RISK ASSESSMENT

7.0 GENERAL

This chapter includes a brief description of public hearing details, Risk & Hazard study, Disaster Management Plan, etc.

7.0.1 Public Consultation

Project site is located within the Non-Notified Industrial Area, at Goyala. The public hearing will be done as per EIA Notification 2006 and its requirement. The proceeding and action plan will be incorporated in final EIA report.

7.0.2 Risk Assessment

This is brown field project of Formaldehyde manufacturing unit at Goyala, Lucknow in Uttar Pradesh. During operation of plant there may be chances of damage to nearby area and properties due to any possible accident while handling, storage and operation of plant. Small accident, near miss in plant may lead to high impact accident if not handled with proper mitigation measures in time. Hence to understand the possible hazards, impacts and their control measures of various toxic, flammable and corrosive chemicals on the study area Qualitative and Quantitative Risk Assessment has been done along with the Disaster Management Plan (DMP).

Objective of the Study

The principle objective of this study is to identify major risks in the manufacturing process and to evaluate on-site and off-site consequences of identified hazard scenarios. To give effective mitigation of hazards in terms of suggestions for effective disaster management, suggesting minimum preventive and protective measures & change of practices to ensure Occupational Health and Safety.

Tools and Software

The consequence analysis for the modeled scenarios has been done using DNV's software PHAST Version 6.7(Process Hazard Analysis Software Tool) which allows assessment of situations which present potential hazards to life, property and the environment, and to quantify their severity. PHAST examines the progress of a potential incident from the initial release to far-field dispersion including modeling of pool spreading and evaporation, and flammable and toxic effects.

PHAST Professionals sophisticated modeling calculates distances effect produced by hazardous events. With this information, you can evaluate the need for mitigating measures such as changes in design, operation or response. PHAST software can be used to model a proposed facility or operational change to ease the selection of the most effective solutions. With PHAST Professional, you can define special events, model the change in a leak over time, and investigate the details of behavior with special stand-alone models and much, much more.

PHAST is integrated into safety and meets regulatory requirements. It uses unified dispersion modeling to calculate the results of the release of material into atmosphere.

The salient features of this package:

It gives the consequence results in terms of – Flammable, Toxic and Explosion effects.

Flammable parameters covered under this package is-

- Defines the LEL and UEL zone
- Jet fire and pool fire scenario along with their respective effect zones (risk contour).
- Flash fire and fire ball envelope

Toxic parameters-

- Cloud concentration at user defined time as well as location
- Categorize the toxic results in terms of ERPG, IDLH and STEL values.
- Summarize results in terms of equivalent toxic dose along with effect zones.

Explosion parameters-

- Categorize the explosion effects in terms of overpressures levels along with distance covered.
- BLEVE (Boiling Liquid Expanding Vapor Explosion)

7.1 RISK & HAZARD STUDY

Elaborated Qualitative and Quantitative Risk assessment

The methodology –

The methodology includes,

- Hazard identification,
- Selection of potential loss scenarios,
- Simulation of release source model on DNV's PHAST, Version 6.7
- Plotting the damage contour on site map

These steps undertaken to carry out risk assessment for this project are described below in Chapter.7.1.1 Chemical Storage Facilities

Details of Storage facility of chemicals is shown in **Table 7.1**

Table 7.1: Storage facility of Product

#	Name of Chemical	Physical state	Number of storage tanks/ cylinders	Capacity of Storage Tank (KL*) each	Type of Storage Tank*	Above ground/ Underground	Storage Temperature (°C)	Operating Pressure (bar)
1.	Formaldehyde	Liquid	5	80	MS	Above Ground	30-35	Atmospheric

7.1.2 Physico-chemical Properties of Chemicals

Physico-Chemical properties of chemicals are shown in **Table 7.2**

Table 7.2: Physico-Chemical Properties of Chemicals

#	Raw Materials/ Products	State	Formula	CAS Number	Color	Odor	Mol. Wt (g/mole)	Boiling Point (°C)	Melting Point (°C)	Flash Point (°C)	LEL %	UEL %	Hazard	LD 50 mg/kg	LC 50 mg/m3	IDLH (ppm)	Stability
1.	Formaldehyde	Liquid	HCHO	50-00-0	Colourless	Pungent	30.03	98	-15	56	6	36.5	Non-Flammable & Toxic	Mouse=42	454000	20	Stable
2.	Methanol	Liquid	CH4O	67-56-1	Colorless	Pungent	32.04	11.11	-97.77	64.61	6000	Stable	Flammable	0.792	6	36.5	100

NA- Not Applicable

7.1.3 Scenarios for Simulation

Scenarios for Simulation of chemical is shown in **Table 7.3**

Table 7.3: Scenarios for Simulation of Chemical

#	Full name of the Raw Material	Hazard involved	No. and Size of storage tonner		Maximum Operating Pressure	Types of Failure Possible	Consequences Considered
			Nos.	Capacity (KL) each			
1.	Methanol	Flammable & Toxic	5	10	Atmospheric (1.0 kg/cm^2)	5 mm dia hole leak in tank	Late Pool Fire
						Catastrophic Rupture of storage tank	Fire ball/ Late Ignition
2.	Formaldehyde	Non Flammable &Non Toxic	5	80	Atmospheric (1.0 kg/cm^2)	5 mm dia hole leak in tank	Late Pool Fire
						Catastrophic Rupture of storage tank	Fire ball/ Late Ignition

7.2 QUALITATIVE RISK ASSESSMENT

Many a time's risk involved in various processes / process equipment's 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 equipment's 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 labors have been considered.

Qualitative Risk Assessment has been carried out for the following areas:

- Storage and Handling Toxic chemicals like of Methanol and Formaldehyde.

Risk involved in various processes/ process equipment 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 equipment 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 in **Table 7.4**, is referred in evaluating the assessment. Risk acceptability criteria given in **Table 7.5**.

Table 7.4: 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)**
		5	**4**	**3**	**2**	**1**
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 7.5: Risk 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.

7.2.1 Storage and Handling of Toxic chemical -Methanol and Formaldehyde

#	Process or Activity	Associated Hazards	Health & Safety Impact (Risk)	Initial Risk			Mitigation Measures	Residual Risk		
				Severity	Likelihood	Risk		Severity	Likelihood	Risk
1	Chemical handling / Loading & Unloading	Exposure to vapours (due to leakage from joints, corroded lines failure *etc.*).	Blistering of skin, Skin burn. Eye and skin irritation and respiratory disorder.	3	C	M	SOPs will be prepared and same will be followed. Containers will be stored in well-ventilated area and away from all possible sources of ignition. Eye wash station and Safety Shower will be installed in nearby location of storage facility. Employee will be provided with protective equipment like aprons (full suit), vapour respirator, gloves, boots and splash goggles. Handling trainings will be provided to the operators/ workers periodically. Spill control procedure will be made available at storage facility. Provision of an automatic leak detection system.	2	B	L
2	Working in Storage Area	Exposure to vapours due to spillage.	Severe burns, corneal damage, possible irreversible eye damage *etc*. Inflammation of the eye (redness, watering, and itching).	4	C	M	Use of provided PPE's will be ensured by Safety officer/ Plant In-charge. Eye wash station or Safety Shower will be installed in storage area. Display of Safety warning postures/signs inside the area, also will be stored in light-resistant	2	B	L

							containers. Keep away from oxidizing materials, heat, sparks, and flame.			
3	Tank overflow	Chemical Exposure	Irritation of upper respiratory tract with coughing, burns, breathing difficulty, and possible coma. Skin burns, wrinkled discoloration. Fatality	5	C	H	Level indicator will be installed and the same shall be checked for its proper operation. Periodic inspection will be carried for all the related accessories of level indicator. Water spray curtain will be provided at storage area to divert vapor drift. Will provide cool containing vessels with water jet in order to prevent pressure build-up, auto ignition or explosion.	2	B	L

7.3 QUANTITATIVE RISK ASSESSMENT

Quantitative Risk Assessment (QRA) is a structured approach to identifying and understanding the hazards and 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.

Consequence analysis

In a plant handling hazardous chemical, 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 vapor clouds. Blast overpressures depend upon the reactivity class of material between two explosive limits.

Damage criteria

In consequence analysis studies, in principle three types of exposure to hazardous effects are distinguished:

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

The chosen damage criteria are given and explained as per the Guidelines for QRA – PHAST Software, version 6.7 (DNV) & Purple Book for QRA released by Centre for Chemical Process Safety (CCPS).

Planning

Hazards that can lead to accidents in operations are discussed in this section. Important hazardous events are classified in **Table 7.6**

Table 7.6: Event Classification

Type of Event	Explanation
BLEVE	Boiling Liquid Evaporating Vapor Explosion; may happen due to catastrophic failure of refrigerated or pressurized gases or liquids stored above their boiling points, followed by early ignition of the same, typically leading to a fire ball
Deflagration	Is the same as detonation but with reaction occurring at less than sonic velocity and initiation of the reaction at lower energy levels
Detonation	A propagating chemical reaction of a substance in which the reaction front advances in the unreacted substance at or greater than sonic velocity in the unreacted material
Explosion	A release of large amount of energy that form a blast wave
Fire	Fire
Fireball	The burning of a flammable gas cloud on being immediately ignited at the edge before forming a flammable/explosive mixture.
Flash Fire	A flammable gas release gets ignited at the farthest edge resulting in flash-back fire
Jet Fire	A jet fire occurs when flammable gas releases from the pipeline (or hole) and the released gas ignites immediately. Damage distance depends on the operating pressure and the diameter of the hole or opening flow rate.
Pool Fire	Pool fire is a turbulent diffusion fire burning above a horizontal pool of vaporizing hydrocarbon fuel where the fuel has zero or low initial momentum
Spill Release	'Loss of containment'. Release of fluid or gas to the surroundings from unit's own equipment / tanks causing (potential) pollution and / or risk of explosion and / or fire
Structural Damage	Breakage or fatigue failures (mostly failures caused by weather but not necessarily) of structural support and direct structural failures
Vapour Cloud Explosion	Explosion resulting from vapour clouds formed from flashing liquids or non-flashing liquids and gases

Hazard and Damage Assessment

Toxic, flammable and explosive substances released from sources of storage as a result of failures or catastrophes, can cause losses in the surrounding area in the form of:

- Toxic gas dispersion, resulting in toxic levels in ambient air,
- Fires, fireballs, and flash back fires, resulting in a heat wave (radiation), or
- Explosions (Vapor Cloud Explosions) resulting in blast waves (overpressure).

