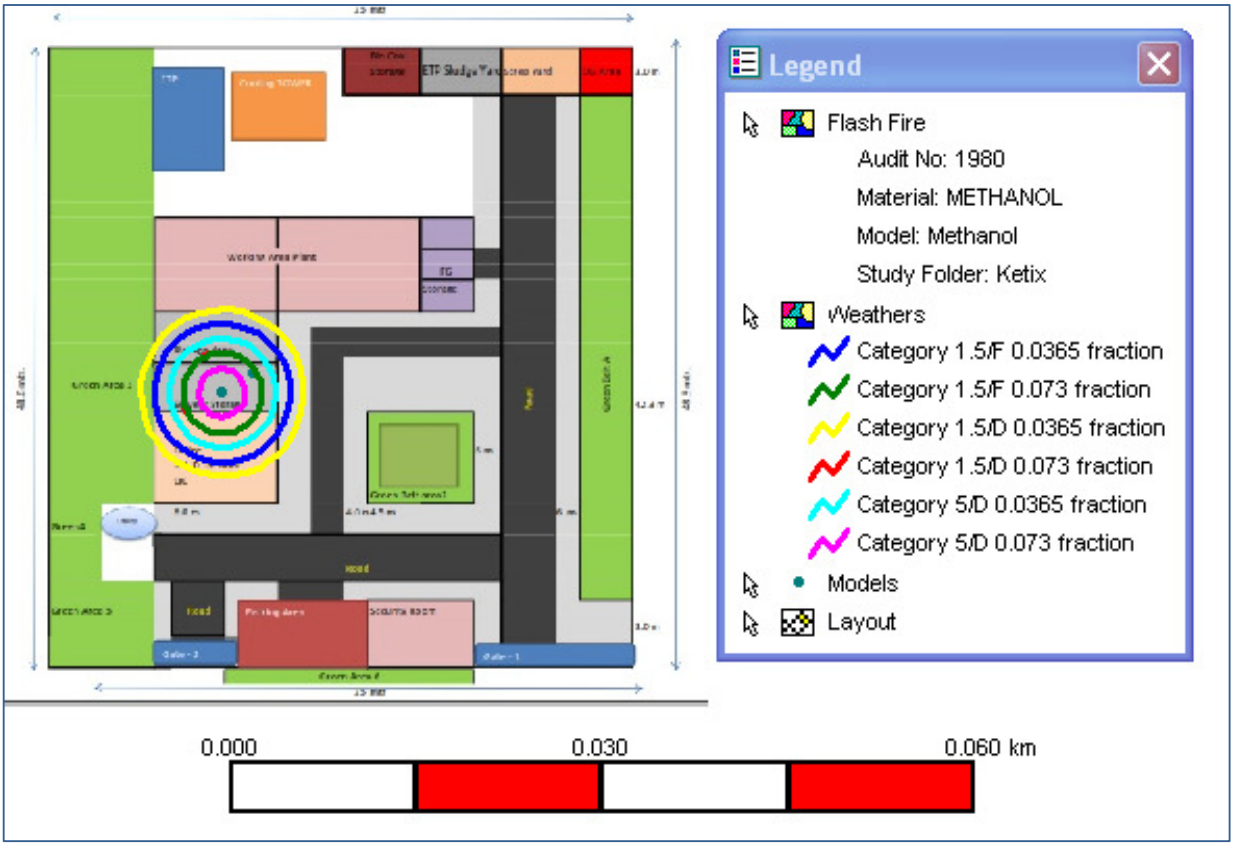


TABLE:- 6.13

SCENARIO# 3 – RELEASE OF THIONYL CHLORIDE

• **Basis: Possible Release/Leakage due to 2" damage to drum or tilting of drum with open lid.**	
Input Data	
Release rate	286Grams/min
Drum Gets empty in	10 min
Temperature Considered	35 deg C
Weather Condition	1.5/F
IDLH	25 ppm
LC_{50}	500 ppm 1 hours [Rat].

RESULTS:

Sr. No.	Concentration	Down wind Direction (meters)
1	IDLH : 25 ppm (Red)	76
2	LC_{50} : 500 ppm (Orange)	11 (Contour not Drawn)

- **76 meters in downwind direction is considered as evacuation area**

TABLE:- 6.14

SCENARIO# 4 – RELEASE OF TRIETHYL AMINE

Basis: Possible Release/Leakage due to 2" damage to drum or tilting of drum with open lid.	
Input Data	
Drum gets empty in	165 secs
Leak Size considered	50 mm
Release Rate	4486.33gms/sec
Pressure	Ambient
Temperature	35 deg C
Weather Condition	1.5/F, 1.5/D, 5/D
LFL	12000 ppm
UFL	80000 ppm

CASE:1 FLASH FIRE

			Distance (m)		
			Category 1.5/F	Category 1.5/D	Category 5/D
Furthest Extent	6000	ppm	13.9349	15.2356	6.57917
Furthest Extent	12000	ppm	9.78827	9.36191	1.99298

CASE:2 VAPOUR CLOUD EXPLOSION (OVERPRESSURE RESULTS)

			Maximum Distance (m) at Overpressure Level	
			Category 1.5/F	Category 1.5/D
Overpressure	0.02068	bar	29.195	25.1105
Overpressure	0.1379	bar	14.9701	13.9125
Overpressure	0.2068	bar	13.8457	13.0274

CASE:3 LATE POOL FIRE (EFFECTS OF RADIATION LEVEL)

			Distance (m)		
			Category 1.5/F	Category 1.5/D	Category 5/D
Radiation Level	4	kW/m2	27.0543	26.9583	28.7852
Radiation Level	12.5	kW/m2	15.9504	15.9186	19.6575
Radiation Level	25	kW/m2	9.28644	9.28444	11.9895
Radiation Level	37.5	kW/m2	6.5263	6.55217	7.65634

Result:

SR. No.	Concentration	Downwind Distance (meters)		
		Category 1.5/F	Category 1.5/D	Category 5/D
1	LC_{50} (1000ppm)	30.63	27.24	No Hazard
2	IDLH(200 ppm)	50.18	44.69	1.08

- **51 meters in downwind direction is considered as evacuation area.**

FIGURE: 6.7

RISK CONTOURS FOR FLASH FIRE:

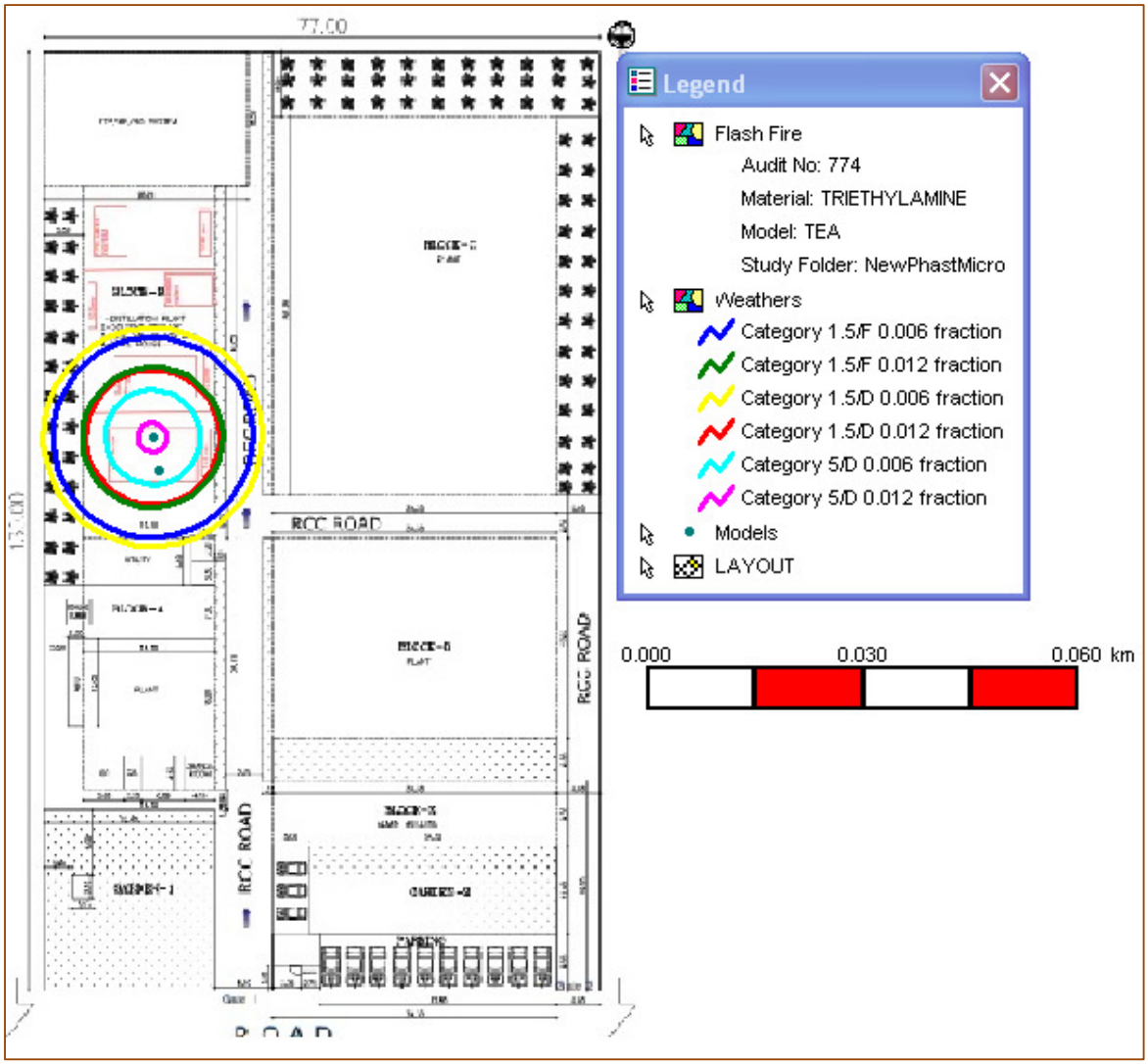


FIGURE: 6.8

RISK CONTOURS FOR LATE POOL FIRE:

