

Qualitative Risk Assessment

1.1.1 Qualitative Risk Assessment

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

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

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

- Storage and Handling of flammable chemicals
- Storage and Handling of Toxic Chemicals
- Storage and Handling of Corrosive Chemicals.

The Risk Matrix presented in **Error! Reference source not found.** is referred in evaluating the assessment.

Risk acceptability criteria given in below table.

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

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.

Table Error! No text of specified style in document..1: Storage and Handling of Flammable Chemicals

S. No	Process Or Activity	Associated Hazards	Health & Safety Impact (Risk)	Initial Risk			Mitigation Measures	Residual Risk		
				Severity	Likelihood	Risk		Severity	Likelihood	Risk
1	Site Clearance, excavation and paving of site	Dust generation & increase in SPM/ RSPM in air Fall into pit due to paving the side	Health effect on workers and surrounding People Risk of injury to workers	2	C	M	<ul style="list-style-type: none"> Water spray on the ground before excavation. Work permit procedure to be followed. Shoring of the sides while manual digging the ground. Use of dust mask. 	1	B	L
2	Vehicular movement for transportation of construction material	Emission of PM ₁₀ , HC, NO _x , & CO Noise generation	Health effect Risk of injury to workers due to accidents	2	E	M	<ul style="list-style-type: none"> P.U.C Certified Vehicles Regular Maintenance of Vehicles Speed control of the vehicles. Specified Route of transport on Paved Roads 	1	C	L

Table Error! No text of specified style in document.-2: Storage and Handling of Solid Chemicals

S. No	Process Or Activity	Associated Hazards	Health & Safety Impact (Risk)	Initial Risk			Mitigation Measures	Residual Risk		
				Severity	Likelihood	Risk		Severity	Likelihood	Risk
1	Handling Chemical bags	Chemical Exposure	Skin and eye irritation	2	C	M	<ul style="list-style-type: none"> Operators/Workers to be trained for Safe Work Practices. Chemical handling bags to be labelled properly Availability of Eye wash and Safety shower station nearby Keep away from sources of ignition. Ground all equipment containing material. 	1	B	L

S. No	Process Or Activity	Associated Hazards	Health & Safety Impact (Risk)	Initial Risk			Mitigation Measures	Residual Risk		
				Severity	Likelihood	Risk		Severity	Likelihood	Risk
							<ul style="list-style-type: none"> Use an approved/certified respirator or equivalent Use of suitable protective clothing like Splash goggles, Lab coat, Dust respirator, Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream Keep away from incompatibles such as oxidizing agents, alkalis Keep container in cool & dry place 			
2	Cleaning of Chemical Spillage.	Dust Exposure.	Inhalation.	2	C	M	<ul style="list-style-type: none"> Use appropriate tools to put the spilled solid in a convenient waste disposal container Vapour and dust respirator, Dust mask shall be used. Suitable protective clothing, gloves, boots shall be used. 	1	B	L

Table Error! No text of specified style in document.-3: Storage and Handling of Corrosive Chemicals

S. No.	Process Or Activity	Associated Hazards	Health & Safety Impact (Risk)	Initial Risk			Mitigation Measures	Residual Risk		
				Severity	Likelihood	Risk		Severity	Likelihood	Risk
1	Acids Loading & Unloading.	Exposure to acid fumes (due to leakage in pipe/ container/ valves etc.). Splash over body	Skin/ Eye irritation. Toxic Vapour inhalation etc. Acid burns	2	C	M	<ul style="list-style-type: none"> Loading & Unloading activity shall be carried out in well-ventilated area under proper supervision. Training for lifting and chemical transporting technique from one location to another location will be provided Periodic Inspection of flanges/ferrule joints 	1	B	L

S. No.	Process Or Activity	Associated Hazards	Health & Safety Impact (Risk)	Initial Risk			Mitigation Measures	Residual Risk		
				Severity	Likelihood	Risk		Severity	Likelihood	Risk
		Spillage.					<ul style="list-style-type: none"> shall be carried out. Availability of Eye wash and Safety shower station nearby. Neutralization media shall be kept available in areas where acids are stored/ handled/ used. PPEs like chemical safety goggles or full face shield, Rubber or neoprene gloves and additional protection including impervious boots, apron shall be used. Respirators shall be used. 			
2	Working in Storage Area.	Exposure to acid fumes.	Severe irritation to eyes, skin. Body burns.	3	C	M	<ul style="list-style-type: none"> Acid proof floorings shall be constructed. Keep container in a cool, well-ventilated area. Keep away from incompatibles such as combustible materials, organic materials, metals, acids, moisture In case of spillage, Absorb with DRY earth, sand or other non-combustible material. Use water spray to reduce vapours PPEs like chemical safety goggles or full face shield, Rubber or neoprene gloves and additional protection including impervious boots, apron shall be used. Respirators shall be used. Eye wash stations & Safety Shower shall be installed in near vicinity. Only trained personnel shall be allowed to work in this area. Dyke wall shall be provided. 	2	B	L

S. No.	Process Or Activity	Associated Hazards	Health & Safety Impact (Risk)	Initial Risk			Mitigation Measures	Residual Risk		
				Severity	Likelihood	Risk		Severity	Likelihood	Risk
3	Tank overflow /leakage from joints etc.	Exposure to acid fumes.	Severe irritation to eyes, skin.	3	B	M	<ul style="list-style-type: none"> Level indicator shall be provided. Provision of adequate Dyke wall. Absorb with DRY earth, sand or other non-combustible material. PPEs like chemical safety goggles or full face shield, Rubber or neoprene gloves and additional protection including impervious boots, apron shall be used. Respirators shall be used. Eye wash stations & Safety Shower shall be installed in near vicinity. 	2	B	L

Table Error! No text of specified style in document.-4: Storage and Handling of Toxic & Flammable Chemicals

S. No.	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 fumes (due to leakage from joints, corroded lines failure etc.).	Skin burn. Eye irritation and respiratory disorder.	3	C	M	<ul style="list-style-type: none"> Dyke will be provide. Shall be stored in well-ventilated area. Eye wash station and Safety Shower shall be installed in nearby location. Maintenance shall be carried as per schedule. Employee will be provided with impervious clothes, gloves, face shield (eight-inch minimum), dust and splash proof safety 	2	B	L

S. No.	Process Or Activity	Associated Hazards	Health & Safety Impact (Risk)	Initial Risk			Mitigation Measures	Residual Risk		
				Severity	Likelihood	Risk		Severity	Likelihood	Risk
							<p>goggles, chemically resistant safety shoes, etc.</p> <ul style="list-style-type: none"> • Proper trainings to be provided to the operators/ workers. • SOPs to be prepared and followed the same. • Keep container in a cool, well-ventilated area. Keep away from incompatibles such as reducing agents, combustible materials, organic materials, metals, acids, moisture. Do not allow the area where cylinders are stored to exceed 52°C for chlorine. • Antidotes will be provided for all pesticide products in OHC. 			
2	Working in Storage Area	Exposure to fumes due to spillage.	Severe irritation to eyes, skin etc. Internal body burns.	3	C	M	<ul style="list-style-type: none"> • Splash goggles. Full suit. Vapour respirator. Boots. Gloves. A self-contained breathing apparatus should be used to avoid inhalation of the product. Be sure to use an approved/certified respirator or equivalent • Exhaust ventilation or other engineering controls to keep the airborne concentrations of vapours below their respective threshold limit value. Maintain the Oxygen level above 19.5% in the workplace for chlorine handling • Bromine will be absorb with an inert material and put the spilled material in an appropriate waste disposal • Eye wash station or Safety Shower shall be installed in storage area. 	2	B	L

S. No.	Process Or Activity	Associated Hazards	Health & Safety Impact (Risk)	Initial Risk			Mitigation Measures	Residual Risk		
				Severity	Likelihood	Risk		Severity	Likelihood	Risk
							<ul style="list-style-type: none"> Provision of an automatic leak detection system Display of Safety warning postures/signs inside the area. 			
3	Tank overflow	Chemical Exposure	Eyes and Skin irritation.	4	B	M	<ul style="list-style-type: none"> Level indicator shall be installed and the same shall be checked for its proper operation. Dyke wall shall be available to contain the spill. Periodic inspection to be carried for all the related accessories of level indicator. 	2	B	L

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

Consequences of Heat Radiation

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

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

The 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 provided in **Table Error! No text of specified style in document..5**.

Table Error! No text of specified style in document..5 : 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 Explosion

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

- A flash fire over the whole length of the explosive gas cloud;

- A blast wave, with typical peak overpressures circular around ignition source.

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

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

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 kilopascals (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. Details of Type of Damage and Peak overpressure are provided in **Table Error! No text of specified style in document..6**.