Consequences of Fire/Heat Wave

The effect of thermal radiation on people is mainly a function of intensity of radiation and exposure time. The effect is expressed in term of the probability of death and different degree of burn. The consequence effects studied to assess the impact of the events on the receptors are:

Table 7.7: Damage due to Radiation Intensity

Radiation (kW/m^2)	Damage to Equipment	Damage to People
1.2	Solar heat at noon	-
1.6	-	Minimum level of pain threshold
2.0	PVC insulated cable damage	-
4.0	-	Causes pain if duration is longer than 20 sec. But blistering is unlikely.
6.4	-	Pain threshold reached after 8 sec. Second degree burns after 20 sec.
12.5	Minimum energy to ignite wood with a flame; melts plastic tubing.	1% lethality in one minute. First degree burns in 10 sec.
16.0	-	Severe burns after 5 sec.
25.0	Minimum energy to ignite wood at identifying long exposure without a flame.	100% lethality in 1 min. Significant injury in 10 sec.
37.5	Severe damage to plant	100% lethality in 1 min. 50% lethality in 20 sec. 1% lethality in 10 sec.

Consequences of Overpressure

The effects of the shock wave vary depending on the characteristics of the material, the quantity involved and the degree of confinement of the vapor cloud. The peak pressures in an explosion therefore vary between a slight over-pressure and a few hundred kilo Pascals (kPa). Whereas dwelling are demolished and windows and doors broken at overpressures as low as 0.03- 0.1 bar. Direct injury to people occurs at greater pressures. The pressure of the shock wave decreases rapidly with the increase in distance from the source of the explosion.

Table 7.8: Overpressure Damage

Overpressure (bar)	Damage
0.001 0.002 0.003	Annoying noise (137 dB if of low frequency 10-15 Hz) Loud noise (143 dB, sonic boom glass failure Occasional breaking of large glass windows already under strain
0.007	Breakage of small windows under strain
0.010 0.020	Typical pressure for glass breakage Projectile limit; some damage to house ceilings; 10% window glass broken
0.027	Limited minor structural damage
0.034 0.034 to 0.068	Large and small windows usually shattered; occasional damage to window frames

0.048 0.068 0.068 to 0.136	Minor damage to house structures Partial demolition of houses, made uninhabitable Corrugated asbestos shattered; corrugated steel or aluminium panels, fastenings fail, followed by buckling, wood panels (standard housing) fastenings fail, panels blown in
0.088 0.136 0.136 to 0.204	Steel frame of clad building slightly distorted Partial collapse of walls and roofs of houses Concrete of cinder brick walls, not reinforced, shattered
0.157	Lower limit of serious structural damage
0.170 0.204 0.204 to 0.272	50% destruction of brickwork of houses Heavy machines (3,000 lb) in industrial building suffered little damage; steel frame building distorted and pulled away from foundations. Frameless, self -framing steel panel building demolished; rupture of oil storage tanks
0.272 0.340	Cladding of light industrial buildings ruptured Wooden utility poles snapped; tall hydraulic press (40,000 lb) in building slightly damaged
0.340 to 0.476 0.476	Nearly complete destruction of houses Loaded train wagons overturned
0.476 to 0.544 0.612 0.680 20.414	Brick panels, 8-12 inches thick, not reinforced; heavy machine tools (7,000 lb) moved and badly Loaded trains boxcars completely demolished Probable total destruction of buildings; heavy machines tools (7,000 lb) moved and badly damaged, very heavy machines tools (12,000 lb) survived. Limit of crater lip

Source: *CCPS Consequence analysis of chemical release*

Consequences of Toxic Release

The effect of exposure to toxic substance depends upon the duration of exposure and the concentration of the toxic substance.

Short-term exposures to high concentration give Acute Effects while long term exposures to low concentrations result in Chronic Effects.

Only acute effects are considered under hazard analysis. Since they are likely credible scenarios. These effects are:

- Irritation (respiratory system skin, eyes)
- Narcosis (nervous system)
- Asphyxiation (oxygen deficiency)
- System damage (blood organs)

Following are some of the common terms used to express toxicity of materials.

- Threshold Limit Value (TLV): it is the permitted level of exposure for a given period on a weighted average basis (usually 8 h for 5 days in a week)
- Short Time Exposure Limit (STEL): It is the permitted short term exposure limit usually for a 15 minutes exposure.
- Immediately Dangerous to life and health (IDLH): It represents the maximum concentration of a chemical from which, in the event of respiratory failure, one could

escape within 30 minutes without a respirator and without experiencing any escape/impairing (eg. Severe irritation) or irreversible health effects.

- Lethal Concentration Low (LCLo): It is the lowest concentration of a material in air, other than LC50, which has been reported to cause a death in human or animals.
- Toxic Concentration Low (TCLo): It is the lowest concentration of a material in air, to which humans or animals have been exposed for any given period of time that has produced a toxic effects in humans or produced carcinogenic, neo-plastigenic or teratogenic effect in humans or animals.
- Emergency Response Planning Guidelines 1 (ERPG1): The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour (without a respirator) without experiencing other than mild transient adverse health effects or without perceiving a clearly defined objectionable odor.
- Emergency Response Planning Guidelines 2 (ERPG2): The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.
- Emergency Response Planning Guidelines 3 (ERPG3): The maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects.

Meteorology

Atmospheric stability plays an important role in the dispersion of the chemicals. “Stability means, its ability to suppress existing turbulence or to resist vertical motion”.

Atmospheric stability plays an important role in the dispersion of chemicals. “Stability means, its ability to suppress existing turbulence or to resist vertical motion”.

Variations in thermal and mechanical turbulence and in wind speed are greatest in the atmospheric layer in contact with the surface. The air temperature has influenced these turbulences greatly and air temperature decreases with the height. The rate at which the temperature of air decreases with height is called Environment Lapse Rate (ELR). It will vary from time to time and from place to place. The atmosphere is said to be stable, neutral or unstable according to ELR less than, equal to or greater than Dry Adiabatic Lapse Rate (DALR), which is a constant value of 0.98 ºC per 100 meters.

Pasquill Stability Classes

Pasquill has defined Six (6) stability classes.

A- Extremely unstable.
B- Moderately unstable
C- Slightly unstable.
D- Neutral
E- Slightly stable.
F - Moderately stable.

Three prime factors that defines Stability

Solar radiation
Night-time sky over
Surface wind

When the atmosphere is unstable and wind speeds are moderate or high or gusty, rapid dispersion of vapors will occur. Under these conditions, air concentrations will be moderate or low and the material will be dispersed rapidly. When the atmosphere is stable and wind speed is low, dispersion of material will be limited and air concentration will be high.

Weather Conditions

Following Weather conditions are selected for consequence analysis

Table 7.9: Weather Condition Selected

Time	Remarks	Weather Condition		
		Temperature in °C	Wind Speed m/s	Stability Class
Day Time	Prevalent during the day, most times of the year	28	3	D
Night Time	Prevalent during the night, most times of the year	22	4	C
Monsoon Period	Prevalent during the monsoon months	30	5	D

Consequences Analysis

The consequences of the release of Hazardous substances by failures or catastrophes and the damage to the surrounding area can be determined by means of models. Models help to calculate the physical effects resulting from the release of hazardous substances and to translate the physical effects in terms of injuries and damage to exposed population and environment. To assess the damage level caused by the various accidental events, it is essential to firm up the damage criteria with respect to different types of accidents e.g. thermal radiation, toxicity, explosion overpressure etc.

Consequence analysis involves the application of mathematical, analytical and computer models for calculation of effects and damages subsequent to a hydrocarbon release accident. Consequence models are used to predict the physical behavior of the hazardous incidents. The techniques used to model the consequences of hydrocarbon and other hazardous material releases cover the following:

- Modeling of discharge rates when holes develop in process equipment/pipe work/pipeline.
- Modeling of the size and shape of flammable and toxic gas clouds from releases in the atmosphere
- Modeling of the flame and radiation field of the releases that are ignited and burn as jet fire, pool fire, flash fire and BLEVE/ Fire ball
- Modeling of the explosion fields of releases, which are ignited away from the point of release

The information normally required for consequence analysis includes meteorological conditions, failure data of equipment and components, ignition sources, population characteristics within and outside the plant, acceptable levels of risk etc.

Assumption

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.

Meteorological Paste other tables

- Atmospheric Conditions: No Inversion
- Ambient Temperature: 25°C has been considered as MCA approach.

Pasquil Stability Classes

- Pasquil Stability category C & D is considered as conservative approach.

Other Assumptions:

- 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.

Input data for software (modeling)

For consequence analysis, input data considered are as below:

- Volume inventory (Quantity of material)
- Scenario
- Leak
- Catastrophic Rupture
- Leak size
- 5 mm hole
- Storage conditions
- Pressure
- Temperature
- Bund details
- Bund height
- Bund area
- Weather condition:
- Wind speed
- Pasquil stability
- Atmospheric temperature
- Relative humidity

MCAS Development Techniques

As a first step towards risk assessment is to identify the possible release scenarios based on available information about scenario development for Maximum Credible Accident Scenarios (MCAS).

Selection of Maximum Credible Loss Scenarios (MCLS')

Following points are considered while selecting the release scenarios:

- Flash point for flammable chemicals
- IDLH of Toxic chemicals

- Operating/ Storage Temperature and Pressure of the material
- Total inventory of the material

Simulation of Release and Development of Contours

As the MCLS' were developed for the selected set of chemicals, the next step is to carry out the consequence analysis. The consequence analysis results along with their contours are presented in the following sections. Contours are presented on plant layout.