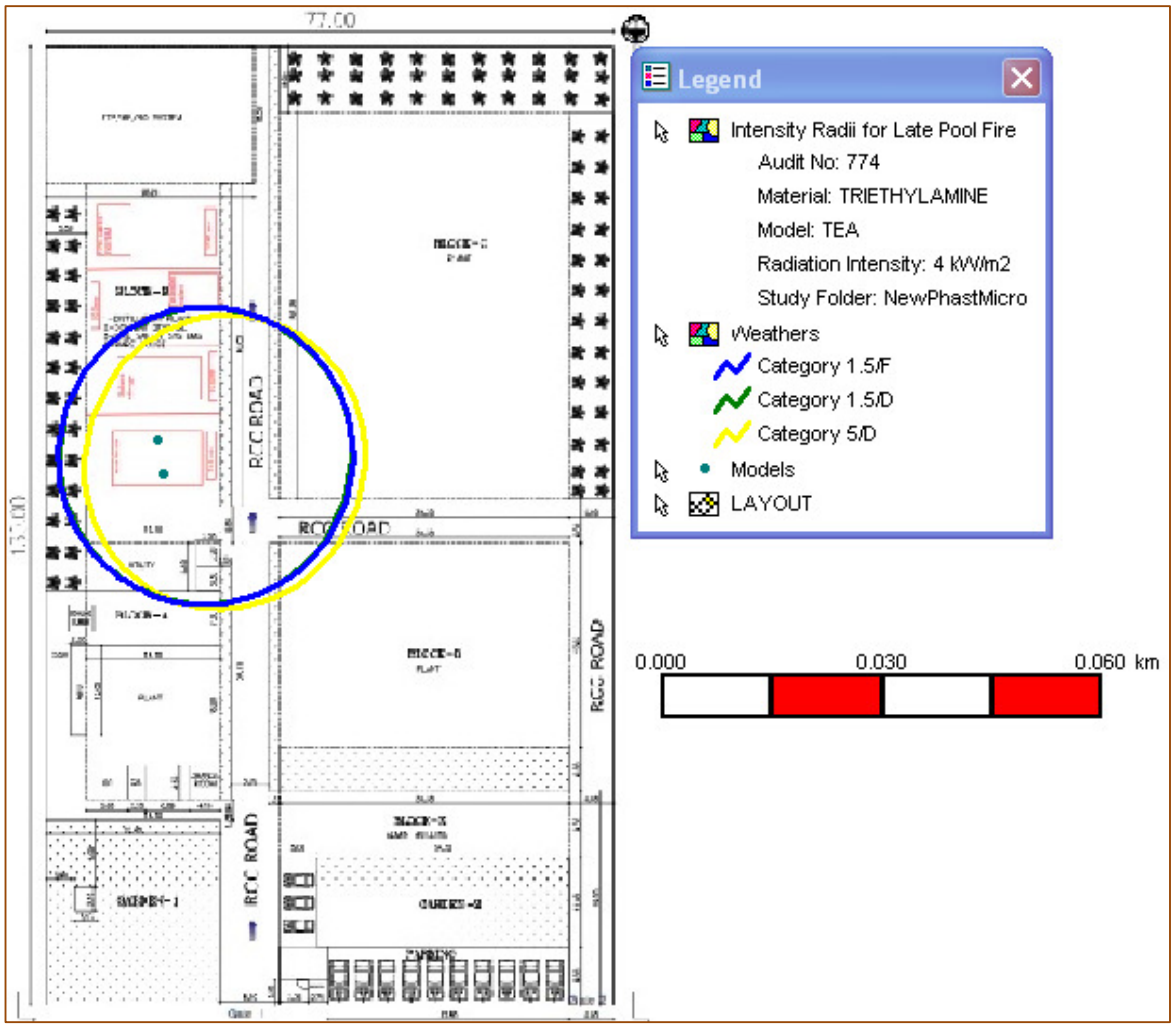


FIGURE: 6.9

RISK CONTOURS FOR OVERPRESSURE:

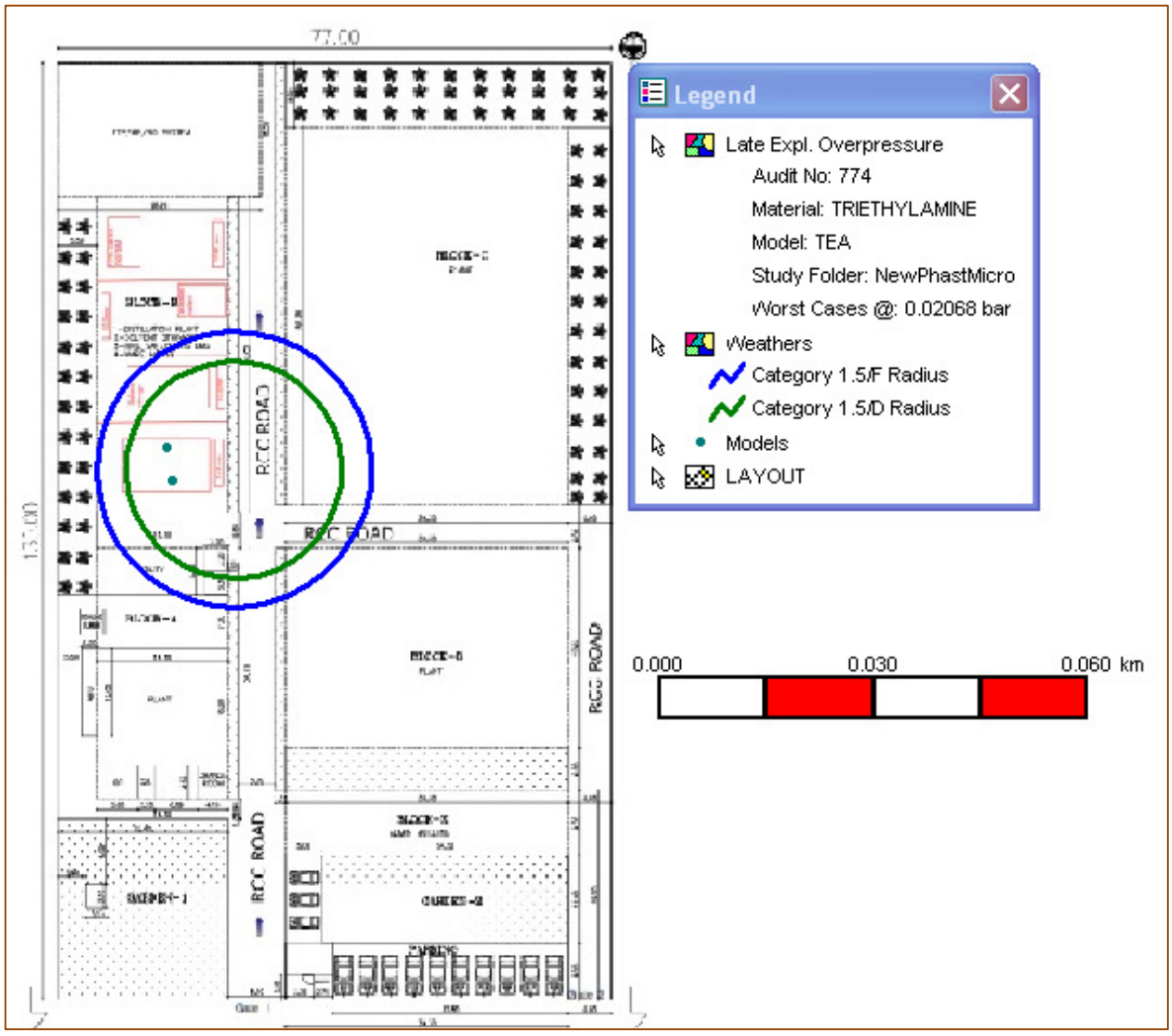


FIGURE: 6.10

RISK CONTOURS FOR IDLH CONCENTRATION:

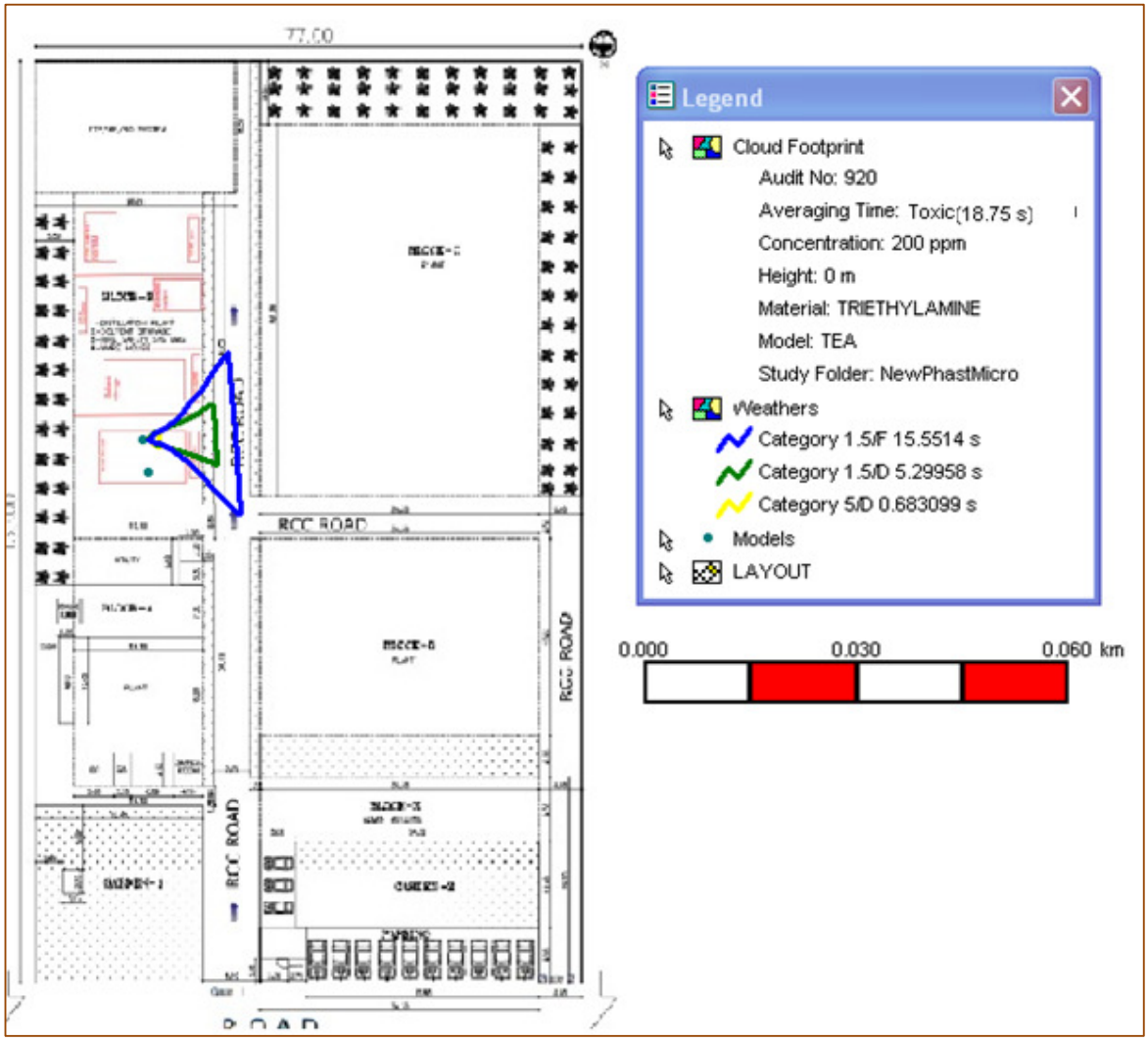
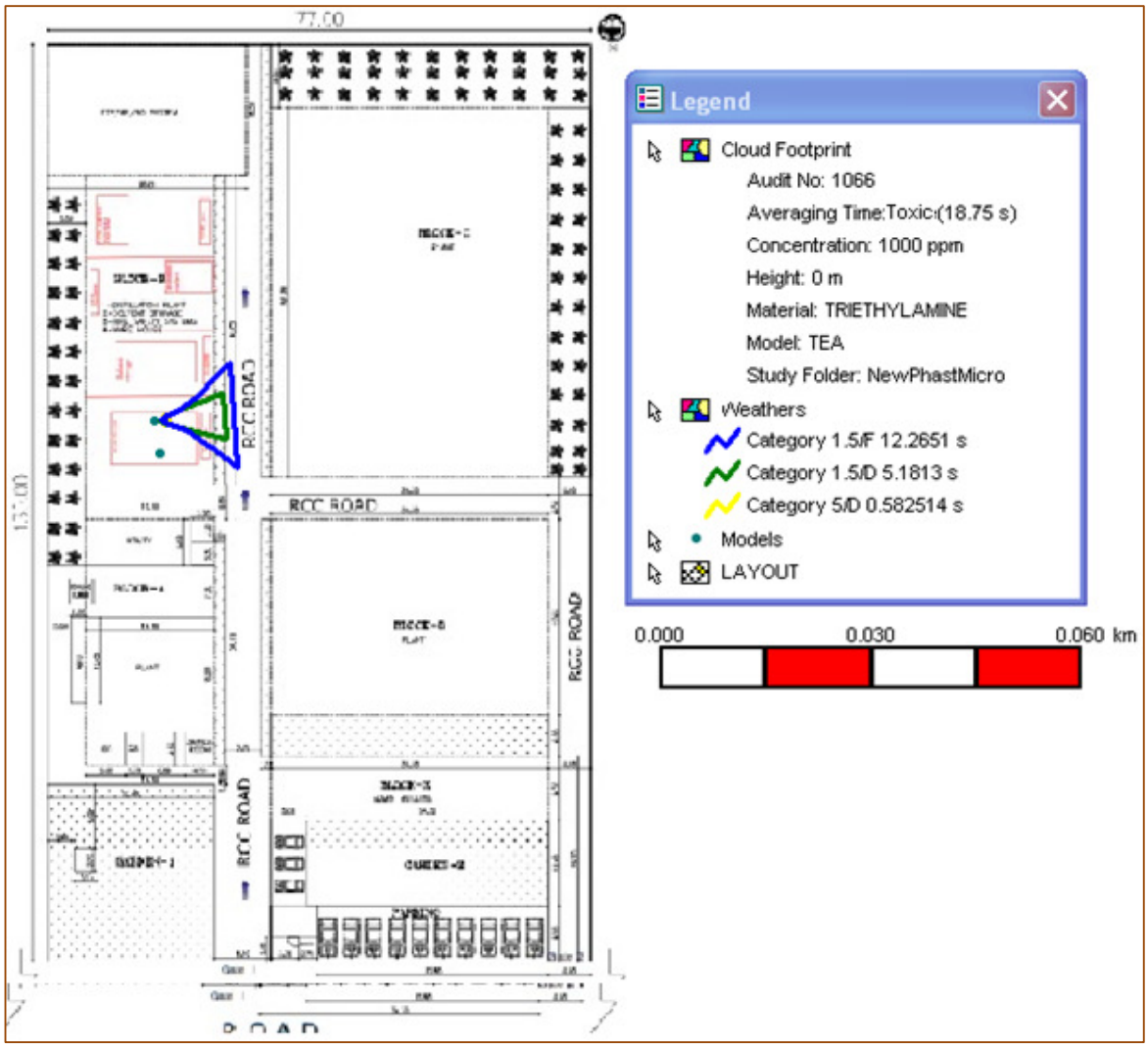


FIGURE: 6.11

RISK CONTOURS FOR LC_{50} CONCENTRATION:



6.3.2.7 CONSEQUENCE ANALYSIS SUMMARY

TABLE: 6.15

FLASH FIRE SCENARIOS

SR. No.	Scenario	Concentration (ppm)	Distance (meters)		
			Category 1.5/F	Category 1.5/D	Category 5/D
1	Release of Diethyl Amine	LFL Frac.14000	5.70	5.67	4.80
		LFL. 28000	3.42	3.41	2.83
2	Release of Triethyl Amine	LFL Frac.6000	13.93	15.23	6.57
		LFL. 12000	9.78	9.36	1.99

TABLE: 6.16

LATE POOL FIRE SCENARIOS:

SR. No.	Scenario	Radiation Level (KW/m^2)	Downwind Distance (meters)		
			Category 1.5/F	Category 1.5/D	Category 5/D
1	Release of Diethyl Amine	4	7.17	7.17	7.68
		12.5	NR	NR	NR
		25	NR	NR	NR
		37.5	NR	NR	NR
2	Release of Triethyl Amine	4	27.05	26.95	28.78
		12.5	15.95	15.91	19.65
		25	9.28	9.28	11.98
		37.5	6.52	6.55	7.65

TABLE: 6.17

EXPLOSION OVERPRESSURE SCENARIOS:

SR. No.	Scenario	Overpressure (Bar)	Downwind Distance (meters)		
			Category 1.5/F	Category 1.5/D	Category 5/D
1	Release of Diethyl Amine	0.02068	NR	NR	NR
		0.1379	NR	NR	NR
		0.2068	NR	NR	NR
2	Release of Triethyl Amine	0.02068	29.19	25.11	NR
		0.1379	14.97	13.9	NR
		0.2068	13.84	13.02	NR

TABLE: 6.18

TOXIC RELEASE SCENARIOS

Sr. No.	Concentration	Downwind Distance (meters)		
		Category 1.5/F	Category 1.5/D	Category 5/D
Diethyl Amine				
1	LC_{50} (4000ppm)	10.53	4.03	No Hazard
2	IDLH(200 ppm)	28.09	27.68	2.98
Dimethyl Sulphate				
1	IDLH : 7 ppm	87	-	-
2	LC_{50} : 45 ppm	25 (Contour not Drawn)	-	-
Thionyl Chloride				
1	IDLH : 25 ppm	76	-	-
2	LC_{50} : 500 ppm	11	-	-
Triethyl Amine				
1	LC_{50} (1000ppm)	30.63	27.24	No Hazard

2	IDLH(200 ppm)	50.18	44.69	1.08

6.4 CONSEQUENCE ANALYSIS

6.4.1 COMMENTS / RECOMMENDATIONS BASED ON CONSEQUENCE ANALYSIS

Flash Fire and UVCE & Late Pool Fire Scenarios:

- In case of release of Triethyl Aminein 1.5/D weather condition, vapor travels to the farthest distance of 15.23 mtr (at the max.). so as to create UVCE (0.02068) 29.19 1.5/F (Unconfined vapor cloud explosion).
- Weather condition 5/D is safer as compared to all other weather conditions.
- It can be seen from the summarized table above that the risk of late pool fire is more in case of release of Triethyl Amine for 4 kw/m2 radiation level in 5/D weather condition.

Toxic Release Scenarios:

- In case of toxic release scenario for Dimethyl Sulphate, (87m) IDLH Concentrations covers more distance in 1.5/ F weather condition.
- Evacuation plan to be designed considering the above mentioned worst case scenario.
- Thus, the category 5/D is the limiting one to decide for evacuation plan.

6.5 Arrangements for ensuring health & safety of workers engaged in handling of hazardous materials.

6.5.1 Following Safety Precautions are Considered during Transportation, Unloading, Handling & Storage Of Solvents and also for Toxic Chemicals, etc.) for its existing facilities, the same shall be updated to cover the new facilities, if required:

Sr.	ACTIVITY	SAFETY PRECATIONS
1.	Transportation of Solvents/chemicals by road tanker.	• Training is given to driver and cleaner regarding the safe driving, hazards of chemicals, emergency handling, use of SCBA sets. • TREM card is kept with TL. • SCBA set is kept with TL. • Fire extinguishers are kept with TL. • Flame arrestor is provided to TL exhaust. • Instructions are given not to stop road tanker/truck in populated area. • Hazard Identification symbol and emergency telephone number are displayed as per HAZCHEM CODE. • Appropriate PPEs are kept with TL.
		In case of leak or spill: • Source of leakage are checked. • Damaged containers or spilled materials are not attended without wearing appropriate protective clothing. • Leak is stopped, if possible to do so without risk. • Water spray are used to reduce vapors (but do not put water directly on leak, spill area or inside container). • Combustibles (wood, paper, oil, etc.) are kept away from spilled material.
2.	Unloading Activity	• Priority is given to Tanker to immediately enter the storage premises at site and is not kept waiting near the gate. • Security person checks License, TREM CARD, Fire extinguisher condition; SCBA set condition, Antidote Kit, required PPEs as per SOP laid down. **Following precautions are taken during unloading:** • Wheel stopper is provided to TL at unloading platform. • Static Earthing is provided to road tanker. • Tanker unloading procedure is followed according to

		check list and implemented strictly. • Flexible SS hose connection is done at TL outlet line. • All TL valves are closed in TL. • Only day time unloading is permitted.
3.	Solvents Storage tank safety.	• Pipes and equipment are inspected at regular intervals. • All storage areas are isolated from all sources of open flame and well posted with' NO SMOKING' signs and provided with adequate fire fighting/extinguishing systems. • Spark-resistant tools are used. • Water spray is used to reduce vapors (but do not put water directly on leak, spill area or inside container). • Combustibles (wood, paper, oil, etc.) are kept away from spilled material. • Dyke wall of sufficient capacity (i.e. 10% extra) is available around the storage tanks. • Level indicators/transmitters are available with low level/high level auto cut-off provision. • Vents are connected to water trap and vent of water trap are provided with flame arrestor. • Fire fighting facilities (along with foam attachment) are available as mentioned below. • Sand Buckets are available. • Dumping /Drain vessel/alternate vessel is available to collect the spillage material inside the dyke wall. • FLP type pumps are provided. • Double static earthing is provided to storage tank, as per the requirement. • Double Jumper clip is provided to all solvent handling pipeline flanges. • Vent connected to scrubber has been provided, wherever required. • Curb wall is available for pumps. • Pumps are guarded properly.

4.	Solvents transfer from storage tank to process plant.	• Double mechanical seal type FLP type pump are provided. • Double on / off switch is provided at tank farm and process area near day tank. Pump auto cut off with day tank high level is provided. • Flame arrestor with breather valve is provided on vent line. • Lightening arrestor is provided on the top of tallest tank. • Over flow system is provided for additional safety and it is connected to main storage tank. • NRV's are provided on pump discharge line. • Double Jumper clip is provided to all solvent handling pipelines. • Double static earthing is provided to day tank.

6.5.2 MEASURES FOR FUGITIVE EMISSION CONTROL

Control Techniques for Fugitive Emissions are in the following order:

(1) First preference: Engineering Controls

(2) Second preference: Administrative / Management Controls

(3) Last resort: Personal Protective Equipment (PPE).

Fugitive Emissions occurs or may occur during :

(1) Charging of Raw Materials.

(2) Leakage from Flanges, joints etc

(3) Tanker loading & unloading

Mitigation Measures

- Regular monitoring of plant area is conducted and records are maintained. At strategic point of the plants, online detectors are provided for detection of such emissions.

- Lines of such hazardous chemicals are tested periodically and such tests are recorded.
- All lines carrying toxic liquid are continuous welded and are provided with proper slopes and special tongue and groove joints to avoid liquid stagnation and leakage.
- In the process area, all the strategic pumps are of submerged type so as to eliminate leakages from glands.
- Safe Operating Procedures and EMERGENCY RESPONSE PROCEDURES are followed strictly.
- Concerned personnel are trained about the safe working practices.
- Dyke wall is provided to storage tanks.
- Level transmitter is also available with low level/high level auto cut-off provision.
- Adequate and relevant PPEs are available.

6.5.3 FIRE CONTROL PLAN

M/s. Suyog Life Science Pvt. Ltd. Ankleshwar has considered fire prevention measures at the project planning stage to avoid any outbreak of fire. But the chances of outbreak of fire cannot be totally ignored. Hence to tackle such a situation, company has planned to develop a well- resourced and adequate fire protection system/fire fighting network. The same facilities shall be updated to cover the expansion facilities also, if required.

Other details on Fire Control Plan:

- Fire load calculation has been carried out and fire fighting facilities comprising of main pump, stand by pump, jockey pump and fire water reservoir has been installed as per the GFR and TAC guidelines, the same shall be updated after the expansion of new facilities, if required.
- Fire Extinguishers like DCP, Carbon Dioxide & Foam types has been provided as per the GFR and TAC guidelines, at conspicuous locations.
- Other Fire fighting facilities like, fire monitor, foam trolley, fire hose boxes with hose pipe, sand buckets, fire blanket, ambu bags, Water Jell Fire Blanket, etc. have been provided within the company at conspicuous locations.
- Working staff is given training to operate DCP and CO2 extinguishers.

- The Fire Hydrant Network has been installed, capacity of the same shall be updated after the expansion of new facilities, if required.
- Emergency Action Team members are working round the clock in all shifts.
- First aiders are available round the clock in all shifts of all plants / sections.
- Rescue kits with SCBA sets are available at site to treat with any kind of chemical emergencies.
- Volume level indication with alarm and trips for high level are provided for vessels containing flammable materials.
- DG Set is available for power backup.