Table Error! No text of specified style in document..6: Overpressure Damage

Peak Overpressure	Damage Type
0.01 bar	Minor Damage
0.02 bar	Glass Damage
0.13 bar	Minor Structural Damage to nearby structures 10% probability of fatality to personnel inside 0% probability of fatality in the open
0.21 bar	Structural Damage to buildings 20% probability of fatality to personnel inside 0% probability of fatality in the open
0.40 bar	Ear Drum Rupture to humans 50 % probability of fatality inside 15% probability of fatality in open

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 hrs. 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, neoplastigenic 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.

Event Classification and Modes of Failure

Hazards that can lead to accidents in operations are discussed in this section. Important hazardous events classification is provided in **Table Error! No text of specified style in document..7.**

Table Error! No text of specified style in document..7: 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

Type of Event	Explanation
Structural Damage	Breakage or fatigue failures (mostly failures caused by weather but not necessarily) of structural support and direct structural failures
Vapor Cloud Explosion	Explosion resulting from vapor clouds formed from flashing liquids or non-flashing liquids and gases

1.1.3 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".

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 °C per 100 meters.

1.1.4 Weather Conditions

Weather conditions selected for consequence analysis are provided in **Table Error! No text of specified style in document..8**

Table Error! No text of specified style in document..8: Weather Condition Selected

Parameter	Weather Category #1
Ambient temperature Deg C	28
Relative Humidity (%)	50
Wind speed (M/S)	3.34
Atmospheric Stability (Pasquill Class)	C

1.1.5 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, explosion overpressure etc.

Consequence analysis involves the application of mathematical, analytical and computer models for calculation of effects and damages subsequent to Aniline Oil, HCl and Sulfuric Acid release accident. Consequence models are used to predict the physical behavior of the hazardous incidents. The techniques used to model the consequences of Aniline Oil, HCl and Sulfuric Acid 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.

The identified failure scenarios (Table 7.4) have been analysed (Using ALOHA and EFFECT Modules) for the impact zones considering damage due to thermal and toxic impacts. Each incident will have Impact on the surrounding environment which in extreme case may cross plant boundary.

Figure Error! No text of specified style in document..1: Acetic Anhydride1

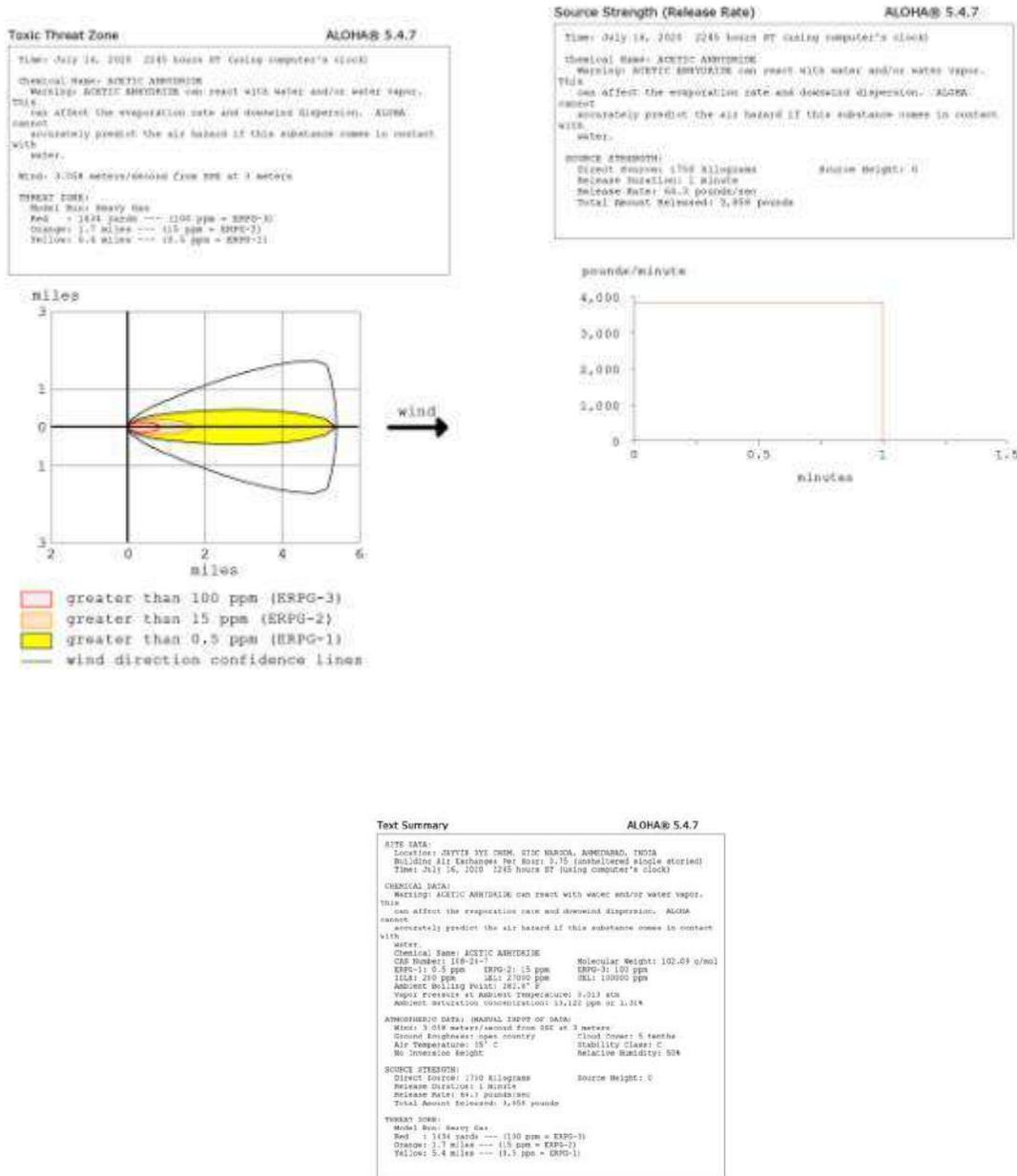


Figure Error! No text of specified style in document..2: Acetic Anhydride2

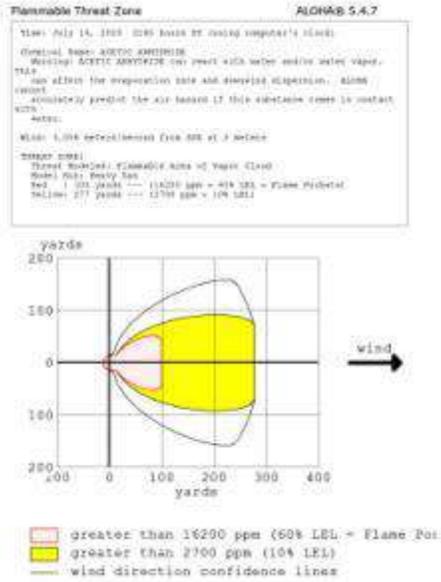


Figure Error! No text of specified style in document..3: Acetic Anhydride3

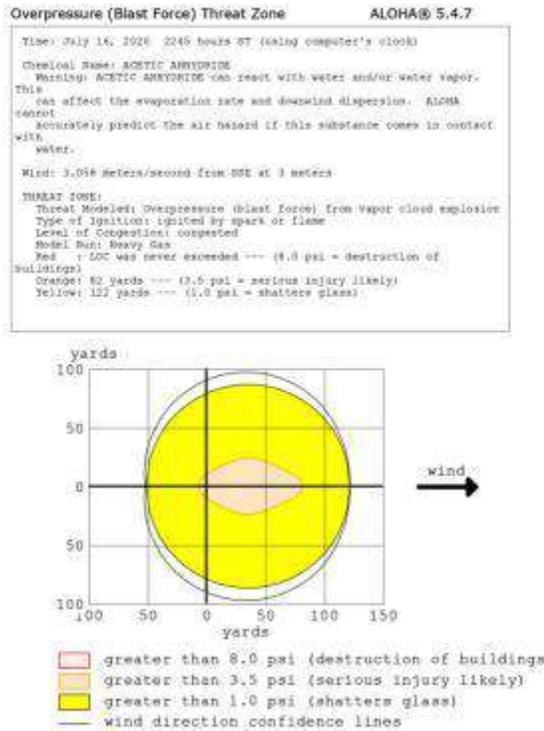
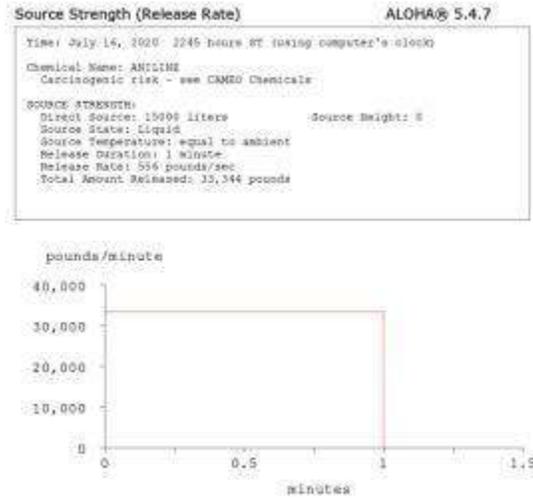
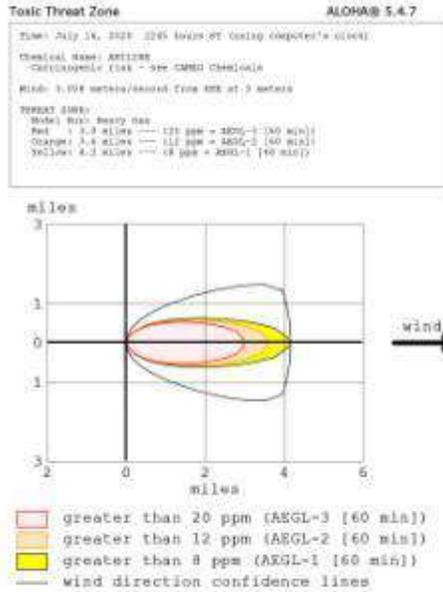