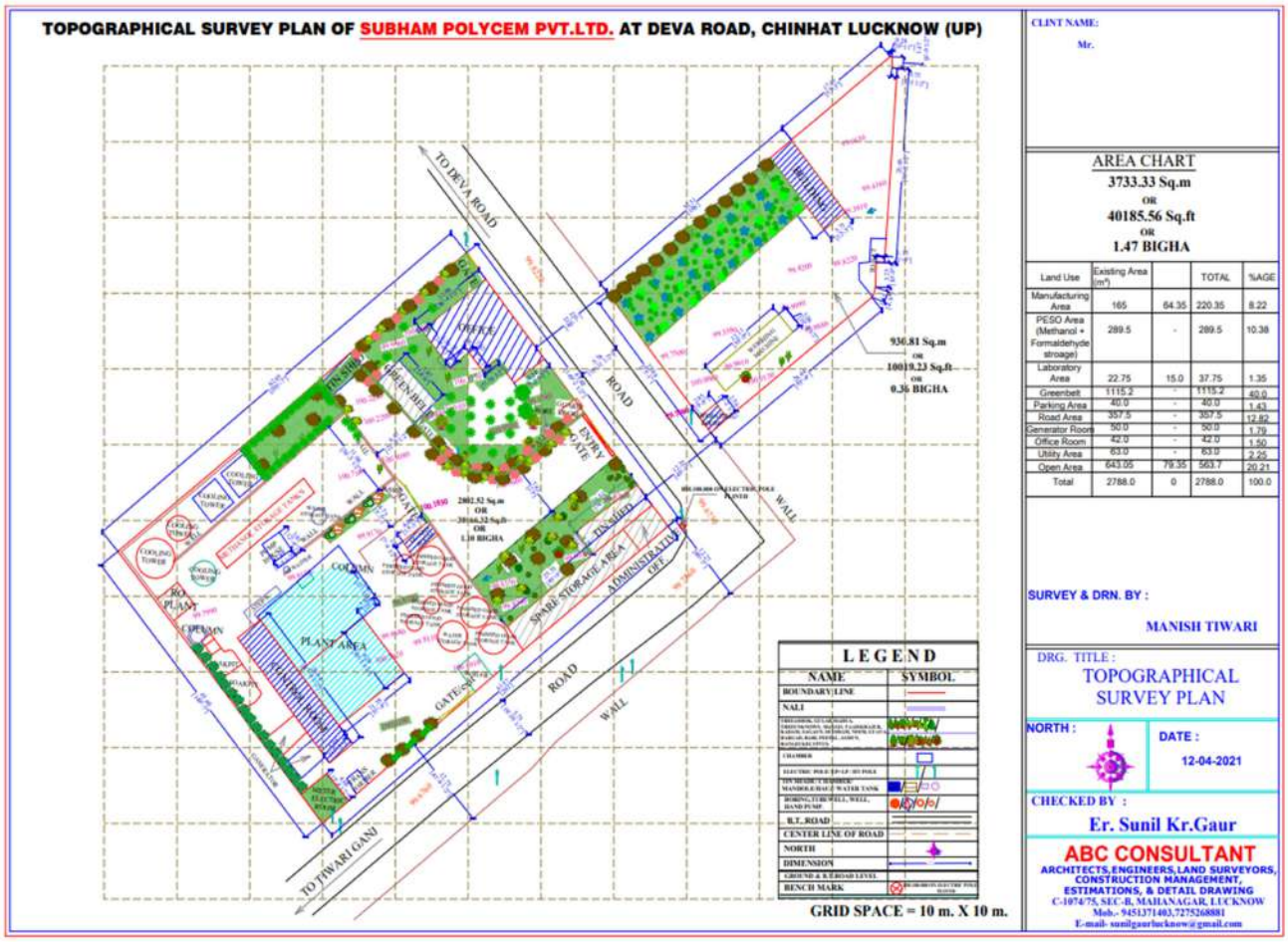

Figure 7.1: Plant Layout showing storage of Chemicals

7.3.1 Methanol

Radiation level effect distance, overpressure effect distance and toxic dose level effect distance due to the release of Methanol are presented below:

Table 7.10: Effect Distance due to Release of Methanol

Chemical (Storage Tank)	Failure Scenario	Consequence	Met Data	Effective Distance in meter to Radiation Level			Overpressure Distance in m		
				4 kW/m^2	12.5 kW/m^2	37.5 kW/m^2	0.02 bar	0.13 bar	0.2 bar
Methanol	5 mm Leak	Late Pool Fire	3.0/D	**30.15**	21.22	6.92	21	11	5
			4.0/C	20.12	12.45	5.22	31	21	11
			5.0/D	20.83	11.37	5.11	44	32	24
	Catastrophic Rupture	Late Pool Fire/Late Ignition	3.0/D	29.91	19.52	8.13	58	41	30
			4.0/C	**32.85**	18.92	8.2	**109**	74	46
			5.0/D	30.61	17.22	8.3	73	51	37
		Fire ball	3.0/D	38.15	21.13	NR	-	-	-
			4.0/C	34.10	19.92	NR	-	-	-
			5.0/D	**39.15**	22.15	NR	-	-	-

*# **NR-** Not Reached*

The contour for effect distance generated for the release of Methanol is presented below;

Figure 7.2:Late Pool Fire effect distance Contour due to 5 mm leak in storage tank at weather condition 3/D

Figure 7.3:Late Pool Fire effect distance Contour due to Catastrophic rupture of storage tank at weather condition 4/C.

Figure 7.4: Fire balldistance Contour due to catastrophic rupture of storage tank at weather condition 5/D.

7.3.2 Formaldehyde

Radiation level effect distance, overpressure effect distance and toxic dose level effect distance due to the release of Formaldehyde are presented below:

Table 7.11: Effect Distance due to Release of Formaldehyde

Chemical (Storage Tank)	Failure Scenario	Consequence	Met Data	Effective Distance in meter to Radiation Level			Effective Distance in meter to Toxic Level		
				4 kW/m^2	12.5 kW/m^2	37.5 kW/m^2	0.02 bar	0.13 bar	0.2 bar
Formaldehyde	5 mm Leak	Late Pool Fire	3.0/D	NR	NR	NR	-	-	-
			4.0/C	NR	NR	NR	-	-	-
			5.0/D	NR	NR	NR	-	-	-
	Catastrophic Rupture	Fire ball/ Late Ignition	3.0/D	**18.30**	NR	NR	NH	NH	NH
			4.0/C	12.95	NR	NR	NH	NH	NH
			5.0/D	13.20	NR	NR	NH	NH	NH

NR- *Not Reached*

The contour for effect distance generated for the release of Formaldehyde is presented below;

Figure 7.5.Fire ball effect distance Contour due to catastrophic rupture of storageTank at weather condition 3/D

7.3.3 Results of Consequence Analysis

Summary of effect distance (in meter) for worst case scenario of hazardous chemical considered for consequence analysis are given below:

Chemical/ Scenario	Effect Distance in Meters at specific Weather condition		
	At Radiation Level 4 kW/m^2	At Overpressure 0.02 bar	IDLH Concentration
Methanol	39.15 (5/D)	109 (4/C)	-
Formaldehyde	18.30 (3/D)	-	-

- The highest distance in worst case scenario of release of Methanol i.e. 39.15 m in 5/D weather condition while 18.30 m for Formaldehyde (3/D).
- Over all Methanol is the most hazardous chemical of the proposed project, but still its radiation effect is within premises as they are storing less quantity.

7.3.4 Specific mitigation measures for safety at storage area for Hazardous chemicals

❖ **Methanol**

Following mitigation measures shall be followed in case of Methanol Leakage:

- Evacuate the area in down wind direction up to 50 meter.
- SCBA and full protective gear will made available in the unit.
- Use water spray, dry chemical, chemical foam, or alcohol resistant foam in case fire.
- Prevent entry into sewers, basements or confined areas.
- Call for assistance on disposal.

Following Safety Measures will be made available to avoid Emergencies related to Methanol:

- Explosion proof ventilation equipment will be provided.
- Safety shower and eye wash station will be available at proximal distance.
- Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value.
- Full body protection suite, vapor respirator and other PPE's will be kept ready.
- Fire water sprinkler system will be provided around the periphery of storage tank.
- Safe Operating procedures and Emergency Response Procedures will be followed strictly.

❖ **FORMALDEHYDE**

Following mitigation measures shall be followed in case of Formaldehyde Leakage:

- Evacuate the area in down wind direction up to 30 meter.

- Use alcohol foam, water spray or fog in case of large fire.
- Use dry chemical powder for small fire.
- Keep away from peroxide, nitrogen dioxide and permformic acid to avoid explosion due to reaction.
- Prevent entry into sewers, basements or confined areas.
- Call for assistance on disposal.

Following Safety Measures will be made available to avoid Emergencies related to Formaldehyde:

- Handling area shall be well ventilated.
- Respiratory equipment will be kept ready at Methanol handling area.
- Safety shower and eye wash station will be available at proximal distance.
- Fire water sprinkler system will be provided around the periphery of storage tank.
- Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value.
- Full body protection suite, vapor respirator and other PPE's will be kept ready.
- Safe Operating procedures and Emergency Response Procedures will be followed strictly.
- Regular worksite inspection will be carried out

7.3.5 Mitigation Measures against Risk

Based on the risk assessment analysis following precautionary mitigation measures are recommended for the project.

- The installation of all the equipment is/will be as per guidelines of provision of Factories Act 1948.
- For any case of fire emergency, standard type of Firefighting equipment's and fire extinguisher is/will be provided in the storage area as well as required places in the plant.
- Smoking will be prohibited inside the factory.
- The adequate and suitable personnel protective equipment's is/will be provide to the operating workers.
- First Aid facility and First-aid trained person is/will be available at the time of handling operation.