6.5.4 WAYS TO MINIMIZE THE MANUAL HANDLING OF THE HAZARDOUS CHEMICALS

1. Fork lifts are used for unloading chemical barrels/carboys, their movements within plant, handling carboys, bulk chemical bags, etc.
2. Cranes, hoists, pallet trucks, conveyors, etc. are used as per the requirement, to eliminate manual handling.
3. Lifting tools & tackles are used, wherever required.
4. SOPs, work instructions are prepared and followed.
5. Trainings are provided to relevant staff, operators, workers for the risk associated with manual handling of hazardous chemicals, ways to overcome those risk, etc.

6.5.5 DO'S & DON'TS

Management has listed some of the Do's & Don'ts activities to strengthen the **SAFETY AT WORK**, which will be followed strictly:

For Preventive Maintenance

Do's:

- Inspection of Storage Area, Earthing & Bonding system.
- Inspection of all Fire Fighting Facilities /Check Alarms operation.
- Ensuring that operators/workers etc. follows the SOPs, Safety procedures & standards, work permit system etc.
- Checking the availability of Spill Containment Kit.

- Make sure existing fire extinguishers are fully charged and ready for action.
- Inspections of plant, machinery, tools, equipment, premises, work practices, processes, procedures and general environment must be carried out for the health and safety of plant, people and surrounding.
- On-site and Offsite Emergency Plans shall be reviewed and updated, as per the requirement.

Don'ts:

- Don't allow anyone who hasn't received specific safety and operational training to get indulge in any site activity.
- Don't perform your own maintenance.
- Don't compromise on Design and Engineering part.
- Don't perform any activity without proper permit.
- Don't panic if you are in a risky situation.
- Don't allow spilled chemicals to drain to sewers/gutters etc.
- Strengthening of HSE (Applicable for Manufacturing Utility Staff)

Do's:

- Follow instructions. Do not take chances. If you don't know, ask.
- Correct or report unsafe conditions.
- Include a timeline for completion of each recommendation.
- Make recommendations that are measurable and track able.
- Ensure that each recommendation is assigned to an individual to oversee implementation.
- Help keep things clean & orderly. Keep gangways clear.
- Do not Horseplay. Do not run. Avoid distracting others. Avoid throwing things.
- Report all injuries. Get first aid promptly.
- Use, adjust and repair equipment only, when authorized.
- Use right tools & equipments for the job, use them safely.
- Do not smoke in restricted areas. Do not flick cigarette / beedi in company.

- Use prescribed protective equipment; keep them in good working conditions.
- Respect signs / warnings. Abide by rules laid down for your safety.

Don'ts:

1) No worker in a factory-

- Shall will fully interfere with or misuse any appliance, convenience or other thing provided in the factory for the purpose of securing the Health, Safety or Welfare of the workers therein:
- Shall will fully and without reasonable cause do anything likely to endanger himself or others; and
- Shall will fully neglect to make use of any appliance or other thing provided in the factory for the purposes of securing the Health or Safety of the workers therein.
- Do not make vague statements, do not overrule supervisor, do not adopt shortcuts.

6.5.6 ANTIDOTES DETAILS:

The appropriate antidotes for the hazardous chemicals for the existing facility are available at site and the same shall be updated & kept available for the expansion facility also.

Following Antidotes for major hazardous chemicals are kept available at the site.

Chemical	Antidote / Medical Treatment
Di Ethyl amine	• **EYES:** First check the victim for contact lenses and remove if present. Flush victim's eyes with water or normal saline solution for 20 to 30 minutes while simultaneously calling a hospital or poison control center. Do not put any ointments, oils, or medication in the victim's eyes without specific instructions from a physician • **SKIN:** IMMEDIATELY flood affected skin with water while removing and isolating all contaminated clothing. Gently wash all affected skin areas thoroughly with soap and water. • **INHALATION**: Provide proper respiratory protection to rescuers entering an unknown atmosphere. Whenever possible, Self-

	Contained Breathing Apparatus (SCBA) should be used; if not available, use a level of protection greater than or equal to that advised under Protective Clothing.
Thionyl Chloride	• Milk of Magnesia, Soda Water, Castor Oil, Soframycine.
Tri Ethyl amine	• Immediate first aid: Ensure that adequate decontamination has been carried out. If patient is not breathing, start artificial respiration, preferably with a demand-valve resuscitator, bag-valve-mask device, or pocket mask, as trained. • Perform CPR as necessary. • If eyes get in contact with TEA, immediately flush contaminated eyes with gently flowing water.

6.5.7 RECOMMENDATIONS TO MITIGATE REACTION HAZARDS:

- A comprehensive HAZOP Study for all the stages of Batch process to be conducted and SOPs to be made considering this findings and recommendations of HAZOP Study.
- Only trained persons to be engaged in reaction processes like charging of raw material, loading & unloading of chemicals and operation of reactor, etc.
- Adequate open space to be kept around the periphery of reactor for the ease of operation.
- Adequate fire fighting facilities to be installed.
- All the electrical fittings in the factory to be made of flame proof type.

6.6 ONSITE AND OFF SITE DISASTER PREPAREDNESS & EMERGENCY MANAGEMENT PLAN

M/s. Suyog Life Science Pvt. Ltd., Ankleshwar has prepared the Disaster Management Plan which is linked with District Disaster Management Plan. This plan has been prepared based on the risk contours plotted on the plant layout map clearly showing the facilities that would be affected, in case an accident takes place.

The purpose of this plan is to provide **M/s. Suyog Life Science Pvt. Ltd.**, Ankleshwar with the means to effectively utilize all the resources at its disposal for the protection of

life, environment and property. The same DMP shall be updated after expansion to cover new plants or facilities, if required. The details of the same are discussed in the following sections.

6.6.1 DEFINING THE NATURE/LEVEL OF EMERGENCY

THE LEVEL OF EMERGENCY CAN BE CLASSIFIED IN THREE CATEGORIES:

LEVEL - 1:

The leakage or emergency, which is confinable within the plant/area. It may be due to:

a) Small pipe/valve rupture or similar leakages that do not affect outside premises.

b) Release of toxic chemicals for short duration.

c) Small fire in the plant.

LEVEL - 2:

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

a) Leakage of toxic chemicals for long duration.

b) Medium scale explosion confined to the factory premises.

c) Medium scale fire inside the factory premises.

LEVEL - 3:

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

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

b) Explosion of high magnitude affecting the adjacent area.

c) Major fire inside the factory premises.

6.6.2 OBJECTIVES OF EMERGENCY MANAGEMENT SYSTEM

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

- To define and assess emergencies, including risk and environment impact assessment.
- To control and contain incidents.
- To safeguard employees and people in vicinity.

- To minimize damage to property or/and the environment.
- To inform employees, the general public and the authority about the hazards/risks assessed, safeguards provided, residual risk if any and the role to be played by them in the event of emergency.
- To be ready for 'mutual aid' if need arises to help neighbouring unit. Normal jurisdiction of an OEP is limited to the own premises only, but looking to the time factor in arriving the external help or off-site plan agency, the jurisdiction must be extended outside to the extent possible in case of emergency occurring outside.
- To inform authorities and mutual aid centers to come for help.
- To effect rescue and treatment of casualties. To count injured.
- To identify and list any serious injuries and or fatalities.
- To inform and help relatives.
- To secure the safe rehabilitation of affected areas and to restore normally.
- To provide authoritative information to the news media.
- To preserve records, equipment etc, and to organize investigation into the cause of the emergency and suggest preventive measures to stop its recurrence.
- To ensure safety of the works before personnel re-enter and resume duty.
- To work out a plan with all provisions to handle emergencies and to provide necessary inputs for emergency preparedness and the periodical rehearsal.

6.6.3 STRUCTURE OF EMERGENCY MANAGEMENT SYSTEM

M/s. **Suyog Life Science Pvt. Ltd**., Ankleshwar has developed an emergency management team. The management structure includes the following personnel's;

- Site Main Controllers
- Incident Controllers and Deputy Incident Controllers
- Key Personnel's
- Essential Workers

The other elements of Disaster Management Plan are:

- Assembly points
- Emergency control center
- Fire control arrangements
- Medical arrangements

- Other arrangements

❖ SITE MAIN CONTROLLER

General Manager and FM are deputed as Site Main Controller. In absence of SMC's, Safety or Shift In Charge will act as a SMC. His task will be to co-ordinate all internal and external activities from the Emergency Control Centre at Main Security Gate from where all operations will be directed. He shall:

- Relieve the incident controller of responsibility for overall main control.
- In consultation with the incident controller decide whether major emergency exists an on declaration of a major emergency ensure that the outside emergency services and mutual help are called , the off side-plan activated and if necessary , nearly factories and population are informed.
- Ensure the key personnel are called.
- Exercise direct operational control of those part of the work outside the affected area.
- Continuously review and assess possible development to determine the most probable causes of event.
- Direct the safe close down and evacuation of plants in consultation with the incident controller and key personnel. If necessary arrange for evacuation of neighbouring population.
- Ensure that causality are receiving adequate attention. Arrange for hospitalization victims and additional help if required. Ensure that their relatives are informed.
- Informed and liaison with police services instruct emergency authority and the factory inspectorate and expert on health and safety provide advice on possible effect on are outside the factory.
- In the cases of prolonged emergencies involving risk to outside area by wind blow materials contact meteorological office to receive early notification of impending changes in weather condition.
- Ensure the accounting for personnel and rescue of missing persons.
- Control traffic movement within the factory.
- Arrange for a chronological record of the emergency to be maintained.
- Where the emergency is prolonged arrange for relief of personnel and the provision of catering facilities.