Figure Error! No text of specified style in document.:4: Aniline1



Text Summary ALDHA® 5.4.7

SITE DATA:
 Location: JAYVIR DYE CRSM, GIDC WAPODA, AHMEDABAD, INDIA
 Building Air Exchanges Per Hour: 0.75 (unabated single storied)
 Time: July 16, 2020 2245 hours BT (using computer's clock)

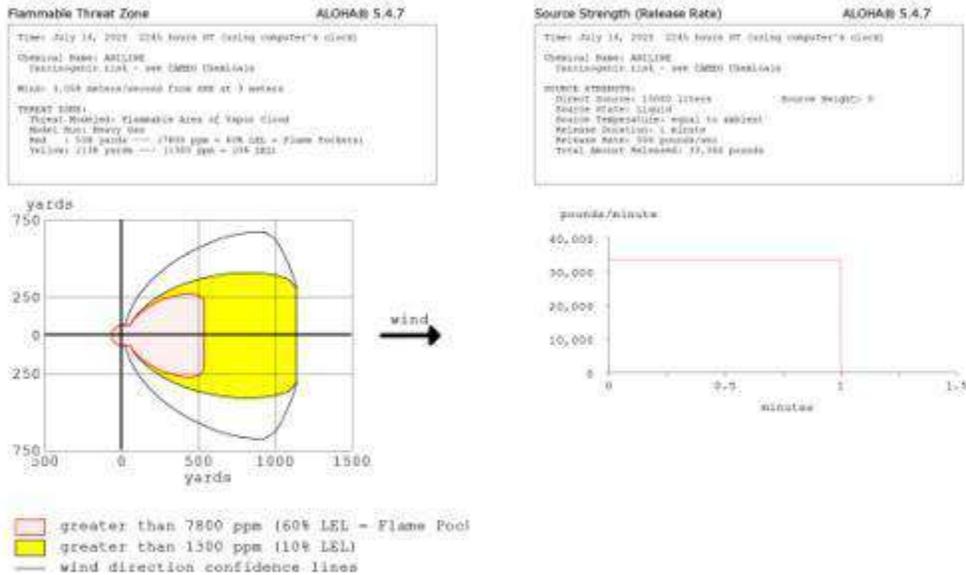
CHEMICAL DATA:
 Chemical Name: ANILINE Molecular Weight: 93.09 g/mol
 CAS Number: 62-53-3
 AEGL-1 (60 min): 8 ppm AEGL-2 (60 min): 12 ppm AEGL-3 (60 min): 20 ppm
 IDLH: 100 ppm LEL: 1.0000 ppm UEL: 110000 ppm
 Carcinogenic risk - see CAMEO Chemicals
 Ambient Boiling Point: 362.3° F
 Vapor Pressure at Ambient Temperature: 0.0018 atm
 Ambient Saturation Concentration: 1.795 ppm or 0.18%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
 Wind: 3.058 meters/second from 088 at 3 meters
 Ground Roughness: open country Cloud Cover: 0 tenths
 Air Temperature: 35° C Stability Class: C
 No Inversion Height Relative Humidity: 50%

SOURCE STRENGTH:
 Direct Source: 15000 liters Source Weight: 0
 Source State: Liquid
 Source Temperature: equal to ambient
 Release Duration: 1 minute
 Release Rate: 556 pounds/sec
 Total Amount Released: 33,344 pounds

THREAT ZONE:
 Model Run: Heavy Gas
 Red: 1.3 miles --- 120 ppm = AEGL-3 (60 min)
 Orange: 3.6 miles --- 12 ppm = AEGL-2 (60 min)
 Yellow: 4.2 miles --- 8 ppm = AEGL-1 (60 min)

Figure Error! No text of specified style in document.5: Aniline2



Text Summary ALOHA® 5.4.7

SITE DATA:
 Location: JAYVIR EYE CEM, SIDC BARODA, AHMEDABAD, INDIA
 Building Air Exchanges Per Hour: 0.75 (unsheltered single storied)
 Time: July 16, 2002 2245 hours BT (using computer's clock)

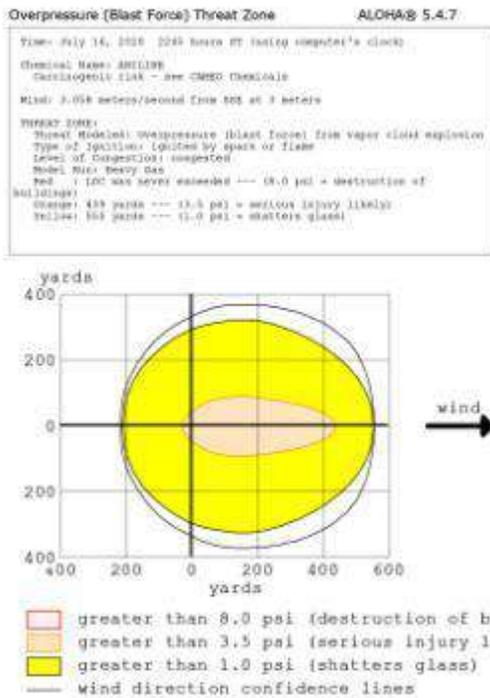
CHEMICAL DATA:
 Chemical Name: ANILINE
 CAS Number: 62-53-1 Molecular Weight: 93.13 g/mol
 AEGL-1 (60 min): 8 ppm AEGL-2 (60 min): 12 ppm AEGL-3 (60 min): 20 ppm
 IDLH: 100 ppm LEL: 13000 ppm UEL: 110000 ppm
 Carcinogenic risk - see OMSD Chemicals
 Ambient Boiling Point: 362.3° F
 Vapor Pressure at Ambient Temperature: 0.0018 atm
 Ambient Saturation Concentration: 1,195 ppm or 0.18%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
 Wind: 3.058 meters/second from SSE at 3 meters
 Ground Roughness: open country Cloud Cover: 5 tenths
 Air Temperature: 35° C Stability Class: C
 No Inversion Height Relative Humidity: 50%

SOURCE STRENGTH:
 Direct Source: 15000 liters Source Height: 0
 Source State: Liquid
 Source Temperature: equal to ambient
 Release Duration: 1 minute
 Release Rate: 556 pounds/sec
 Total Amount Released: 33,364 pounds

THREAT ZONE:
 Threat Modeled: Flammable Area of Vapor Cloud
 Model Run: Heavy Gas
 Red : 538 yards --- (7800 ppm = 60% LEL = Flame Pockets)
 Yellow: 1138 yards --- (1300 ppm = 10% LEL)

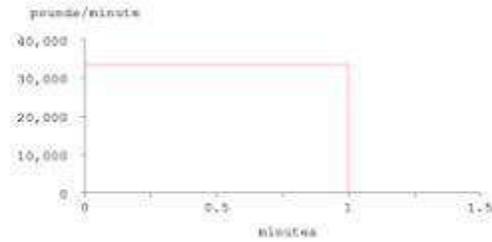
Figure Error! No text of specified style in document.6: Aniline3



Source Strength (Release Rate) ALOHA® 5.4.7

Time: July 14, 2005 2245 hours AT Gaslog computer's clock
 Chemical Name: ANILINE
 CAS#/RegNo: 124-40-3 - see CAMEO Chemicals