7.4 SAFETY MEASURES FOR TRANSPORTATION, STORAGE AND HANDLING OF CHEMICALS

7.4.1 General Safety measures for transportation, storage and handling are listed below

- Display Boards shall be provided on all storage drum which include the name of the chemicals, material of construction, Calibration of tanks and date of Painting.
- The level indicators shall be placed on all storage drums to know the exact liquid level inside the drum and to avoid the accidental spillage or overflow.
- All equipment's related to hazardous chemical storage shall be maintained and calibrated regularly.
- Drum trolley will be used for the movement of drums of hazardous chemicals to avoid accident due to manual error.

- SOP for handling hazardous chemicals will be displayed in local language for safe operating procedure.
- Proper inventory of hazardous chemicals will be maintained and buffer stock will be kept as minimum as possible.
- Standard procedure for unloading will be in place and will be implemented for safe unloading of road tanker.
- Static Earthing provision will be made for tanker unloading.
- Water showering system (Automated sprinkling system) will be provided to the flammable liquid storage area, wherever required to avoid the vaporization due to increase in atmosphere temperature.
- On-site detectors for fire based on heat or smoke detection with alarm system will be provided as required.
- Adequate firefighting system will be provided as required along with the fire water tank having capacity 50000 KL.
- First aids boxes will also be provided at prominent places in the plant.
- Area will be declared as "NO SMOKE ZONE".

7.4.2 Specific Safety measures for storage and handling of other chemicals and gas cylinders are given below

i. Storage and Handling of other Chemicals

- It will be labeled properly and stored in a cool, well-ventilated and fire resistant area in a tightly closed container.
- Material Safety Data Sheet will be displayed in front of respective chemicals
- Proper training and knowledge will be provide to workers for physical and chemical characteristics of the each chemical they are using
- Proper PPEs will be provided to the workers
- Proper firefighting equipment's will be installed at storage yard and maintenance and calibration for that equipment will be carried out on regular basis.

ii. Storage and Handling of gas cylinders

- Store cylinders upright with valve outlet seals and valve protection caps in place.
- Store cylinders in accordance with ISO Standard 11625.
- Segregate full and empty cylinders.
- Visually inspect stored cylinders on a routine basis, or at least weekly, for any indication of leakage or problems
- Use regulators approved for the specific gas.
- Move cylinders using a suitable hand truck or cart.
- Secure cylinders when in storage, transit, or use.
- Use a cylinder cage or cradle to lift a cylinder

7.4.3 Process Safety Measures

Safety measures are the most important aspect of selection of process technology to ensure safety in production unit. For the safety in production area some important critical safety measures must be provided within the process technology/equipment itself.

The details of the general safety measures for process unit are as below;

- Process parameters control will be provided vide Standard Operating Procedures.
- All reaction vents will be connected to either vapor condensers system or gaseous scrubber system.
- Trained person will be engaged for handling of hazardous materials.

- Proper safety precautions will be taken during handling of hazardous materials.
- Further all the vessels will be examined periodically by a recognized competent person.
- All the vessels and equipment's will be well earthed appropriately and well protected against Static Electricity. Also for draining in drums proper Earthing facilities have been provided.
- Reaction column pressure and temperature data will be regularly monitored and assessment of properties of flammable chemicals will be evaluated to avoid fire/explosion scenarios.
- Temperature indicators will be provided near all reactors.
- Caution note, safety posters, stickers, periodic training and updating in safety and emergency preparedness plan will be displayed and conducted.
- Total reaction will be carried out in closed jacketed vessel having cooling water supply to control temperature in case of run-away reaction.
- Emergency reactor shutdown system will be implemented.

7.4.4 Safety Measures for Drum Storage and Handling

- Drums will be stored at designated location or secured in a safety storage cabinet.
- Approved methods of equipping a drum and dispensing liquids from it will be followed.
- Drums, carboys and related accessories will be inspected on regular basis for maintenance purpose.
- All the vessels and equipment's will be earthed properly and protected against static electricity. Also, proper Earthing facilities shall be provided for drums.
- Materials will be transferred by pumping through pipeline or by vacuum, from drums.
- Drums for flammable liquids will have proper closures that can withstand the expected handling conditions without leaking.

7.4.5 Safety Measures for Preventive Maintenance

The safety measures in form of the general Do's & Don'ts for safety in process & other plant area are as below:

- Make sure equipment is empty and fluxed with nitrogen and air.
- Use proper PPE will be ensured by safety officer.
- Check VOC content for flammable vapor and make sure that no flammable vapor contents.
- Keep proper and adequate fire extinguisher near work area.
- Check all motors are disconnected and fuse pulled out before maintenance.
- Work in any equipment must be conducted in presence of supervisor.
- Make sure all process lines are disconnected.
- Do not work on equipment's without permission from plant head and maintenance head.
- Do not allow any employment without pre medical checkup or without checking fitness.

Additional safety measures in form of the checklist covering Do's and Don'ts of preventive maintenance, strengthening of HSE, manufacturing utility staff for safety related measures is/will be updated timely and will be made available to all concern department and personnel.

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:

Ensuring that operators/workers etc. follows the SOPs, Safety procedures & standards, work permit system etc.

Inspection of Storage Area, Earthing & Bonding system.

Inspection of all Fire Fighting Facilities /Check Alarms operation.

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 any activity without proper permit.

Don't perform your own maintenance.

Don't compromise on Design and Engineering part.

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 tractable.

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 & equipment's for the job, use them safely.
Smoking is prohibited.
Use prescribed protective equipment; keep them in good working conditions.
Respect signs / warnings. Abide by rules laid down for your safety.

Don'ts:

No worker in a factory-
Shall willfully 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 willfully and without reasonable cause do anything likely to endanger himself or others; and Shall willfully 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 and do not adopt shortcuts.

The Petroleum and Explosive Safety Organization standards are followed for storage of solvents.

- Earthing is to be provided to the storage area for dealing with the static charges that might generate during the loading and unloading of the solvents.
- Provision of sand buckets, foam monitor, fire extinguishers & hydrant line near PESO area were made available.
- Appropriate drainage with the slope of 2% is provided to remove small and large spillage of the chemicals.
- Provision of spill kit is provided to deal with the minor spillage scenario.
- Permission of Joint Chief Controller (explosives), West circle is obtained
- Petroleum storage is constructed of non-combustible materials.
- The secondary containment is provided and is kept clean and free from any accumulation of inflammable liquids.
- The storage shed is ventilated near the ground level and also near the roof. The ventilators are covered with two layers of fine copper or non-corrodible metal wire gauge of mesh not less than 11 meshes per linear cm.
- No alteration is carried out without written permission of licensed authority.
- The safety distance of 7.5mtr is kept from the shed.
- All the empty receptacles are kept securely closed unless they have been thoroughly cleaned.
- The suitable extinguishers (DCP) are kept immediately outside the storage shed.
- Access of unauthorized person to petroleum receptacles is restricted.
- Daily inventory of petroleum is to be maintained.

7.5 FIRE FIGHTING SYSTEM / FIRE CONTROL PLAN

By looking to the hazardous nature of process and the chemicals that are handled and processed, the chances of outbreak of fire cannot be totally ignored. Hence to tackle such a

situation, company has developed proposed, well-resourced and adequate fire protection system. The management has proposed to keep the following extinguishers at site:

- Flame detectors, smoke / temperature actuated heat detectors with alarms, automatic sprinkler system, shall be installed at conspicuous locations as per the requirements.
- Company will have Fire Water Tank of adequate capacity to combat the emergency, if a rise, water shall also be made available, if required.
- Working staff will be trained to operate Foam, DCP and CO2 extinguishers.
- DG set will be available as a separate power backup for fire network.
- Company has done tie up with Fire Brigade and nearby companies, for handling emergency situations.
- Electric driven alarms and sirens will be placed at the conspicuous locations. Hand Bell shall be used in case of power failure.
- Proponent had provided separate entry and exists with adequate margin all around the periphery for unobstructed easy movement of the emergency vehicle / fire tenders without reversing back.

7.6 DISASTER MANAGEMENT PLAN (DMP)

In order to be in a state of readiness to face any accident or disaster caused by the project operation, a Disaster management plan is required to be prepared. The plan will cover possible disaster, On and Off-site emergency preparedness plans, establishment of emergency Control Centre (ECC), Location of emergency services and duties of officers / staff during emergency.

7.6.1 Basic Contents of DMP

Basically, DMP contains following aspects

- Description of Site
- Brief description of the Plant
- On – Site Emergency Plan
- Off- Site Emergency Plan

7.6.2 Definitions and Classification of Emergency

An Incident: Undesired event giving rise to death, ill health, injury, damage or other loss.

A Major Incident: Is a sudden, unexpected, unplanned event, resulting from uncontrolled developments during an industrial activity, which causes or has the potential to cause. Serious adverse effects immediate or delayed (death, injuries, poisoning or hospitalization) to a number of people inside the installation and / or to persons outside the establishment, or significant damage to crops, plants or animals or significant contamination of land, water, air or an emergency intervention outside the establishment (e.g. Evacuation of local population stopping of local traffic) or significant change in the process operating conditions, such as stoppage or suspension of normal work in the concerned plant for a significant period of above, or any combination of the above effects.

An Emergency: An emergency is an abnormal event, which could result in danger to personnel, property and environment. It could be due to fire, Explosion, Heavy spillage of hazardous liquid, toxic gas release etc.

A Major Emergency: Is one that may affect several departments within it and/or may cause serious injuries, loss of life, and extensive damage to property or serious disruption outside the works? It will require the use of outside resources to handle it effectively.

Note: Emergency due to operating conditions, uncontrolled reaction, small fire, small gas leak, spill, failure of power, water, air, steam, cooling media, scrubbing media etc. and which can be locally handled by plant personnel alone (without outside help) is not considered as major emergency.

Disaster: Is a catastrophic situation in which the day-to-day life patterns are, in many instances, suddenly disrupted and people are plunged into helplessness and suffering and as a result need protection, clothing, shelter, medical and social care other necessities of life, such as: Disasters resulting from natural phenomena like earthquakes, volcanic eruptions, storm surges, cyclones, tropical storms, floods, landslides, fierce fires and massive insect infestation. Also in this group, violent drought which will cause a creeping disaster leading to famine, disease and death must be included.