- Issue authorized statement to the news media where necessary inform head office.
- Ensure that proper consideration is given to the preservation of evidence Arrange for photographs / video.
- Control rehabilitation of affected areas and victims on cessation of the emergency . Do not restart the plant unless it is ensured safe to start and authorized the sounding of All Clearance siren which will be one continuous longs siren for one minutes".

❖ ROLE OF INCIDENT CONTROLLER AND DEPUTY INCIDENT CONTROLLER

As our factory is running 24 hrs, so each Dy. Managers, Officer, Supervisors, Engineers, etc. from different depts. (like production, stores, P&A, engineering, R&D, etc.) are nominated as I.C and they will be always available in the shift and can take charge till the arrival of SMC. Any one shall be available in each shift & on holiday on call.

His primary duties are to take charge at the scene of the incident. In the initial stage he may be required to take decisions involving the operation of the other plants or to stop or continue any process and to take technical decisions to control the incident. The deputy incident controller should take the charge of incident controller, if he is not available due to any reason. Supervisors & Shift Incharge are deputed as DIC.

Responsibilities/Duties of Incident Controller and Deputy Incident Controller:

All shift Incharges of respective plant / Officer (Production).

Duties / Function: Immediately on being aware of the emergency and its location he will proceed to the scene On arrival he will take charge of accident and operate from scene as well as plant control.

He will :

- Assess the scale of emergency and decide if a major emergency exists or is likely. on his decision he will active the on - side emergency plan and if necessary the off- side emergency plan.
- Inform side main controller and perform as side main controller till his arriving and he will deputed his Dy. incident controller on the scene and he will go the emergency control centre. Particularly he will:

- ✓ Direct the shutting down and evacuation of plant and areas likely to be affected by the emergency.
- ✓ Ensure that emergency services including mutual aid have been called in.
- ✓ Ensure that key personnel have been called in.

- Direct all operations within the affected area with the following priorities.
  - ✓ Secure the safety of the personnel.
  - ✓ Minimize damage to plant property and the environment.
  - ✓ Minimize loss of material.
  - ✓ Direct rescue and fire fighting operation unit the arrival of the outside fire brigade.
  - ✓ Search for casualties.
  - ✓ Evacuate non essential worker to the assembly points.
  - ✓ Set up a communication point and established telephone messenger contact appropriate with the emergency controller centre.
  - ✓ Give advice and information as requested to the head of the fire brigade and other emergency services.
  - ✓ Brief the site main controller and keep informed of development.
  - ✓ Preserved evidence that will be necessary for subsequent inquiry into the cause of the emergency and concluding preventive measures.

❖ **KEY PERSONNELS**

Senior officers of various departments like Fire, Security, Safety, Administration, Engineering, Project, Production, Transport, Pollution control, Technical Services and Stores are nominated as Key Personnel in their respective fields. As necessary, they decides the actions needed to shutdown plants, evacuate personnel, carryout emergency engineering work, arrange for supplies of equipments, utilities, carryout environment monitoring, provide catering facilities, liaise with police, fire brigade and other local authorities, relative of casualties, hospital, press & neighboring industries, action at assembly points, outside shelters and mutual aid center under the direction of the SMC. All the key personnel and other called in so to assist, shall report to the ECC. They are available at any time on duty or on call or on holidays.

❖ **ESSENTIAL WORKERS**

Essential Workers are those who are trained in Fire Fighting, First Aid, Rescue& Salvage. Supervisors, Operators & technicians from production dept. are designated as E.W.'s & are supposed to report at EMERGENCY SITE to take instructions from I.C. or Dy. I.C. Such work instructions will include:

- Fire fighting and spill control till a Fire Brigade takes the charge.
- To help the Fire Brigade and mutual aid teams, if it is so required.
- Shutting down plant and making it safe.
- Emergency engineering work e.g. isolating equipment, material process, providing temporary by-pass lines, safe transfer of materials, urgent repairing or replacement, electrical work, etc.
- Provision of emergency power, water, lighting, instruments, equipments, materials, etc.
- Movement of equipment, special vehicle and transport to or from the scene of the accident.
- Search, evacuation, rescue and welfare.
- The injured is given First Aid.
- Moving tankers or other vehicles from area of risk.
- Carrying out atmospheric test and pollution control.
- Manning of assembly points to record the arrival of evacuated personnel. Manning for outside shelters and welfare of evacuated persons there.
- Assistance at causalities reception areas to record details of causalities.
- Assistance at communication centres to handle outgoing and incoming calls and to act as messengers if necessary.
- Manning of works entrances in liaison with the police to direct emergency vehicles entering the work, to control traffic leaving the works and to turn away or make alternative safe arrangements for visitors, contractors and other traffic arriving at the works.
- Informing surrounding factories and the public as well as directed by the Site Main Controller.
- Any special help required.

OTHER ELEMENTS OF DMP:

❖ **ASSEMBLY POINT**

In affected & vulnerable plants, all nonessential workers (who are not assigned any emergency duty) will be evacuated from the area & they shall report to specified Assembly Points. Assembly Point is located near main gate, well away from area of risk and least affected by the down wind direction.

To ensure that workers do not have to approach the affected area to reach the Assembly Point, proper location and numbers have been marked at Assembly Points. Each Assembly Point is manned by a nominated person to record the names and dept. At each Assembly Point, duties of Assembly Point In-charge are displayed in brief. Before reaching an Assembly Point or subsequently, if it is required to pass through an affected area or due to presence of toxic substances, suitable PPE's including respirators, helmet etc., are issued & made available with workers.

❖ EMERGENCY CONTROL CENTER

The Emergency Control Center is the place or room from where the operations to handle the emergency are directed and coordinated. A room near Security Gate has been earmarked/identified as the Emergency Control Room.

Telephone and other facilities required with necessary documents are displayed in ECC for ready reference. ECC has been operated by Site Main Controller, key personnel and Senior Officers of the Fire, Police, Factory Inspectorate, District Authorities and Emergency Services.

The ECC center is equipped with the following facilities:

- Internal and external telephone including STD facility.
- Telephone directory/ Telephone nos. of mutual aid centers.
- Factory Layout showing evacuation plan, fire fighting arrangements, emergency control centre, location of assembly points, etc.
- First Aid.
- Gate pass book.
- Muster roll of Workers.
- Work permit book.
- Identicard register.
- Copy of ON SITE/ OFF SITE PLAN.

- Stationeries like- note book, pen, pencils etc.
- SCBA Sets.
- Sand Buckets & Hydrant Network.
- Adequate numbers of PPE's (like dust mask, Air Mask, safety dress, PVC hand gloves, Full Face piece respirator with 3M cartridge, helmet, goggles, etc).

❖ FIRE CONTROL ARRANGEMENTS (FIRE FIGHTING, GAS LEAK CONTROL AND RESCUE OPERATION)

A. Role of Manager (Fire and Safety) / Shift In-Charge (Fire & Safety)

1. Incident Controller directs the fire fighting and Emergency operation. His duties include…
2. Keep the constant touch with the SMC / Incharge - EHS.
3. Direct the crew members to the scene of emergency and arrange replenishment of Manpower / equipment / extinguishing media etc.

B. Role of EHS Representative:

1. On being notified about the location of fire/ gas leakage, he immediately proceeds to the help.
2. Decides his line of action in consultation with Incident controller and takes appropriate measures to handle the emergency.
3. Assessing the severity of the incident, immediately report to emergency controller about the gravity of the situation.
4. He assess the extra requirement required if any, from the neighbouring industry.

C. Fire crew members

1. On hearing fire alarm, emergency siren they immediately reports to control room and proceed to the scene of emergency and work under the direction of IC/ Dy IC.
2. The personal availability at the scene of incident to be made optimize.

D. Emergency Squad Members

1. On hearing Emergency Siren, they immediately reports to site main controller, safety in charge or incident controller.

2. They shall combat the emergency situation as per the direction of site main controller, safety in charge or incident controller.
3. They helps for safe evacuation.