SOURCE STRENGTH:
 Direct Source: 1000 liters Source Height: 0
 Evaporative State: Liquid
 Evaporative Temperature: equal to ambient
 Release Duration: 1 minute
 Release Rate: 554 pounds/mole
 Total Amount Released: 554 pounds



Text Summary ALOHA® 5.4.7

SCENARIO DATA:
 Location: 2472N DIS CHEN, 81DC WASHDC, 20000000, 20018
 Building Air Exchanges Per Hour: 0.75 (understated - single storied)
 Time: July 14, 2005 2245 hours AT Gaslog computer's clock

CHEMICAL DATA:
 Chemical Name: ANILINE
 CAS Number: 62-83-3 Molecular Weight: 93.094 g/mol
 MWL-1 (kg/m3): 0.939 MWL-2 (kg/m3): 1.2 ppm MWL-3 (kg/m3): 140 mg/m3
 20 ppm
 TOCL: 554 ppm MEL: 10000 ppm MEL: 10000 ppm
 CAS#/RegNo: 124-40-3 - see CAMEO Chemicals
 Ambient Mixing Point: 100.0 ft
 Vapor Pressure at Ambient Temperature: 3.052E-05
 Ambient Saturation Concentration: 1.795 ppm at 8.15K

AMBIENT DATA: (NAMING INPUT OF DATA)
 Wind: 3.054 meters/second from 93E at 3 meters
 Ground Roughness: open country Cloud Cover: 3 Gusts
 Air Temperature: 35° C Stability Class: C
 No Inversion Height Relative Humidity: 50%

SOURCE STRENGTH:
 Direct Source: 1000 liters Source Height: 0
 Evaporative State: Liquid
 Evaporative Temperature: equal to ambient
 Release Duration: 1 minute
 Release Rate: 554 pounds/mole
 Total Amount Released: 554 pounds

WHAFF DATA:
 Threat Model(s): Overpressure (blast force) from vapor cloud explosion
 Type of Ignition: Ignited by spark or flame
 Level of Detonation: suspended
 Model Mix: Heavy Gas
 Ref: 1. IBC was never exceeded --- 9.0 psi = destruction of bulk building
 Orange: 439 yards --- 3.5 psi = serious injury likely
 Yellow: 554 yards --- 1.0 psi = shatters glass

Figure Error! No text of specified style in document..7: HCI 30%

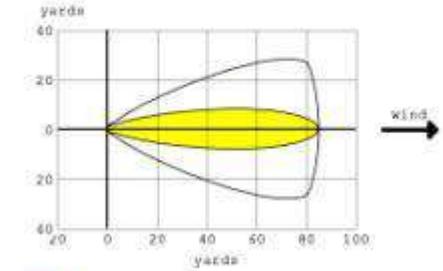
Toxic Threat Zone ALPHA@ 5.4.7

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Time: July 16, 2020 2245 hours ET (using computer's clock)
Chemical Name: HYDROCHLORIC ACID
Solution Strength: 10% (by weight)
Hazardous Component: HYDROGEN CHLORIDE
Wind: 3.058 meters/second from SSE at 3 meters

SOURCE STRENGTH:
Evaporating Puddle
Puddle Diameter: 1.9 meters      Puddle Volume: 15900 liters
Ground Type: Default: Soil        Ground Temperature: 35° C
Initial Puddle Temperature: Ground temperature
Release Duration: ALPHA limited the duration to 1 hour
Max Average Sustained Release Rate: 0.175 pounds/min
(averaged over a minute or more)
Total Amount Hazardous Component Released: 10.5 pounds

THREAT ZONE:
Model Run: Gaussian
Red : less than 10 meters (10.9 yards) --- (100 ppm = AEGL-3 [60 min])
Note: Threat zone was not drawn because effects of near-field patchiness
make dispersion predictions less reliable for short distances.
Orange: 24 yards --- (22 ppm = AEGL-2 [60 min])
Note: Threat zone was not drawn because effects of near-field patchiness
make dispersion predictions less reliable for short distances.
Yellow: 45 yards --- (1.8 ppm = AEGL-1 [60 min])
    
```

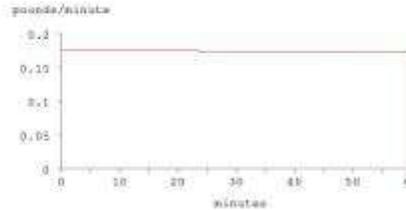


- greater than 100 ppm (AEGL-3 [60 min]) (not dr)
- greater than 22 ppm (AEGL-2 [60 min]) (not dr)
- greater than 1.8 ppm (AEGL-1 [60 min])
- wind direction confidence lines

Source Strength (Evaporation Rate) ALPHA@ 5.4.7

```

Time: July 16, 2020 2245 hours ET (using computer's clock)
Chemical Name: HYDROCHLORIC ACID
Solution Strength: 10% (by weight)
Hazardous Component: HYDROGEN CHLORIDE
SOURCE STRENGTH:
Evaporating Puddle
Puddle Diameter: 1.9 meters      Puddle Volume: 15900 liters
Ground Type: Default: Soil        Ground Temperature: 35° C
Initial Puddle Temperature: Ground temperature
Release Duration: ALPHA limited the duration to 1 hour
Max Average Sustained Release Rate: 0.175 pounds/min
(averaged over a minute or more)
Total Amount Hazardous Component Released: 10.5 pounds
    
```



Text Summary ALPHA@ 5.4.7

```

SITE DATA:
Location: JAYVIR DYE CEM, GIDC HARODA, AHMEDABAD, INDIA
Building Air Exchanges Per Hour: 0.75 (unsheltered single stored)
Time: July 16, 2020 2245 hours ET (using computer's clock)

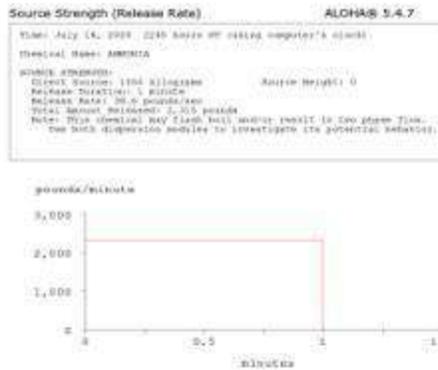
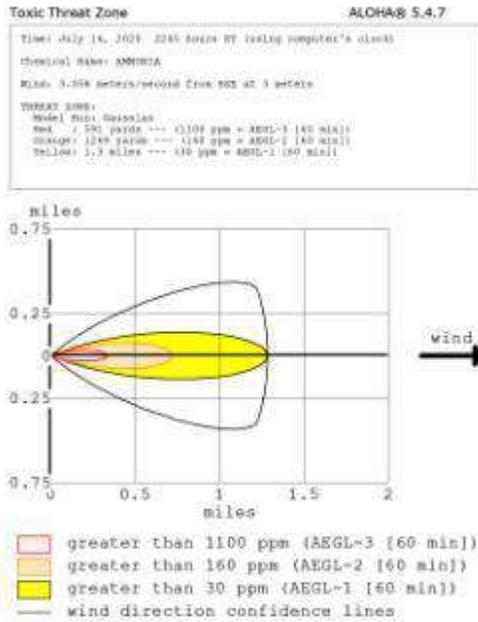
CHEMICAL DATA:
Chemical Name: HYDROCHLORIC ACID
Solution Strength: 10% (by weight)
Ambient Boiling Point: 194.3° F
Partial Pressure at Ambient Temperature: 0.538 atm
Ambient Saturation Concentration: 37.869 ppm or 3.73%
Hazardous Component: HYDROGEN CHLORIDE
CAS Number: 7647-1-8      Molecular Weight: 36.46 g/mol
AEGL-1 (60 min): 1.8 ppm  AEGL-2 (60 min): 22 ppm  AEGL-3 (60 min): 100 ppm
IDLH: 50 ppm

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
Wind: 3.058 meters/second from SSE at 3 meters
Ground Roughness: open country      Cloud Cover: 5 tenths
Air Temperature: 35° C              Stability Class: C
Mix Inversion Height:                Relative Humidity: 90%

SOURCE STRENGTH:
Evaporating Puddle
Puddle Diameter: 1.9 meters      Puddle Volume: 15900 liters
Ground Type: Default: Soil        Ground Temperature: 35° C
Initial Puddle Temperature: Ground temperature
Release Duration: ALPHA limited the duration to 1 hour
Max Average Sustained Release Rate: 0.175 pounds/min
(averaged over a minute or more)
Total Amount Hazardous Component Released: 10.5 pounds