Second group includes disastrous events occasioned by man, or by man's impact on the environment, such as armed conflict, industrial accidents, factory fires, explosions and escape of toxic releases of chemical substances, river pollution, mining or other structural collapses, air, sea, rail and road transport accidents, aircraft crashed, collisions of vehicles carrying inflammable liquids, oil spills at sea and dam failures.

Hazard: Source or situation with a potential for harm in terms of injury or ill health, damage to property, damage to the workplace environment or a combination of these

Risk: Combination of the likelihood and consequence(s) of a specified hazardous event occurring.

Classification of Emergency:

LEVEL – 1

The incident or emergency which are confinable, controllable within the plant premises, which under normal circumstances does not affect area outside the said plant battery limit and controlling does not involve / require external help. This situation is called emergency stand by and affected unit / plant have to handle emergency

It may be due to

- Small pipe/valve rupture or similar leakages that do not affect outside premises.
- Release of toxic chemicals for short duration.
- Small fire in the plant.

LEVEL – 2

When the incident or emergency is not controlled within 10 to 15 minutes or does not come under control within 10 to 15 minutes, incident controller, site main controller reviews the situation and decides if situation is Worsening.

It may arise due to -

- Leakage of toxic chemicals for long duration.
- Medium scale explosion confined to the factory premises.
- Medium scale fire inside the factory premises.

LEVEL – 3

After surveying off-site implications of level – 2 emergencies if there is a likely hood of chemical/material gas cloud formation and spreading of cloud in down wind direction affecting neighboring population of industry and villagers and / or in case of following incident IC and SMC are of the opinion that there will be off-site implications.

It may arise due to -

- Heavy / Profuse leakage of toxic / Flammable gases for a long duration.
- Explosion of high magnitude affecting the adjacent area.
- Major fire inside the factory premises.

Note: Level-I and Level- II shall normally be grouped as onsite emergency and Level- III as off- site emergency.

Mode of Emergency:

Man Made	Natural Calamities	Extraneous
• Heavy Toxic Leakage/ Spillage • Fire • Explosion • Failure of Critical Control system • Design deficiency • Unsafe acts • In-adequate maintenance	• Flood • Earthquake • Cyclone • Outbreak of Disease • Tsunami	• Riots/Civil Disorder/Mob Attack • Terrorism • Sabotage • Bomb Threat • War/Hit by missiles • Food Poisoning/Water Poisoning

On-Site Emergency:

The On-site emergency plan: deals with, measures to prevent and control emergencies within the factory and not affecting outside public or Environment.

Table 7.12: List of Important Contact Numbers

#	Code of Practice	Objective	Line of Action
1.	• In Case of Fire at Factory/Hazardous chemicals storage area/ Diesel or storage area.	• To deal with Fire efficiently and quickly at different locations in the factory including diesel storage tank and electrical Panel	Any person notices any sign of fire shall start shouting **FIRE, FIRE** (Aag, Aag) to seek assistance and also immediately take steps to give warning by blowing the siren continuously and take steps to extinguish the fire by using fire extinguishers available near the site of fire After giving information reach the spot, remove Man & Machinery and take steps to tackle the fire in accordance with the firefighting instructions. Inform at security office to get Ambulance if required.
2.	• In case of Heavy • Spillage,	• To deal with the incidence of Methanol or	Any person who notices any leakage or spillage of Methanol or Formaldehyde from storage tank,

	Leakage of Methanol and Formaldehyde.	Formaldehyde spillage or leakage efficiently and quickly	pipe line or from any equipment should try to warn the nearby persons and report to the shift supervisor without any delay. The Person should not go near the spill unless he is wearing a proper PPE and has been fully trained to handle the chemicals leaks.

Off-Site Emergency:

The Off-site emergency plan: deals with, measures to prevent and control emergencies affecting public and the environment outside the premises

7.6.3 Objectives of Emergency Management System

- In the effects of the accident or disaster inside the plant is felt outside its premises, it calls for an off-site emergency plan, which would prepared and documented in advance in consultation with the district authorities.
- The off-site emergency plan prepared herein will deal with those incidents identified under Level – 3 in the on-site plan, which have the potential to harm persons or the environment outside the boundary of the factory premises.
- The most significant risk to outside areas is that associated with a large release of Methanol or Formaldehyde. Spread of its effected outside the works may require traffic control, evacuation, shelter arrangement.
- Off-site emergency plan has been drawn up with a view to mobilize resources and integrate with district contingency plan for an effective system of command and control in combating the emergency.
- Thus in brief the two main purpose of the off-site emergency plan are:
- To provide the local / district authorities, police, fire brigade, doctors, surrounding industries and the public, the basic information of risk and environment impact assessment and to appraise them of the consequences and the protection prevention measures and control plans and to seek their help to communicate with the public in case of major emergency
- To assist the district authorities for preparing the off-site emergency plan for the district or particulate area and to organize rehearsal from time to time and initial corrective action based on the lesson learnt.

7.6.4 Structure of the Off-site Emergency Plan

- This off-site emergency plan will be integrated properly with the district contingency plan to tackle any kind of emergency. The site main controller will keep liaison for this purpose with the district authorities.
- External telephone facilities from company to Local Fire Station, Mutual Aid Members, and DPMC Lucknow will be established for quick communication.

- The names of the key persons will be defined to establish contacts and Co-ordinate the activities with the help of the collectorate and disaster management center in case of major emergency.
- An on-site emergency control room has been identified by company, which can be activated / used for emergency control and manned round the clock.
- As far as off-site emergencies are concerned, information shall be received first by the police control room, Lucknow on telephone next information to local fire brigade on telephone and to DPMC – Lucknow. The police / fire brigade control room shall in turn inform DSP, collector.
- The safety department and individual plant has already the list of quantities of resources like breathing air sets, rescue masks, fire extinguishers, water resources etc. available with various industries in the vicinity which can be spread under Mutual Aid System to tackle such emergencies after receiving call from them.
- The District Superintendent of Police, US Nagar District will be in overall charge of security, evacuation and rescue operations at the time of emergency.

7.6.5 Arrangement made for Off- site Emergency

Considering distance from district Head Quarters, other nearby external emergency control organization. Following arrangements will be arranged in consultation with DY. DISH, District Collector, SDM, etc.

Disclosure of information to neighboring organization and population:

- Company will prepare booklet and circulate among neighboring organization and population containing hazardous operation and chemicals.
- First aid, emergency treatment, probable types of emergencies that can arise.
- Preventive steps will be taken to control emergency.
- Emergency warning siren code system, to make them aware in advance. Company will carry out group get together, acquaintance round, meeting with neighboring public, population to train, brief the and make them aware about our operation and preparedness.
- The same groups along with external emergency control organization were invited during mock drill, rehearsals for training and acquaintance

7.6.6 Local Crisis Group

- As per central government notification and DISH office for preparation of offsite emergency plan and Company will become member of local level crises group, will set up disaster management center of industrial area using existing available facility of industries in the area with facility and emergency contact phone numbers.
- During emergency with in local group reach in and around industrial area any one can contact DMC – control room situated in both the factories and manned round the clock will initiate actions and arrange to organize resource mobilization and communication.

7.6.7 Local Crisis Group Members

Chairman : Dy. Collector
Member Secretary: Asst. Directorate – Industrial Safety & Health, Lucknow
Member : Factory manager of all industries of nearby area in Lucknow
Member : Transport contractors
Member : Safety Manager
Member : Police Inspector
Member : TDO
Member : Civil defense inspector,
Member : Medical officer, PHC,
Member : Press reporter
Member : Community leader, Pradhan, nearby village
Member : NGO, Lions club, nearby village
Member : Local social worker, nearby village
Member : Local social worker nearby village

- Local crisis group will prepare local emergency response plan and will submit to Directorate – Industrial Safety & Health, Lucknow.
- Rehearsal of local off-site emergency response plan will be carried out involving industries nearby as per mutual aid arrangements.
- Local crisis group will have to start emergency control action before arrival of and activation of district off site emergency plan and involvement of district crisis group.
- Any escalation need of further help will activate full district level off site control room.
- All type of emergencies like village fire, chemical accident, natural calamities and industrial accidents will be covered in the scope of local crisis group action plan.

7.6.8 District level Crisis Group

- Under chairmanship of collector district level crisis group will be formulated to aim at:
- Update off-site emergency plan regularly
- To organize, initiate action for mock drill
- To run central control room
- To coordinate for training need of all member government officials
- To maintain communication link among members through central control room.
- To monitor preparation of industrial organization and adequacy of on-site emergency plan.
- Dy. Director – Industrial Safety & Health hold responsibility of member secretary for district level crisis group.