❖ **MEDICAL SERVICES**

The roles of Medical officers are as follows;

(a) He will report immediately to the SMC/IC.

(b) He will render necessary treatment, at Occupational Health Center.

(c) He will arrange for Hospitalization and Treatment at outside hospitals, if required.

(d) He will mobilize in getting the services of External medical agencies, other Para – medical services etc. and transportation services etc.

(e) He will arrange for extra medical assistance/antidotes, from out, if required.

(f) He will arrange for first-aid trained volunteers for necessary help.

(g) He will liaise with the Government Health Authorities for treatment of the affected persons nearby.

❖ **ROLE OF SECURITY IN-CHARGE (SECURITY OFFICER)**

- On hearing the emergency siren, he shall find out the location of the incident (fire / gas leak / spill / explosion) and inform the location of the same to the key personnel coming to the plant.
- He will depute the security guards for managing gates and traffic control at the incident site & send remaining guards to the site of incident.
- He will prevent unauthorized entry in to the site
- He will render assistance as demanded by the safety in-charge.
- He will mobilize additional security force for help, if required.
- He will direct ambulance(s) and emergency vehicle(s) to the scene of incident.
- He will help evacuate persons within the scene of incident.
- As directed by the site main controller, he may be required to address the public of surrounding villages for warning / evacuation.

❖ **ROLE OF MUTUAL-AID MEMBERS**

- Company has Mutual Aid with various nearby factories and GIDC fire station etc.

- On receiving the call, they shall proceed immediately with fire squad & fire tenders.
- They will be guided to the place of the incident by the main gate security guard.
- The fire squad in-charge will report to the safety in-charge of the unit in which the incident has occurred.

❖ **OTHER ARRANGEMENTS**

Other arrangements include external transport (transport centre), heavy vehicles, lift/cranes, Utilities, generator sets to supply emergency power, environment monitoring equipment, special instruments/equipments, rescue items etc. is made available from Ankleshwar Association or near by locations, when available resources do not meet the requirements.

STANDARD OPERATING PROCEDURE (FOLLWED DURING EMERGENCY)

- As soon as emergency alarm is heard, all essential workers shall report to IC or SMC.
- They shall carefully listen to the instructions given by IC or SMC
- According to the type of emergency/accident, they shall get equipped with PPE/Fire fighting equipment and devices.
- The runner among the workers shall inform SMC/IC and key personnel if they are not at site.
- The messenger amongst the workers shall deliver messages to nearby units as per the instructions of SMC/IC.
- The in-charge of medical arrangements shall prepare first-aid and other required facilities for the injured.
- The other essential workers shall try to control the emergency as per the instructions given to IC.
- IC would keep SMC informed about the status of control measures being taken at the site and ask for other requirements e.g. Mutual aid, equipment etc. if he find necessary.
- SMC would co-ordinate with outside agencies regarding control measures being taken, need for external help, evacuation, medical treatment etc.

6.6.4 COMMMUNICATION SYSTEM

Communication System is a Crucial Factor while handling emergency. Company has quick & effective Communication System through which, any situation, which can lead to emergency, can be informed or known to…

i. All persons working inside the plant.

ii. Key Personnel outside during normal working hours & during off-duty hours.

iii. Outside emergency services, Statutory and Local Authorities and

iv. Neighbouring facilities and public leaving in vicinity.

Each and every section, Plant & Department of the Factory are connected by internal telephones with SMC, Supervisor or IC's. External Phone at Office and Residence is also be made available with Key Personnel and top executive of the factory. The Communication System shall begins with raising the alarm declaring the emergency, Telephone messages and Procedure to communicate the emergency to other persons & General Public.

List of external telephone nos. of important agencies like: District Collector & Magistrate, Police Commissioner, Director of Industrial Safety & Health, GIDC Fire Brigade, Ankleshwar Emergency Control Centre, Ankleshwar Industries Association, Nearby Hospitals, etc. is made available to be used in case of an emergency.

❖ **RAISING THE ALARM**

As soon as incident takes place inside the factory and is noticed by someone, the first step shall be to raise the nearest manual emergency bell to alert the nearby people. Next, he/she shall informs the security persons to raise the emergency siren.

There is siren system available to warn neighbouring factories about major emergency. Sirens are tested daily to check its readiness. UPS power is available to siren in case of power failure. The security personnel sounds the siren.

The alarm sound informs the I.C and the S.M.C that an emergency has been created and emergency organization is to be activated. The I.C. rushes to the site and shall takes charge of the scene.

❖ **DECLARING THE MAJOR EMERGENCY**

Major emergency is declared after sufficient and thorough check because the declaration of major emergency puts many agencies on action and it may disturb the running system, which may be Costly at, time or its Consequence may be Serious. Therefore, major emergency must not be decided on whims or immature judgment or without proper thought. Looking to all the above, we have nominated the persons (SMC: Director & Production Manager) who can declare the emergency; we have selected them on the basis of their knowledge & experience. These persons are technically qualified and experienced. The decision about major emergency is taken as early as possible and without wasting time so that control action can be started immediately.

❖ TELEPHONE MESSAGES

A Telephone operator who is precise, sharp, attentive and quick in receiving and noting the message and subsequently effective in further Communication, has been appointed. A form to record emergency telephone calls is available with telephone operator or Person available in Emergency Control Center, who records such calls during emergency. Telephonic messages are given out by the telephone operator to Site main Controller and key personnel as per the instructions of the Incident Controller. Telephonic messages are also given to authorities and external agencies to describe the type of emergency. All details of emergency are collected/delivered according to this format, available with the telephone operator.

❖ COMMUNICATION OF EMERGENCY & STATUTORY INFORMATION

Communication of Emergency:

An effective system to communicate emergency has been made to communicate about the emergency situation as mentioned below:

- Inside the factory i.e. workers including key personnel and essential workers, on duty & inside during normal working hours.
- To key personnel and essential workers not on duty and outside during normal working hours.
- To the outside emergency services and the Government authorities.
- To the neighbouring factory & the General Public in the vicinity.

STATUTORY INFORMATION:

a) Information to Workers

Set of Statutory information regarding types of hazards and their prevention and control as directed in the Factories Act is prepared by the unit. This information is printed in the local language and given in the form of booklet to all workers including contract workers.

b) To the outside emergency services and District Emergency Authority

Statutory information in the form of booklet is given to outside emergency services and authorities, if required.

c) To neighbouring firms, general public & Factory Inspectorate

Statutory information in the form of booklet is given to neighbouring units and the general public of the villages in the vicinity of the unit, if required.

6.7 OCCUPATIONAL HEALTH & SAFETY.

M/s. Suyog Life Science Pvt. Ltd., Ankleshwar has prepared the **Occupational Health Surveillance Programme** for its existing facility. The same programme shall be updated (if required) after the expansion, to cover new plants or facilities. The details of the existing programme are described in the following sections.

6.7.1 OCCUPATIONAL HEALTH

Occupational health needs attention both during construction & erection and operation & maintenance phases. However, the problem varies both in magnitude and variety in the above phases.

6.7.2 HOSPITAL FACILITIES

Company has made formal agreements with Jayaben Modi hospital having facilities to attend fire and toxic effect cases for attending the affected persons in the emergency arising out of accidents, if any.

One ambulance is available round the clock in the factory to transport the victim/injured person from the factory to the near by hospital. Ambulance is equipped with Stretcher, First aid box, Oxygen Cylinder, Mask, etc.

6.7.3 FACTORY MEDICAL OFFICER/OHC

A qualified doctor has been appointed as FMO on retainer ship basis. Apart from him, Paramedical Staff has also been employed. Adequate no. of employees are trained in First aid.

6.7.4 PLAN FOR PERIODIC MEDICAL CHECKUP

Periodic Medical Examination is being conducted as per the following schedule;

Workers employed are examined by a Qualified Medical Practitioner/ Factory Medical Officer, in the following manner:

(a) Before employment, to ascertain physical fitness of the person;

(b) During employment, once in a period of 6 months, to ascertain physical fitness of the person to do the particular job;

Medical examinations is then documented in Form no.: 32 & 33 and maintained.

6.7.5 DETAILS OF OCCUPATIONAL HEALTH IMPACTS AND SAFETY HAZARDS

Occupational Hazards	Occupational Health Impacts
• Exposure to Toxic Chemicals.	• Toxication, Irritation,
• Exposure to Flammable Solvents.	• Fall Injury, Electrocution,
• Fire due to Static charge generation	• Body Injury, Burns, Skin sensitization,
• Slip/trip, fall, electric shock, etc.	• Severe irritation to eyes & skin,
• Spillage/leakage,	• Respiratory disorder,
• Overflow,	• Damage to nearby equipments,
• Exposure to Corrosive Chemicals.	• Fatality, etc

Mitigation measures/Safety Measures proposed to avoid the human health hazards are mentioned under section 6.5. Personal protective equipments like Helmet, Safety shoes/ Gumboots Hand gloves, Gas Mask / Nose Mask, PVC apron, SCBA Set, PVC pressure suit, Bobble hood are also provided to the required personnel.