THREAT ZONE:
Model Run: Gaussian
Red : less than 10 meters (10.9 yards) --- (100 ppm = AEGL-3 [60 min])
Note: Threat zone was not drawn because effects of near-field patchiness
make dispersion predictions less reliable for short distances.
Orange: 24 yards --- (22 ppm = AEGL-2 [60 min])
Note: Threat zone was not drawn because effects of near-field patchiness
make dispersion predictions less reliable for short distances.
Yellow: 45 yards --- (1.8 ppm = AEGL-1 [60 min])
    
```

Figure Error! No text of specified style in document.:8: Liquor Ammonia1



Text Summary ALOHA 5.4.7

SITE DATA:
 Location: JAYVIR ONE TRAIL, RICE HARBOR, AMHERST, ILLINOIS
 Building Air Exchange Per Hour: 0.75 (assumed single storied)
 Time: July 14, 2003 2245 hours BT (Using computer's clock)

PHYSICAL DATA:
 Chemical Name: AMMONIA Molecular Weight: 17.03 g/mol
 CAS Number: 7804-61-7
 AEGL-1 (60 min): 30 ppm AEGL-2 (60 min): 160 ppm AEGL-3 (60 min): 1100 ppm
 IDLH: 300 ppm LEL: 15.000 vol UEL: 28.000 vol
 Ambient Boiling Point: -29.4° F
 Vapor Pressure at Ambient Temperature: greater than 1 atm
 Ambient Atmospheric Concentration: 1.000,000 ppm at 100.00

ATMOSPHERIC DATA (USING INPUT OF DATE):
 Wind: 3.008 meters/second from 503 at 3 meters
 Ground Roughness: open country Cloud Cover: 5 tenths
 Air Temperature: 35° C Stability Class: C
 No Inversion Height Relative Humidity: 50%

SOURCE STRENGTH:
 Direct Source: 1249 kilograms Source Height: 0
 Release Direction: 5 RADIANS
 Release Rate: 30.0 pounds/sec
 Total Amount Released: 2.310 pounds
 Note: This chemical may flash back and/or result in two phase flow.
 The HIRL dispersion model is investigating its potential behavior.

TOXIC ZONE:
 Model: HIRL Gaussian
 Ref: 7.50 pounds --- 1100 ppm = AEGL-3 (60 min)
 Orange: 1249 pounds --- 160 ppm = AEGL-2 (60 min)
 Yellow: 1.3 miles --- 30 ppm = AEGL-1 (60 min)

Figure Error! No text of specified style in document..9: Liquor Ammonia2

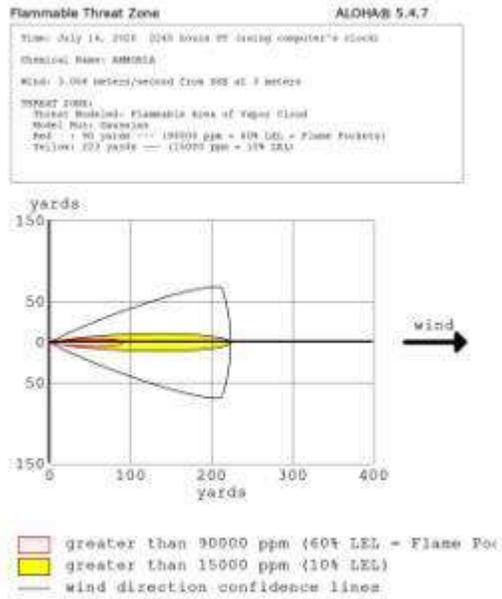


Figure Error! No text of specified style in document..10: Liquor Ammonia3

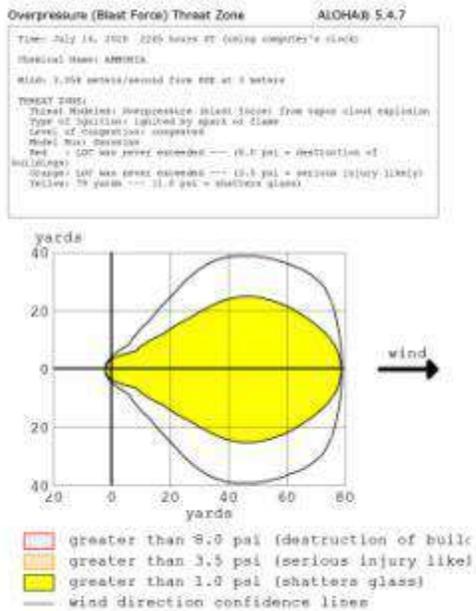
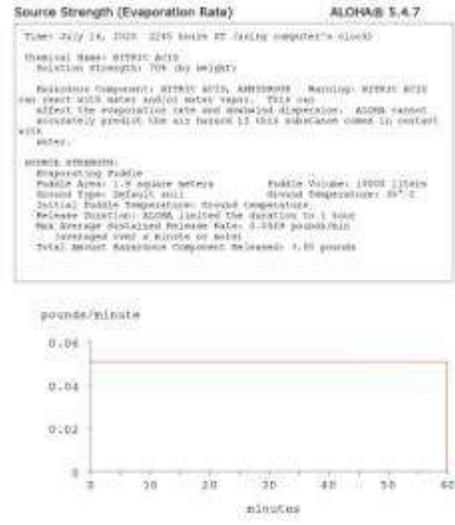
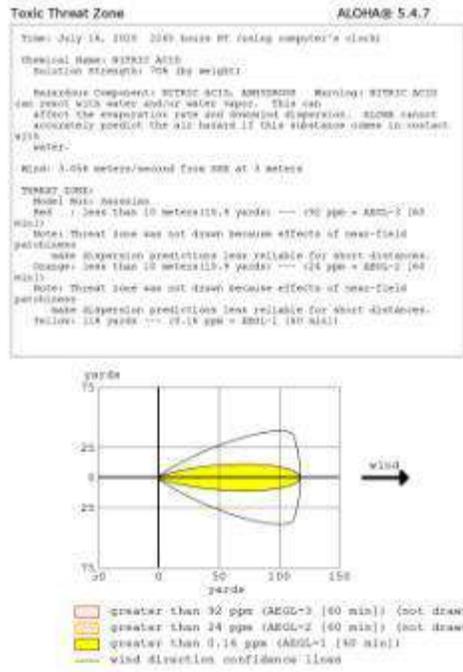


Figure Error! No text of specified style in document..11: Nitric Acid



Text Summary ALOHAS 5.4.7

FILE INFO
 Location: ALVIN 010 0100, 4300 WARD, AMHERST, OHIO
 Building ID: Package No: 800 2.75 (unpublished single storage)
 Time: July 14, 2025 2:45 hours ET (using computer's clock)

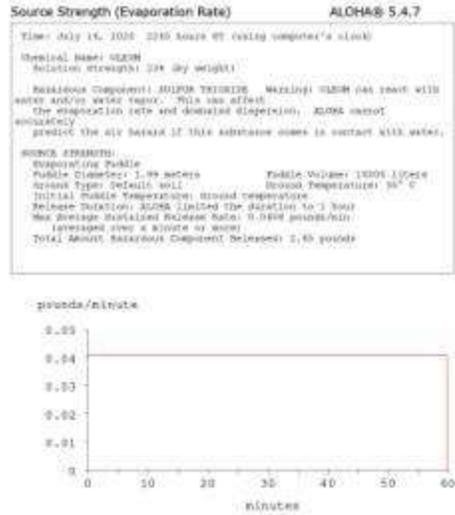
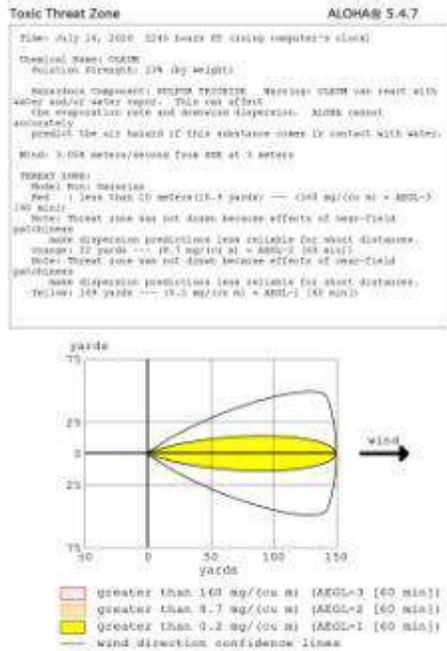
THREAT ZONE:
 Chemical Name: NITRIC ACID
 Solution Strength: 70% by weight
 Release: 3.58 meters/second from 800 at 3 meters
 Model: Full Gaussian
 Wind: 1 meter/second (10 meters/10.4 yards) --- 100 ppm = AERL-2 (60 min)
 Note: Threat zone was not drawn because effects of near-field particulates make dispersion predictions less reliable for short distances. (range: less than 10 meters/10.4 yards) --- 124 ppm = AERL-2 (60 min)
 Note: Threat zone was not drawn because effects of near-field particulates make dispersion predictions less reliable for short distances. (below: 14 ppm) --- 17.18 ppm = AERL-1 (10 min)

ENVIRONMENTAL DATA: INITIAL STATE OF DATA
 Release: 3.58 meters/second from 800 at 3 meters
 Ground Temperature: 30.000000 C Wind Speed: 1 meter/second
 Air Temperature: 30° C Humidity: 0.000000
 No Inversion Depth: Relative Humidity: 100%

SOURCE STRENGTH:
 Evaporating Puddle
 Puddle Area: 1.9 square meters Puddle Volume: 1200 LITERS
 Ground Type: Default: null Ground Temperature: 30° C
 Initial Puddle Temperature: Ground temperature
 Release Direction: 32508 (limited the direction to 1 loop
 Max Average Evaporation Release Rate: 0.3369 pounds/min (averaged over a minute or more)
 Total Weight Available Component Released: 1.31 pounds

THREAT ZONE:
 Model: Full Gaussian
 Wind: 1 meter/second (10 meters/10.4 yards) --- 100 ppm = AERL-2 (60 min)
 Note: Threat zone was not drawn because effects of near-field particulates make dispersion predictions less reliable for short distances. (range: less than 10 meters/10.4 yards) --- 124 ppm = AERL-2 (60 min)
 Note: Threat zone was not drawn because effects of near-field particulates make dispersion predictions less reliable for short distances. (below: 14 ppm) --- 17.18 ppm = AERL-1 (10 min)

Figure Error! No text of specified style in document..12: Oleum1



Text Summary ALOHA® 5.4.7

SITE DATA:
 Location: BT-COOLING-001 (cont.)
 Release at: BT-COOLING-001 (cont.)
 Time: July 14, 2005 22:45 hours BT cooling computer's cloud

CHEMICAL DATA:
 Material: OLEUM (as liquid with water and/or water vapor). This was added.
 The evaporation rate and downwind dispersion. ALOHA cannot accurately predict the air behind it this substance comes in contact with water.
 Chemical Name: OLEUM
 Molecular Weight: 224 (by weight)
 Molecular Weight: 224.07 g/mol
 Initial Pressure at Ambient Temperature: 0.000 atm
 Release Component: SULFUR TRIOXIDE
 Release Duration: ALOHA limited the duration to 1 hour
 Max Average Evaporation Release Rate: 0.000 pounds/minute
 (average over a minute or more)
 Total Amount Released Component Release: 0.00 pounds

AMBIENT DATA (DEFAULT INPUT OF DATA):
 Wind: 3.000 meters/second. This was at 3 meters
 Ground Temperature: 15.000 C
 Air Temperature: 15.000 C
 In: Inlet Air Height: 3.000 meters
 Relative Humidity: 50%

SOURCE STRENGTH:
 Evaporating Puddle
 Puddle Diameter: 1.00 meters Puddle Volume: 1000.0 liters
 Ground Type: Default: SOIL Ground Temperature: 15.0 C
 Initial Puddle Temperature: Initial Temperature
 Release Duration: ALOHA limited the duration to 1 hour
 Max Average Evaporation Release Rate: 0.000 pounds/minute
 (average over a minute or more)
 Total Amount Released Component Release: 0.00 pounds

THREAT ZONE:
 Wind: Full direction
 Pub: 1.000 than 10 meters(10.0 yards) --- 100 mg/(cu m) = ALOHA-3 (60 min)
 100 yards
 Note: Threat zone was not drawn because effects of near-field pollution
 Note: Dispersion predictions less reliable for short distances.
 Change: 10 yards --- 10.0 mg/(cu m) = ALOHA-2 (60 min)
 Note: Threat zone was not drawn because effects of near-field pollution
 Note: Dispersion predictions less reliable for short distances.
 Change: 100 yards --- 10.0 mg/(cu m) = ALOHA-1 (60 min)

Safety Measures/ Mitigation measures for Transportation, Storage and Handling of Chemicals

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

1. General safety measures for transportation, storage & handling are listed below.

- Layout and location of hazardous chemical storage area shall be based on natural and Mechanical ventilation.
- The installation of all the equipment will be as per guidelines of provision of Gujarat Factories Rule 1963.
- Spare barrels of sufficient quantity will be kept ready for any emergency spillage or leakage.
- Display Boards shall be provided on all storage tank which include the name of the chemicals, material of construction and date of Painting.
- All equipments related to hazardous chemical storage shall be maintained and calibrated regularly.