7.6.9 Communication and Warning by Disaster Management Center

When a disaster occurs, the industry affected by the disaster will immediately inform the disaster management center with all available information, the DPMC will act as per the contingency plan and DPMC will also communicate immediately to district Collector. The integration of on – site plan with district contingency plan and various functions to be carried out are mentioned in chart OFF – SITE emergency plan as follow:

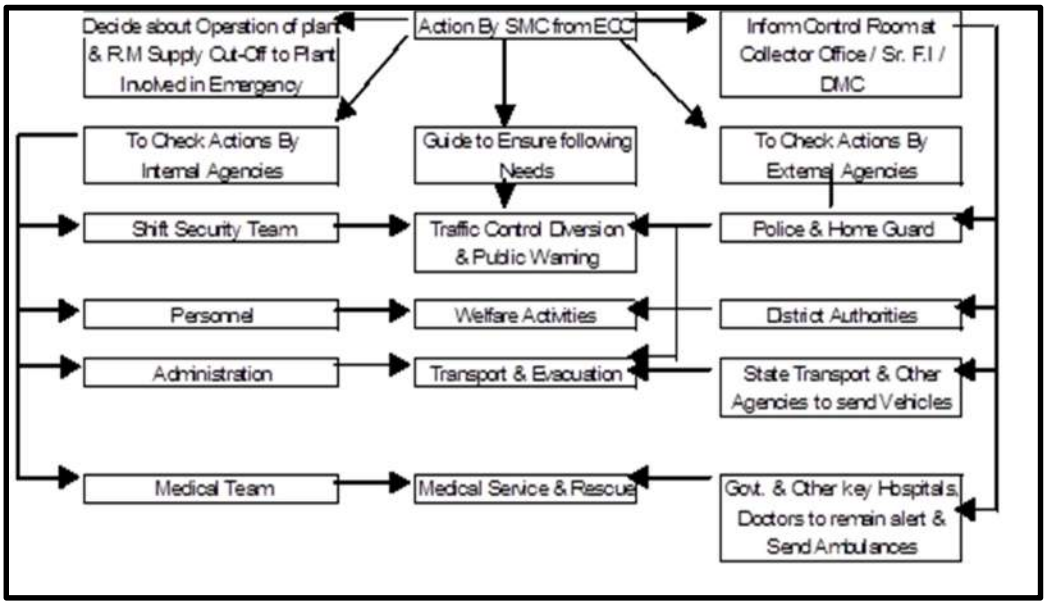

Figure 7.8: Off-Site Emergency Plan

7.6.10 District Level Crisis Group

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

- To identify and assess types of emergencies due to different types of hazards.
- Emission of chemical vapors into the shop floor ambience and any injurious effects of physical contact with corrosive chemicals, inhalation of fumes, vapors and solvents. The consequences will be off minor type and major emergency in this case is not perceived.
- Fire preceded or followed by explosion. Explosion could be in tanks, barrels, drums and cylinders due to pressure build up. A safety arrangement will be made in pressure vessels.
- To work out plan with all provisions to handle emergencies and safeguard employees and people in the vicinity of the factory.
- To provide for emergency preparedness and the periodical rehearsal of the plan.
- To plan mode of proper communication and actions to be followed in the event of emergency.
- To keep all necessary information with respect to hazard/accident control and emergency contacts in one document for easy and speedy reference.
- To inform employees, general public and the authorities about the hazards/risk if any and the role to be played by them in the event of emergency.

- To control and contain the accident.
- To effect rescue and treatment of casualties.
- To inform and help relatives of casualties.
- To secure rehabilitation of affected area and restore normalcy.
- To provide information to media and government agencies.
- To preserve record, equipment etc. for investigating cause of emergency.
- To be ready for "mutual aid" if need arises to help neighboring units.

7.6.11Structure of Emergency Management System

Subham Polychem Pvt. Ltd. shall develop an Emergency Management Team. The management structure shall include the following personnel's;

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

The other elements of Emergency Plan shall be:

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

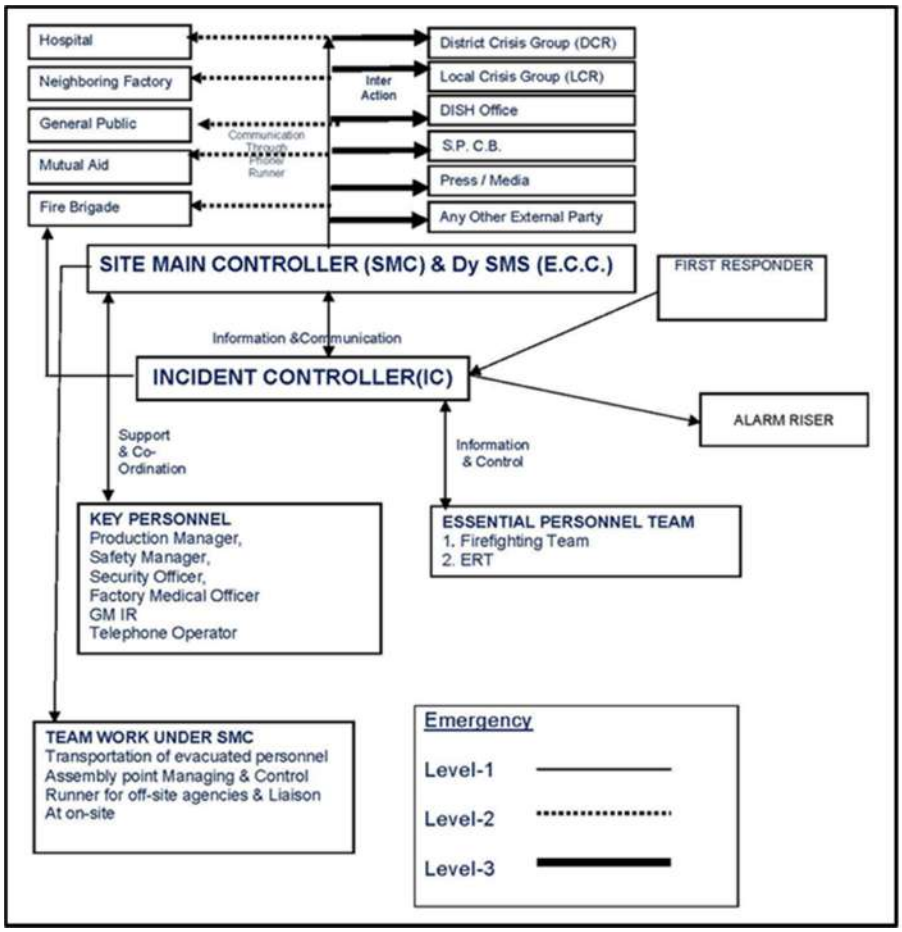

Figure7.9: Emergency Organization Chart

7.6.12 Role & Responsibility of Emergency Management Team

Site Main Controller (SMC):

Senior most Executives (i.e. Director and Supervisor) of the company shall be nominated as SMC. His task will be to co-ordinate all internal and external activities from the Emergency Control Centre (ECC) at Main Security Gate, from where all operations will be directed. He shall:

- Immediately on being informed of the emergency and its location, will arrive at the site, review the situation and control further actions.
- Direct all Emergency Operations within the approved area with the following priorities:
- Personnel Safety,
- Plant, Property and Environment Safety and
- Minimum loss of production.
- Co-ordinate to avail services from external agencies like fire brigade, hospitals etc, if called for, following the declaration of major emergency. If necessary, major installations in the vicinity may also be informed of the situation.
- Exercise direct operational control of the unaffected section of the plant.

- In consultation with the advisory team, expedite the shutting down of loading / unloading operations of tankers and if necessary, instruct the supervisor / security personnel to evacuate tankers.
- Ensure that all employees are evacuated from the affected area and the casualties, if any, are given necessary medical attention. Instruct P & A Assistant / Security for rushing casualties to hospitals if required.
- Liaise with fire and police officials, pollution control board officials and other statutory bodies and advise them of all possible consequence effects outside the premises.
- Arrange for relief of personnel when emergency is prolonged.
- Issue authorized statement or press release to the news – media.
- Ensure preservation of evidence for enquiries to be conducted by statutory authorities.
- Authorize the sounding of "All Clear" and "Evacuation Siren".
- Arrange for obtaining the head – count of all personnel within the premises and cross-checking with the data from records available for no. of persons within the premises.
- Nominate a person from advisory team, to maintain chronological log of event during the entire period of emergency.

A. Role of Incident Controller (IC) and Deputy Incident Controller (DIC):

Respective Shift In-charge of the Plant (Site) & Department holds the responsibility of the Incident Controller, if the incident is in their plant/area. Two Production officers in each shift will be identified as Deputy Incident Controllers.

His primary duties shall be 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 will take the charge of incident controller, if he is not available due to any reason. They will be always available in each shift and can take charge of the incident.

Responsibilities/Duties of Incident Controller and Deputy Incident Controller:

- He shall take charge at the scene of incident.
- He shall immediately assess the gravity of risk and alert panel and field operators to start controlling their respective section.
- if the emergency is minor, try to prevent by using internal resources like fire extinguishers in case of fire, and cover the spillage by sand in case of liquid spillage.
- He will work under the direction of the SMC, but till his arrival he may have to execute following responsibilities.
- He will ensure that all the Key Personnel are called.
- Direct for evacuation of plant and areas likely to be affected by the emergency.
- He shall communicate to the SMC the type of outside help needed.
- He shall direct all emergency operations within the affected area with the following priorities.
- Personnel safety, including of surrounding community.
- Minimum damage to Plant, Property and Environment.
- Appropriate actions to minimize loss of Production and Material.

- Give information to the head of firefighting and rescue team and other emergency services.
- Depending on the incident, instruct partial or total shut down, isolations, depressurization, Nitrogen purging, firefighting and rescue operations.
- Instruct upstream/downstream units to take emergency shutdown /cutting off supply and other appropriate actions and emergency evacuation help etc.
- Direct for search of casualties.
- Evacuate non-essential workers/visitors/contractors to safe assembly points.
- Brief site main controller and keep him informed about the developments.
- Preserve evidences. This will be necessary for investigation for cause and concluding preventive measures.

Key Personnel:

Senior officers of various departments like Fire, Security, Safety, Administration, Engineering, Project, Production, Transport, Pollution control, Technical Services and Stores shall be nominated as Key Personnel in their respective fields. As necessary, they shall decides the actions needed to shutdown plants, evacuate personnel, carryout emergency engineering work, arrange for supplies of equipment's, 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 shall be available at any time on duty or on call or on holidays.

The responsibilities and duties of key personnel are as follows.

Production Manager:

- To keep in touch with IC & SMC in assessing/ controlling the emergency.
- To guide essential personnel team.
- To guide personnel for safe close down of the plant.
- To guide transport for safe shifting of materials from one place to other.
- To guide mutual aids services and the teams.
- To keep informed the SMC about developments.
- To make arrangement like emergency light, water etc.
- To assess the emergency & evacuate the neighboring factory workers and neighboring population through SMC.
- To inform the effect of emergency and steps to be taken to avoid the effects of a radiation etc.