6.7.6 MEASURES ADOPTED BY COMPANY TO KEEP AIR BORNE CONCENTRATION OF HAZARDOUS CHEMICALS BELOW PEL:

- Each workplace is evaluated. Air-borne concentration of toxic chemicals is measured and records are kept. It has been found that, the exposure levels air borne concentration of hazardous chemicals are below PEL.
- For purpose of measuring worker exposure across a single shift, a reasonably accurate exposure measuring device (Alarms will be configured at TLV value) has been placed within the worker's breathing zone, and have it operates for the full shift. Company studies the exposure data when the plant is operative.
- To avoid mixing of hazardous chemicals in air; leak surveys are conducted every 15 days. LDR (Leak Detection and Rectification) program has been designed for early detection of leakages of hazardous chemicals and to rectify leakages.
- Flange/Ferrule joints, pipelines, transfer lines, etc. are checked on regular basis for maintenance purpose.
- Regular maintenance check up are carried out for pumps, equipment, instruments handling toxic and corrosive chemicals.
- PPEs like Air mask, Berating canisters, SCBA sets, On-line breathing apparatus are kept available at the places where there is possibility of presence of toxic chemicals.
- The ambient monitoring devices (portable) with alarm for leakage of hazardous chemicals are available.
- Third party environment monitoring is in practice.
- Portable detectors are available SO2, Ammonia. HCl, Chlorine, H2S etc.
- Explosive meter meter and Oxygen meter are also available.
- Noise meter is also available.
- There is volume level indication with alarm and trips for bulk toxic storages.
- The interlocks, alarms and trip systems are tested on quarterly basis.

6.7.7 WORKZONE MONITORING ARRANGEMENTS FOR HAZARDOUS CHEMICALS

Work zone monitoring is carried out by independent competent third party every month. Records are kept in Form No. 37 as per Gujarat Factories Rules. Location for samplings shall be identified. Samples are analyzed for Air borne concentration of

hazardous chemicals in ppm. Following information is incorporated in the format for maintaining records of work zone monitoring:

- Location/Operation monitored
- Identified contaminant
- Sampling instrument used
- Number of Samples
- Range of contaminant concentration as measured in sample
- Average concentration
- TWA concentration of contaminant (As given in Second Schedule of Factories Act)
- Reference method used for analysis
- Number of workers exposed at the location being monitored
- Signature of the person taking samples
- Other relevant details

6.7.8 HEALTH STATUS EVALUATION OF WORKERS (EXPOSURE SPECIFIC)

1. Management has device a plan to check and evaluate the exposure specific health status evaluation of workers.
2. Workers are 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. Complete medical examinations including PFT, Urine and Blood examination, Liver Function tests, chest X-ray, Audiometry, Spirometry Vision testing, ECG, etc. is carried out. However, the parameters and frequency of such examinations are decided in consultation with Factory Medical Officer and Industrial Hygienists and the details of the same are maintained in record.
3. While in work also, all the workers are periodically examined for the health with specific reference to the hazards which they are likely to be exposed to, during work. Again, the parameters and frequency of such examination are decided in consultation with Factory Medical Officer and Industrial Hygienists. Monthly and yearly report of the health status of workers with special reference to Occupational Health and Safety, is maintained.

6.7.9 ACTION PLANFOR SAFE HANDLING & SAFETY SYSTEM

Action Plan For Safe Handling of Hazardous Chemicals:

1. Manual Handling is eliminated or replaced by fork lifts, cranes, hoists, pallet trucks, etc.
2. Appropriate PPEs are used.
3. Lifting tools & tackles are used, wherever required.
4. Do's and Don'ts for strengthening the safety system is being practiced.
5. SOPs, work instructions are followed.
6. Training is being provided to relevant staff, operators, workers for the risk associated with handling of hazardous chemicals, ways to overcome those risk, etc.

Action Plan for Safety System:

Following action plan for Safety System has been implemented:

SAFETY ORGANIZATION/COMMITTEE

A qualified and experienced safety officers are appointed together constitute a safety committee and meetings are held at least once in a quarter. Safety Saturday meeting is also organized sometimes to share the problem or suggestions, if any. The responsibilities of the committee include identification of the hazardous conditions and unsafe acts of workers and advice on corrective actions, conduct safety audit, organize training programs and provide professional expert advice on various issues related to occupational safety and health.

Safety organization is responsible to ensure compliance of Safety Rules/ Statutory Provisions. Safety Organization organizes Safety contests like Safety Slogan, Quiz, Safety Poster, safety Speech by individual, Safety Exhibition, etc. to educate the staff, workers, operators on safety aspects. Employees, contractor employees and their representatives are properly informed of their rights and process hazard analyses.

SAFETY CIRCLE

In order to fully develop the capabilities of the employees in identification of hazardous processes and improving safety and health, safety circle is also constituted. The circle would consist of about three to four employees. The circle normally meets for about an hour every week.

SAFETY TRAINING

Company has made a policy of identifying the Safety Training Needs at different positions/levels. Safety trainings are arranged by Safety deptt. in consultation with the plant/area in-charge and the Occupier and some times external faculty is also deputed for the same. One day training on safety induction is arranged for each category of new employee.

In addition to regular employees, limited contract labors are also allowed to attend safety training. To create safety awareness, safety films are shown to workers and leaflets are distributed. Training programmes cover plant safety rules and hazard communication, safety aspects, BBS, etc. Bulletins on health awareness are circulated through mails. Visits to safety institutes / organizations are also arranged. The man days and man-hours used in safety training are recorded. Safety training calendar is devised for one year. It is also ensured that the given training works in the proper safe direction.

6.7.10 PLAN AND FUND ALLOCATION TO ENSURE THE OCCUPATIONAL HEALTH & SAFETY OF ALL CONTRACT AND CASUAL WORKERS

Company has prepared Safety Plan and implemented for the existing project activity. Also, management has allotted enough funds to ensure the occupational health &safety of all contract & causal workers and also allotted a special budget for employees appreciation for proactive and rescue operations .The same shall be followed for the expansion facilities also. Details of the same are as follows:

- To allocate sufficient resources (like PPEs) to maintain safe and healthy conditions of work;
- To take steps to ensure that all known safety factors are taken into account in the design, construction, operation and maintenance of plants, machinery and equipment;
- Daily briefing/ safety instructions are given by security at main gate,
- Daily checking of helmet and shoes is done by security at gate,
- Tool Box Talk by plant personnel before start up of work, like informing employees about materials, equipment or processes used in their work which are known to be potentially hazardous to health or safety;

- To keep all operations and methods of work under regular review for making necessary changes from the point of view of safety in the light of experience and up to date knowledge;
- To provide appropriate facilities for first aid and prompt treatment of injuries and illness at work;
- To provide appropriate instruction, training, retraining and supervision to employees in health and safety, first aid and to ensure that adequate publicity is given to these matters;
- To ensure proper implementation of fire prevention methods and an appropriate fire fighting service together with training facilities for personnel involved in this service;
- To organize collection, analysis and presentation of data on accident, sickness and incident involving people injury or injury to health with a view to take corrective, remedial and preventive action;
- To organize safety programs, celebrating safety week, safety competitions during safety week, etc.;
- To promote through the established machinery, joint consultation in health and safety matters to ensure effective participation by all employees;
- To publish/notify regulations, instructions and notices in the common language of employees;
- To prepare separate safety rules for each type of occupation/processes involved in a plant; and
- To ensure regular safety inspection by a competent person at suitable intervals of all buildings, equipments, work places and operations.

6.7.11 ARRANGEMENTS FOR ENSURING HEALTH AND SAFETY OF WORKERS ENGAGED IN HANDLING OF TOXIC MATERIALS

As discussed in previous clauses, company has made various plans & arrangements to ensure health and safety of workers engaged in handling of toxic materials. Summary of the same is as follows :

- Each workplace is being evaluated for the existing work conditions.
- Unsafe Act & Unsafe Practices are identified.
- Unsafe equipments, unsafe areas, etc., are identified.

- First Aid Injuries are minimised to zero.
- Environmental Incidents & Chemical exposures are minimised.
- Area are checked for proper Ventilation and Illumination.
- Air-borne concentration of toxic chemicals are measured, mitigation measures are followed to keep them under PEL and the same is documented.
- Periodic Medical check up& Health evaluation is being done.
- Adequate funds are allotted for the Safety Management System.

6.7.12 MOCK DRILLS

To evaluate the effectiveness of emergency preparedness and to spread the awareness among employees mock drill is carried out at the interval of every three months.

After completion of the mock drill, summary report is made and corrections are made if any weakness has been observed.

FREQUENCY OF MOCK DRILLS:

- On-site emergency : Once every 6 months
- Off-site emergency : Once every year