- SOP for handling hazardous chemicals is displayed in local language for safe operating procedure.
- Proper inventory of hazardous chemicals is maintained and buffer stock will be kept as minimum as possible.
- Standard procedure for unloading will be implemented for safe unloading of road tanker.
- 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 is/will be provided as required.
- Adequate firefighting system is/will be provided as required along with the fire water tank.
- First aids box will be provided at prominent places in the plant.
- Area will be declared as “NO SMOKE ZONE”.

2.1 Specific Safety measures for Acetic Acid, storage & handling are listed below.

Hazard Information

- Flammable liquid and vapor.
- Causes severe skin burns and eye damage.
- Harmful to aquatic life.

Precautionary statements

- Keep away from heat, sparks, open flames, hot surfaces. - No smoking.
- Keep container tightly closed.
- Ground/bond container and receiving equipment.
- Use explosion-proof electrical, ventilating, lighting equipment.
- Use only non-sparking tools.
- Take precautionary measures against static discharge.
- Do not breathe mist, vapors, spray.
- Wash exposed skin thoroughly after handling

In case of fire

- Flammable. Gas/vapor flammable with air within explosion limits.
- May be ignited by sparks. Reactions involving a fire hazard

- Water spray. Polyvalent foam. Alcohol-resistant foam. BC powder. Carbon dioxide.
- Cool tanks/drums with water spray/remove them into safety.
- Do not move the load if exposed to heat.
- Dilute toxic gases with water spray.
- Do not enter fire area without proper protective equipment, including respiratory protection.
- Gas-tight suit. Corrosion-proof suit.
- Take account of toxic fire-fighting water.

Health Information

- **Eye contact:** Rinse immediately with plenty of water for 15 minutes. Do not apply neutralizing agents. Take victim to an ophthalmologist.
- **Skin Contact:** Wash immediately with lots of water (15 minutes)/shower. Do not apply (chemical) neutralizing agents. Remove clothing while washing. Do not remove clothing if it sticks to the skin. Cover wounds with sterile bandage. Consult a doctor/medical service. If burned surface > 10%: take victim to hospital.
- **Inhalation:** Remove the victim into fresh air. Immediately consult a doctor/medical service. Doctor: administration of corticoid spray.
- **Ingestion/If swallowed:** Rinse mouth with water. Immediately after ingestion: give lots of water to drink. Give milk to drink. Do not induce vomiting. Do not give activated charcoal. Immediately consult a doctor/medical service. Call Poison Information Centre (www.big.be/antigif.htm). Take the container/vomit to the doctor/hospital. Ingestion of large quantities: immediately to hospital. Do not give chemical antidote. Doctor: gastric lavage is not recommended.

Storage and Handling

- **Incompatible products:** Strong bases. Oxidizing agent, metals.
- **Incompatible materials:** Direct sunlight. Heat sources, Sources of ignition.
- **Storage temperature:** > 17 °C
- **Heat-ignition:** KEEP SUBSTANCE AWAY FROM: heat sources. Ignition sources.
- **Prohibitions on mixed storage:** KEEP SUBSTANCE AWAY FROM: combustible materials, oxidizing agents, (Strong) bases, Metal, alcohols, amines, water/moisture.
- **Storage area:** Store in a dry area. Ventilation at floor level. Keep out of direct sunlight. Fireproof storeroom. Keep locked up. Protect against frost. Provide for a tub to collect spills. Provide the tank with Earthing. Detached building. Store only in a limited quantity. Meet the legal requirements.
- **Special rules on packaging:** SPECIAL REQUIREMENTS: closing. dry. clean. correctly labelled. meet the legal requirements. Secure fragile packaging in solid containers.
- **Packaging materials:** SUITABLE MATERIAL: aluminium. glass. MATERIAL TO AVOID: steel. iron. zinc. lead. copper. bronze.

2.2 Specific Safety measures for Aniline Oil, storage & handling are listed below.

Hazard Information

- Toxic if swallowed, in contact with skin or if inhaled.
- May cause an allergic skin reaction.
- Suspected of causing genetic defects.
- Suspected of causing cancer.
- Causes damage to organs (Blood) through prolonged or repeated exposure.
- Very toxic to aquatic life with long lasting effects.
- Causes serious eye damage.

In case of fire

- Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
- Special hazards arising from the substance or mixture: Carbon oxides, Nitrogen oxides (NO_x)
- Use water spray to cool unopened containers.
- Wear self-contained breathing apparatus for firefighting if necessary.

Health Information

- **Eye contact:** Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.
- **Skin Contact:** Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.
- **Inhalation:** If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.
- **Ingestion/If swallowed:** Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

Storage and Handling

- Store and handle in accordance with all current regulations and standards.
- Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.
- Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.
- Store in cool place.
- Keep container tightly closed in a dry and well-ventilated place.
- Containers which are opened must be carefully resealed and kept upright to prevent leakage.
- Storage class (TRGS 510): Non-combustible, acute toxic Cat. 1 and 2 / very toxic hazardous materials.

2.3 Specific Safety measures for Hydrochloric Acid, storage & handling are listed below.

Hazard Information

- Contact with metals may evolve flammable hydrogen gas. May spatter or generate heat when mixed with water.
- This material is corrosive
- Releases sulfur dioxide at extremely high temperatures.

In case of fire

- Not combustible, but if involved in a fire decomposes to produce irritants and toxic gases.
- Use media appropriate for surrounding fire
- Keep unnecessary people away, isolate hazard area and deny entry. Wear NIOSH approved positive-pressure self-contained breathing apparatus operated in pressure demand mode. Move container from fire area if it can be done without risk. Cool non-leaking containers with water. Avoid inhalation of material or combustion by-products. Stay upwind and keep out of low areas

Health Information

- **Eye contact:** Immediately rinse eyes cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Continued irrigation may be necessary to ensure neutral pH. Water or saline may be used. GET MEDICAL ATTENTION IMMEDIATELY.
- **Skin Contact:** If on skin or hair, immediately flush contaminated areas with water. Immediately remove all contaminated clothing, jewelry, and shoes. Rinse skin with large amounts of water. Thoroughly clean and dry contaminated clothing and shoes before reuse. The specific treatment is dilution with water. There is no antidote. If you feel unwell, IMMEDIATELY CONTACT A POISON CENTER, PHYSICIAN/DOCTOR, OR GET MEDICAL ATTENTION.