Safety Manager:

- To assist incident controller in controlling emergency
- To help site main controller in communication.
- To provide necessary equipment like FFE (Firefighting Equipment's), PPE & RPE.
- To guide transport for safe shifting of materials from one place to other.
- To guide mutual aids services and the teams.
- To keep informed the site main controller about developments.
- To make arrangement like emergency light, water etc.

- To assess the emergency and evacuate the neighboring factory workers and neighboring population through SMC.
- To inform the effect of emergency and steps to be taken to avoid the effects of a Fire etc.

Security Officer:

- To help incident controller & site main controller at the time of emergency.
- To cordon the area and inform incident controller or site main controller about the development of emergency.
- To fight the fire with available internal FFE.
- To make arrangement for evacuating workers from the place of accident and guide non- essential workers towards company assembly point.
- To carry out head counting at assembly point &search of missing persons.
- To ensure that the roadway to plant is clear for emergency vehicles. Obtain assistance to keep roadway clear and to stop non-emergency traffic from entering.
- To direct their personnel (Response force & Task force) for evacuation of non-essential workers & Crowd control.
- To liaise with mutual aid services for their help and guide to them.
- To blow emergency siren & all clear siren on receiving message from IC/SMC through telephone office.

Factory Medical Officer:

- To take charge of Occupational Health Centre.
- To provide treatment/ first aid to the affected persons and if necessary, send them to hospitals for further treatment.
- To keep liaison with hospitals and inform them about the type of emergency help required as per discussion with Site main control.
- Arrangement for adequate stock of antidotes, lifesaving drugs and special medicines.
- To keep the record of persons given first aid/ treatment and send them to hospitals with their name.
- To keep ready the list of blood groupings.
- To inform site main controller about the developing situation.
- To guide/instruct first aider, first aid and rescue team in case of any emergency.
- To keep ready the list of first aider.
- To identify of all the hospitals for facilities to render medical aid to victims of exposure to dangerous chemical substances, burns and other specific injuries. (State authorities, local authorities, ESICS, Private, Railways/Voluntary institutions, trusts etc.) and report to SMC
- To keep provisions of buffer stock of essential medicines like intravenous fluids, dressing materials, splints, oxygen cylinders, suction apparatus etc. Keeping in view the large number of third degree burns, heat radiation.

General Manager-IR:

- To assist site main controller and incident controller in controlling emergency.
- To guide mutual aids services and the teams.
- To keep informed the site main controller about developments.
- To make arrangement like emergency light, water, etc.

- To arrange external help like Medical, Fire, etc.
- To assess the emergency and evacuate the neighboring factory workers and neighboring population through SMC.
- To inform the effect of emergency and steps to be taken to avoid the effects of a Fire etc.
- To deal with external communication like media and external agencies

Adjacent Plant In-charge:

- To assist site main controller and incident controller in controlling emergency
- To help site main controller in communication.
- To guide mutual aids services and the teams.
- To keep informed the site main controller about developments.

Telephone Operator:

- He will guide all visitors of admin building to move at assembly point.

Essential Workers (EW):

Essential Workers shall be those who shall be trained in Fire Fighting and First Aid. One Supervisor and two helpers from each shift will be identified as EW's & shall supposed to report at EMERGENCY SITE to take instructions from IC or Dy IC. IC/ Dy IC work instructions will include:

- To rush at the site for help with fully equipped i.e. firefighting equipment, SCBA sets, etc.
- To decide line of action in consultation with incident controller and Key personnel and take appropriate measures to extinguish the fire and to control spillage.
- Firefighting and spill control till a Fire Brigade takes the charge.
- To help the Fire Brigade and mutual aid teams, if it is 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, equipment, materials, etc.
- Movement of equipment, special vehicle and transport to or from the scene of the accident.
- Search, evacuation, rescue and welfare.
- The injured will be given First Aid.
- To help and assist Factory Medical officer.
- Moving tankers or other vehicles from area of risk.
- Carrying out atmospheric test and pollution control.
- Manning of assembly points to record the arrival of evacuated personnel. Manning for outside shelters and welfare of evacuated persons there.
- Assistance at causalities reception areas to record details of causalities.
- Assistance at communication centers to handle outgoing and incoming calls and to act as messengers if necessary.
- Manning of works entrances in liaison with the police to direct emergency vehicles entering the work, to control traffic leaving the works and to turn away or make

alternative safe arrangements for visitors, contractors and other traffic arriving at the works.

- Informing surrounding factories and the public as well as directed by the Site Main Controller.
- Any special help required.

B. Other Elements of DMP:

Assembly Point:

In affected and vulnerable plants, all nonessential workers (who are not assigned any emergency duty) will be evacuated from the area and they shall report to specified assembly points. Assembly Points shall be located at a safe place, well away from area of risk and least affected by the down wind direction.

To ensure that workers will not have to approach the affected area to reach the assembly points, proper location and numbers will be marked at assembly points. Each assembly point shall be manned by a nominated person to record the names and dept. At each assembly point, duties of assembly point In-charge will also be 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., shall be issued and made available with workers.

Emergency Control Center (ECC):

The Emergency Control Center is the place or room from where the operations to handle the emergency are directed and coordinated. Safe and easily approachable room has been earmarked/identified as the Emergency Control Room.

Telephone and other facilities required with necessary documents shall be displayed in ECC for ready reference. Designated trained personnel will operate ECC. In case of Major Emergency, the Site Main Controller will operate from ECC.

The ECC center will be equipped with the following facilities.

- Internal and external telephone including STD facility
- Telephone directory/ Telephone nos. of mutual aid centers
- First Aid
- Muster roll of workers
- Identity card register
- Layout plan of the factory showing the location of hazardous materials, assembly point, first aid centers etc.
- Map of surrounding area with fire extinguishers location
- M.S.D.S
- Copy of ON SITE OFF SITE PLAN
- Stationeries like- note book, pen, pencils etc.
- S.B. Apparatus
- List of Government Agencies /Local press agencies with phone no.
- Sand Buckets & Hydrant Network
- Adequate numbers of PPE's

Fire Control Arrangements (Fire Fighting, Gas Leak Control and Rescue Operation):

Fire is classified in following three classes. The appropriate fire extinguishers are used to extinguish the different class of fire.

1. **Class A:** General Fire - Cotton Waste, Paper, Rubbish and Scrap: water, ABC powder type
2. **Class B:** liquid Fire - All solvents, Resin, Paints, LDO, HSD: Mechanical foam, ABC type
3. **Class C:** Gaseous /Electrical fire - Gaseous fire & panels etc.: CO_2, DCP/ABC

Sufficient number of fire hydrant valves and riser valves will be arranged to fulfill fire extinguishing need of the plant. Apart from this, fire extinguishers will be kept at various locations inside plant and those will be hydrostatically tested and refilled at intervals as specified by statutory body.

- Water spray- 30 Nos.
- Foam type – 20 Nos.
- Dry chemical powder type - 25 Nos.
- CO_2 type - 10 Nos.

Fire drill will be carried out by all the security guards apart from safety persons to keep them ready fortnightly. Sufficient amount of firefighting water will always be stored in storage tank for firefighting works. In case of power failure, diesel driven fire engine pump has arranged to generate the power for emergency lighting and to run water pump.

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

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

Role of EHS Representative:

1. On being notified about the location of fire/ gas leakage, he shall 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. Shall assess the severity of the incident & shall immediately report to emergency controller about the gravity of the situation.
4. He shall also assess the extra requirement required if any, from the neighboring industry.

Fire Crew Members:

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

Emergency Squad Members:

1. On hearing Emergency Siren, they shall 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 will help for safe evacuation.

Medical Services:

The roles of Medical officers are as follows;

1. He will report immediately to the SMC/IC.
2. He will render necessary treatment, at Occupational Health Center.
3. He will arrange for Hospitalization and Treatment at outside hospitals, if required.
4. He will mobilize in getting the services of External medical agencies, other Para – medical services etc. and transportation services etc.
5. He will arrange for extra medical assistance/antidotes, from out, if required.
6. He will arrange for first-aid trained volunteers for necessary help.
7. He will liaise with the Government Health Authorities for treatment of the affected persons nearby.

Role of Security In-Charge (Security Officer):

1. 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.
2. He will depute the security guards for managing gates and traffic control at the incident site & send remaining guards to the site of incident.
3. He will prevent unauthorized entry in to the site
4. He will render assistance as demanded by the safety in-charge.
5. He will mobilize additional security force for help, if required.
6. He will direct ambulance(s) and emergency vehicle(s) to the scene of incident.
7. He will help evacuate persons within the scene of incident.
8. 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:

1. Company will have Mutual Aid with various nearby factories.
2. On receiving the call, they shall proceed immediately with fire squad & fire tenders.
3. They will be guided to the place of the incident by the main gate security guard.
4. 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 center), heavy vehicles, lift/cranes, generator sets to supply emergency power, environment monitoring equipment, special instruments/equipment's, rescue items etc. shall be made available (if required) from nearby Industries /locations, when available resources do not meet the requirements.

Standard Operating Procedure (Shall Be Followed During Emergency)

1. As soon as emergency alarm is heard, all essential workers shall report to IC or SMC.

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

Security System:

1. A premise is covered by fully fencing and Main gate is secured by guard for 24 hours.
2. All transport vehicles are checked at the gate for driver licenses, MSDS, Emergency Information Panel and for any unwanted / undesired threat material etc.
3. Security staff takes round throughout the factory for security of plant & others.
4. CCTV camera installed at all critical locations.

Communication 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…

1. All persons working inside the plant.
2. Key Personnel outside during normal working hours & during off-duty hours.
3. Outside emergency services, Statutory and Local Authorities &
4. Neighboring facilities and public leaving in vicinity.