- **Inhalation:** If inhaled and adverse effects occur, remove victim to fresh air and keep at rest in a position comfortable for breathing. Evaluate ABC's (is Airway constricted, is Breathing occurring, and is blood Circulating) and treat symptomatically. IF exposed or concerned: Get medical advice/attention. If you feel unwell, GET MEDICAL ATTENTION IMMEDIATELY
- **Ingestion/If swallowed:** Rinse mouth. Do NOT induce vomiting. Give large amounts of water. If vomiting occurs spontaneously, keep airway clear. Give more water when vomiting stops. Never give anything by mouth to an unconscious or convulsive person
- **Most Important Symptoms/Effects (Acute and Delayed)** Hydrochloric acid may be corrosive to the eyes, skin, and mucus membranes. It may be corrosive to any tissue it comes in contact with. Depending on the concentration, duration, and nature of the exposure, it can cause serious burns and extensive tissue destruction.

Storage and Handling

- Store and handle in accordance with all current regulations and standards.
- Store in rubber-lined steel, acid-resistant plastic or glass containers. Keep container tightly closed. Store in a cool, dry area. Store in a well-ventilated area.
- Keep away from heat, sparks and open flames.
- Keep separated from incompatible substances (see below or Section 10 of the Safety Data Sheet). Do not store in aluminum container or use aluminum fittings or transfer lines.
- Protect from physical damage. Dike and vent storage tanks.

2.4 Specific Safety measures for Sulphuric Acid, storage & handling are listed below.

Hazard Information

- Odorless, clear to amber, heavy, oily liquid. A pungent odor may exist if certain impurities are present in the acid..
- Extremely corrosive. Causes severe burns and / or eye damage.
- Reacts violently with water.
- Concentrated Sulfuric Acid will react with many organic materials and may cause fire due to the heat of the reaction.

In case of fire

- Not flammable, but reacts with most metals to form explosive/flammable hydrogen gas.
- Wear a NIOSH/MSHA approved self-contained breathing apparatus if vapors or mists are present and full protective clothing.
- For fighting fires in close proximity to spill or vapors, use acid-resistant personal protective equipment.

- Evacuate personnel to a safe area.
- Prevent unauthorized entry to fire area.
- Dike area to contain runoff and prevent contamination of water sources.
- Neutralize runoff with lime, soda ash or other suitable neutralizing agents (see Deactivating Chemicals, Section 6).
- Cool containers that are exposed to flame with streams of water until fire is out.

Health Information

- **Eye contact:** Immediately flush eyes with running water for a minimum of 20 minutes. Hold eyelids open during flushing. If irritation persists, repeat flushing. Obtain medical attention IMMEDIATELY. Do not transport victim until the recommended flushing period is completed unless flushing can be continued during transport.
- **Skin Contact:** Immediately flush skin with running water for a minimum of 20 minutes. Start flushing while removing contaminated clothing. If irritation persists, repeat flushing. Obtain medical attention immediately. Do not transport victim unless the recommended flushing period is completed or flushing can be continued during transport.
- **Inhalation:** Move victim to fresh air. Give artificial respiration ONLY if breathing has stopped. Do not use mouth-to-mouth method if victim ingested or inhaled the substance: induce artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Give Cardiopulmonary Resuscitation (CPR) if there is no pulse AND no breathing. Obtain medical attention IMMEDIATELY.
- **INGESTION:** DO NOT INDUCE VOMITING. If victim is alert and not convulsing, rinse mouth and give ½ to 1 glass of water to dilute material. If spontaneous vomiting occurs, have victim lean forward with head down to avoid breathing in of vomitus, rinse mouth and administer more water. IMMEDIATELY contact local poison control center. Vomiting may need to be induced but should be directed by a physician or a poison control centre. IMMEDIATELY transport victim to an emergency facility.

Storage and Handling

- Always add acid to water never the reverse.
- Wear appropriate Personal Protection Equipment.
- Keep ignition sources away from sulfuric acid storage, handling and transportation equipment.
- Locate safety shower and eyewash station close to chemical handling area.
- Hydrogen, a highly flammable gas, can accumulate to explosive concentrations inside drums, or any types of steel containers or tanks upon storage.
- Carbon steel storage tanks must be vented.
- If stored in non-reactive container, keep container tightly closed.

1. Visitor Card

Visitor card to be provided to each visitor with gate pass & Visitor badge; which will contain the Rules & Information as below:



ID Badges: ID Badges must be worn and visible at all times. They are to be returned to the reception desk/security gate when leaving the premises.



Mobile phone: Mobile phones with a camera function must not be used on these premises. The use of mobile phones is strictly prohibited in designated areas



Electronic devices: Electronic devices may not be connected to the company network without authorization



Smoking is prohibited: Smoking is prohibited on the company premises. The sale and consumption of tobacco products, alcohol and other narcotic substances is forbidden



Personal protective equipment (PPE): PPE must be worn in many areas of our site. For your own safety you must wear the appropriate protective equipment when entering these areas.



Alarm Signal: Obey alarm signals and follow the instructions of the fire safety team. A triggered piezo siren signal indicates a fire system alarm and alerts the fire safety team. However, piezo sirens emitting a continuous tone indicate that you must evacuate the building immediately.



Emergency Call: To report an accident or environmental incident, please call our internal emergency number on XXXX/XXXXXX. Please contact the emergency services; if there is any immediate danger. Emergency personnel will provide further instructions. Manual call points can be used to alert the fire brigade directly in the event of a fire.



Emergency Exit: Please leave the danger zone immediately and warn people at risk. In the event of fire, try to put out the fire with a fire extinguisher, if possible. Escape routes are marked in green on the emergency and evacuation plans displayed inside buildings. In the event of an evacuation, please proceed to the appropriate assembly point.



Assembly Point: Make your way to one of the designated assembly points and await further instructions. Report any missing colleagues to management at the assembly point.



First aid boxes: First aid boxes are provided for treating injuries, and qualified first aiders are on hand during working hours.

2. 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:

- Use of proper PPE will be ensured by safety officer.
- Check VOC content for flammable vapors 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 equipments 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 & 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 & personnel.