Each and every section, Plant & Department of the Factory will be connected by internal telephones with SMC, Supervisor or IC's. External Phone at Office and Residence and Mobile shall also be made available with Key Personnel and top executive of the factory. The Communication System shall begin with raising the alarm declaring the emergency, Telephone messages and Procedure to communicate the emergency to other persons & General Public. Emergency contact numbers to be used during an emergency is mentioned below:

Table 7.13: List of Important Contact Numbers

#	Emp Name	Designation	Contact No
1.	Munna Lal Baghel	Manager	7607716600
2.	Hansraj	Supervisor	8923045896
3.	Siyaram	Electrician	9956038814
4.	Ajab Singh	Operator	9651576231
5.	Kuldeep	Operator	7897138631

#	**Important Contacts**	
1.	Fire Station	Gomtinagar
2.	Hospital Name	Samarpan Hospital (Goyla)
3.	Police Station	Untron Chauki
4.	Emergency Contact No.	7607716600

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 inform the security persons to raise the emergency siren located at the factory gate. The security personnel sound the siren.

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

Telephone Message:

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

Emergency Time Activities:

The probable emergency situation that can arise in the unit and the corresponding control actions as described below shall be followed:

Toxic Releases:

Following Control Actions will be taken –

1. Anyone who notices the release shall sound emergency alarm.
2. SMC/IC who is at site, shall immediately rush to the scene and assess the situation. For toxic release from a reactor, he activates the on-site plan as -
    - He evacuates all the persons to safe assembly point.
    - He calls in DIC (if DIC is not present there) and asks essential workers to wear self-breathing apparatus and if the reaction is exothermic, start cooling water flow in the reactor jacket and cool the reactor as soon as possible.
    - The essential workers stop all the charging pumps of that reactor and the nearby reactors.
    - He informs mutual aid teams and asks for necessary help.
    - He arranges first-aid / hospitalization for the affected persons.

- Mutual aid teams shall be asked for help in the form of first-aid, transport etc.
- When the leak stops and the air shall clear of toxic release, IC tells essential workers to sound all clear.
- The incident shall be recorded
- SMC arranges to inform families / relatives of injured / dead.
- SMC issues authorized statement to press / media.
- SMC informs Factories Inspector about the incident and related information

Chemical Spill:

Most of the drums/bags shall be located in storage yards. Neutralizing material shall be kept available. For dilution, water connection will be provided on all sides of storage area. Sand buckets shall be available for covering spillage of flammable / corrosive materials.

❖ **SAFETY AWARENESS AMONG THE WORKERS:**

Details of training and periodic retraining programs for the personnel of safety and fire department:

Security guards who act as firemen during fire emergency are trained, retrained and refreshed on regular basis. Safety professional is sent for external training and some training program also conducted at works site by external experts of the field.

Details of Training and retraining programs for the workers:

Training programs on safety aspects with special attention to firefighting are regular feature of company. Plant organizes 3-4 sessions every month on safety aspects and cover good number of workmen in these programs.

All these training programs would at least include the following:

- Lectures
- Seminars and workshop
- Practical Exercises
- Distribution and practice safety instructions
- Safety quiz contests/competitions for individual as also for groups
- Display of safety posters and safety slogans at convenient and conspicuous places.
- Explanation of instructions (in the language easily understood by workers) about the possible hazards involved in handling of chemicals ad methods to deal with such hazards failing which possible emergency situation are likely to arise.
- Developing safety instructions for every job and ensuring practice to these instructions/ booklets or manuals by workers.
- Educating workers about the
- Physical and health hazards arising out from the exposure of handling substance
- Measures taken to ensure safety and control physical and health hazards.
- Measures to be taken by workers to ensure safe handling, loading and unloading.
- Storage and transportation of hazardous substances
- Meaning of various labels and marking used on containers of hazardous substances and to whom to report
- Measures to be taken in case of any spillage or leakage.

7.7 OCCUPATIONAL HEALTH AND SAFETY PROGRAM

Subham Polychem Pvt. Ltd. has prepared the Occupational Health Surveillance Program which shall be followed right from the project construction and erection phase and the same shall be updated for the upcoming new facility, if required. The details of the same are described in the following sections.

7.7.1 Occupational Health

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

7.7.2 Hospital Facilities /Factory Medical Officer and OHC

- Company had made formal agreements with nearby hospitals having facilities to attend fire and toxic effect cases, emergency cases, attending the affected persons in the emergency arising out of accidents, if any, etc.
- A qualified doctor will be appointed as FMO on retainer ship basis. Apart from him, required medical facilities applicable as per Factories Act shall also be made available.
- All types of first aid related accessories, Medicines and Antidotes as prescribed by FMO, etc. shall be made available at conspicuous locations.

7.7.3 Ambulance and First Aid Box

An Emergency Vehicle shall be made available on call during emergency. First Aid Boxes will be made available at Security gate, emergency room, ETP and process plants. Training shall be given to employees for First Aid.

7.7.4 Plan for Periodic Medical Checkup

Periodic Medical Examination shall be conducted as per the following schedule;
Workers employed will be examined by a Qualified Medical Practitioner/ Factory Medical Officer, in the following manner:

1. Before employment, to ascertain physical fitness of the person;
2. During employment, every six months (blood & physical examination) as per Factories Rules, to ascertain physical fitness of the person to do the particular job.

7.7.5 Details of Occupational Health Impacts and Safety Hazards

Details of Occupational Health Impacts and Safety Hazards are shown in **Table 7.12.**

Table 7.14: Details of Occupational Health Impacts and Safety Hazards

Occupational Hazards Identification	Occupational Health Impacts
Exposure to Toxic and Corrosive Chemicals	Toxication, Irritation.
Exposure to Chemical Dust, Spillage/ Leakage, Overflow	Severe irritation to Eyes and Skin, Respiratory Disorder, Fatality, etc.
Slip/Trip, Fall, Electric Shock, etc.	Body Injury, Burns, Skin Sensitization, Fall Injury, Electrocution, Damage to nearby equipment's, Fatality, etc.

Mitigation measures/ Safety Measures proposed to avoid the human health hazards are mentioned in additional studies. In addition to these safety measures, personal protective equipment (IS approved) will also be provided to the required personnel. List of PPE's given below:

Table 7.15: List of PPE's

#	Personal Protective Equipment's (PPE's)	Numbers
1.	Safety Shoes	30
2.	Safety goggles	30
3.	Dust masks	30
4.	Cartridge Masks	30
5.	Hand gloves (Rubber, cotton, etc.)	30
6.	Refractive Jacket	30
7.	Ear Plugs	30
8.	Ear Muffs	30
9.	Safety helmet	30
10.	Others (PVC apron, SCBA Set, PVC pressure suit)	As per requirement

7.7.6 Details of Work Place Ambient Air Quality Monitoring Plan

Work zone monitoring will be carried out by independent competent third party every month. Records will be kept as per Factories Rules. Location for samplings shall be identified. Ambient Air & Noise Monitoring shall be done as per UKPCB Consent to operate requirements.

Following information will be 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

7.7.7 Monitoring of the Occupational Injury andIts Impact on Workers

Following action plan will be prepared & followed to monitor the occupational injury to workers:

- Each workplace will be evaluated for the existing work conditions.
- Unsafe Act and Unsafe Practices will be identified.
- Unsafe equipment's, unsafe areas, etc., will be identified.

- Area will be checked for proper Ventilation and Illumination.
- Air-borne concentration of toxic chemicals will be measured and records will be kept.
- Evaluation of training & on the job work.

Impact of the above mentioned unsafe conditions on workers will be studied and remedial measures for the same will be adopted.

7.7.8 Safety Trainings and Mock Drills

Safety trainings (on Safe Material Handling, First Aid, & all Safety Aspects) shall be provided every 15 days by the Safety Officers with the assistance of faculty members called from other Professional Safety Institutions and Universities. In addition to regular employees, limited contractor labors will also be given safety training. To create safety awareness, safety films shall be shown to workers and leaflets shall be distributed.

Mock Drills:

To evaluate the effectiveness of emergency preparedness and to spread the awareness among employees mock drill will be carried out at the interval of every six months.
After completion of the mock drill, summary report shall be made and corrections will be done if any weakness has been observed.

Frequency of Mock Drills:

On-site emergency: Once every 6 months

Off-site emergency: Once every year

7.7.9 Health and Safety Monitoring Plan

The health of all employees shall be monitored once in a year for early detection of any ailment due to exposure to heat, fumes and noise. Plan and fund allocation to ensure the occupational health and safety of all contract and casual workers have been given below:

Health Parameters

S. No.	Parameters	Frequency
1	Blood Pressure	Every Year
2	Blood Group and RH	Every Year
3	Blood Sugar (RBS)	Every Year
4	Spirometry	Every Year
5	Audiometry	Every Year
6	Vision	Every Year
7	Drug Allergy	Every Year

The fund allocation for Occupational Health and Safety of all contract and casual workers is **10.00**

Lakhs as capital cost.

Following Mitigation Measures suggested in QRA.

- The installation of all the equipment will be as per guidelines of provision of Factories Act1948.
- Smoking will be prohibited inside the factory.
- First Aid facility and First-aid trained person will be available at the time of handling operation.
- Chemical Drums will be stored at designated location or secured in a safety storage cabinet.
- Drums, carboys and related accessories will be inspected on regular basis for maintenance purpose.
- All the vessels and equipment's will be earthed properly and protected against static electricity.

Company had made formal agreements with nearby hospitals to attend fire and/or emergency cases for attending the affected persons in the emergency arising out of accident. First Aid Boxes will be made available at Security gate, emergency room and process plants. Mock drill will be carried out at the interval of every six months.

7.8 SUMMERY

Additional studies like public hearing, Risk and Hazard study, Disaster Management Plan, etc. has been incorporated in EIA report as per scope of StdToR letter issued by MoEFCC. Project site is located Industrial area – private land; hence public hearing is applicable to proposed expansion project. To identify major risks in the manufacturing process and to evaluate on-site and off-site consequences of identified hazard scenarios qualitative and quantitative risk assessment has been conducted. Scenarios for Simulation of Methanol and Formaldehyde for 5 mm dia. hole leak in tank and Catastrophic Rupture of storage tank has been carried out. Qualitative Risk Assessment has been carried out for Storage and Handling Toxic chemicals like of Methanol and Formaldehyde for Late pool fire **Consequence Under various Weather condition.**

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