1.2 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.

1.2.1 Basic Contents of DMP

Basically, DMP contains following aspects

1. Description of site
2. Brief description of the plant
3. On – site Emergency plan
4. Off- site Emergency plan

1.2.2 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.

Table Error! No text of specified style in document..9: Mode of Emergency

Man made	Natural Calamities	Extraneous
<ul style="list-style-type: none"> • Heavy Toxic Leakage/ Spillage • Fire • Explosion 	<ul style="list-style-type: none"> • Flood • Earthquake • Cyclone • Outbreak of Disease 	<ul style="list-style-type: none"> • Riots/Civil Disorder/Mob Attack • Terrorism • Sabotage

<ul style="list-style-type: none"> • Failure of Critical Control system • Design deficiency • Unsafe acts • In-adequate maintenance 	<ul style="list-style-type: none"> • Tsunami 	<ul style="list-style-type: none"> • Bomb Threat • War/Hit by missiles • Food Poisoning/Water Poisoning
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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 Error! No text of specified style in document..10: On-Site Emergency Planning

Sr. No.	Code of Practice	Objective	Line of Action
1	In Case of Fire at Factory/Hazardous chemicals storage area/Diesel	To deal with Fire efficiently and quickly at different locations in the factory including diesel storage tank and electrical Panel	<ul style="list-style-type: none"> • 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, Leakage of hazardous chemicals.	To deal with the incidence of hazardous chemicals spillage or leakage efficiently and quickly	<ul style="list-style-type: none"> • Any person who notices any leakage or spillage of hazardous chemicals from storage tank, 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.

Objective of Offsite emergency plan

- 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 flammable and toxic chemicals.
- 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.

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 M/s. Jayvir Dyechem. to Local Fire Station, Mutual Aid Members will be established for quick communication.
- The names of the key persons are/will be defined to establish contacts and Co-ordinate the activities with the help of the Collect orate and disaster management center in case of major emergency.
- An on-site emergency control room has been identified by M/s. Jayvir Dyechem. 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, on telephone next information to local fire brigade on telephone and to DPMC –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, District will be in overall charge of security, evacuation and rescue operations at the time of emergency.

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 collectorate, mamlatdar.

Disclosure of information to neighboring organization and population:

- M/s. Jayvir Dyechem. 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. M/s. Jayvir Dyechem. 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.

Local crisis group:

As per central government notification and DISH office for preparation of offsite emergency plan and M/s. Jayvir Dyechem. will become member of local level crises group, will set up disaster management center of industrial estate using 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 estate 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.

Local crisis group consists of:

Chairman	: Dy. Collector
Member Secretary	: Asst. Directorate – Industrial Safety & Health
Member	: Factory manager of all industries
Member	: Transport contractors
Member	: Safety Manager,
Member	: Police Inspector,
Member	: TDO,
Member	: Civil defense inspector,
Member	: Medical officer, PHC Ltd.
Member	: Press reporter
Member	: Community leader, Sarpanch, 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, Bharuch.
- 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.

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.

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 Collectorate. 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:

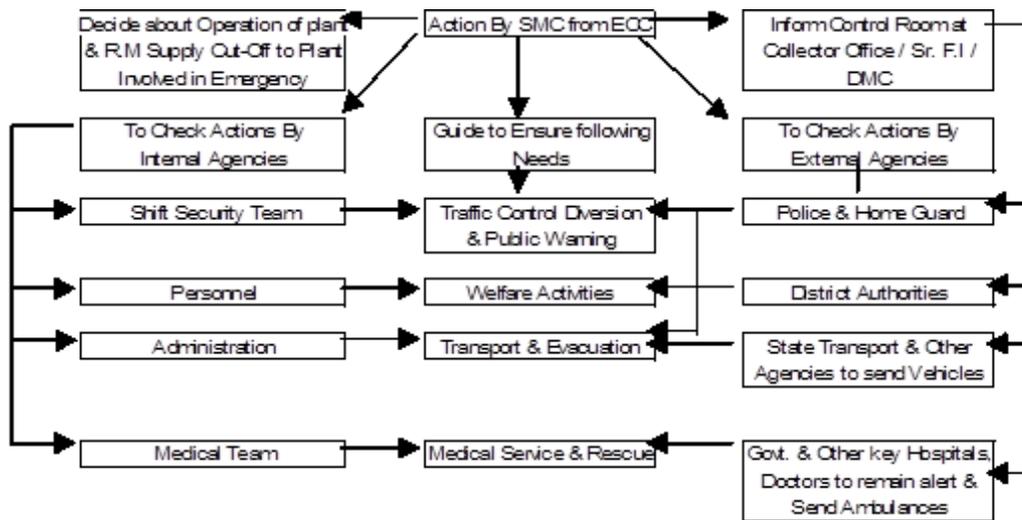


Figure Error! No text of specified style in document..2: Off-Site Emergency Plan

1.2.3 Objectives of Emergency Management System

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

- To identify and assess types of emergencies due to different types of hazards.
 - Emission of chemical vapors into the floor ambience and any injurious effects of physical contact with corrosive chemicals, inhalation of fumes, vapors and solvents. The consequences will be of 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.

1.2.4 Structure of Emergency Management System

M/s. Jayvir Dyechem. 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

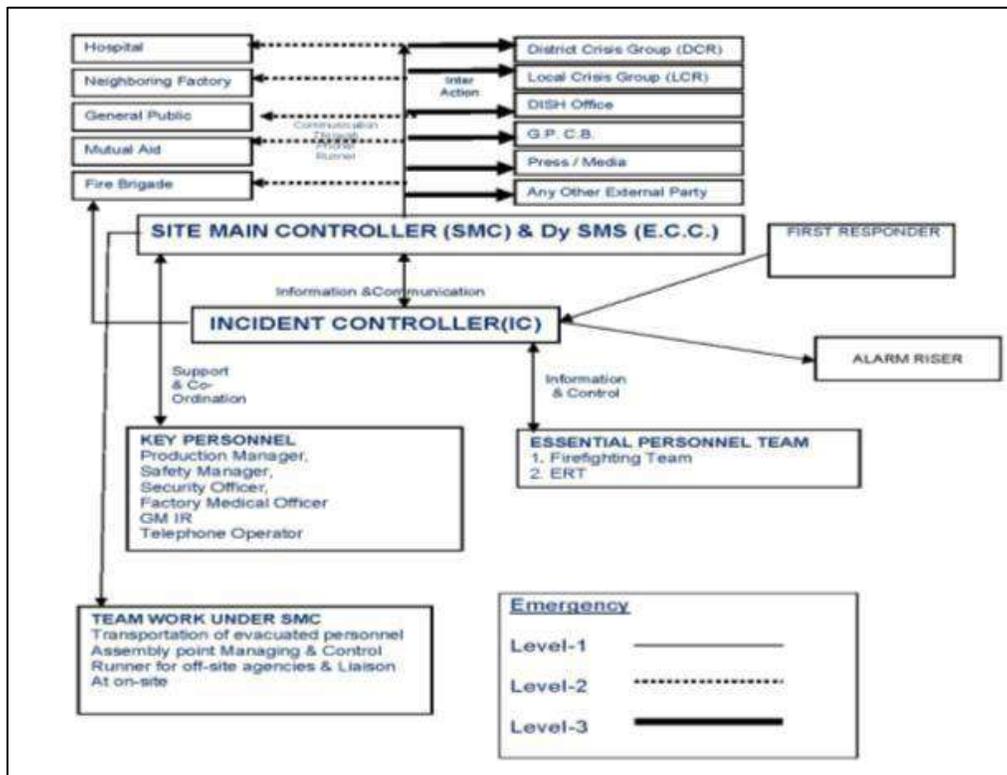


Figure 7.20: Emergency Organization Chart

1.2.5 Role & Responsibility of Emergency Management Team

Site Main Controller (SMC)

Senior most Executives (i.e. Director & 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.

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/she shall take charge at the scene of incident.
- He/she 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/she will work under the direction of the SMC, but till his/her arrival he may have to execute following responsibilities.
 - He/she will ensure that all the Key Personnel are called.
 - Direct for evacuation of plant and areas likely to be affected by the emergency.
 - He/she shall communicate to the SMC the type of outside help needed.
 - He/she 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 decide 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 Equipments), 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 & 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 DylC. IC/ DylCwork 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, equipments, materials, *etc*.
- Movement of equipment, special vehicle and transport to or from the scene of the accident.
- Search, evacuation, rescue and welfare.
- The injured 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 casualties reception areas to record details of casualties.
- 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.

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 Aids
- 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.: CO₂, 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

- Foam type
- Dry chemical powder type
- CO₂ type - 10 Nos.

Fire drill will be carried out periodically 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.

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 and 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.

1.3 OCCUPATIONAL HEALTH & SAFETY PROGRAMME

M/s Suren Dyechem Industries will prepare the Occupational Health Surveillance Programme which shall be followed right from the project construction & erection phase and the same shall be updated for the upcoming facility, if required.

The details of the same are described in the following sections.

Occupational Health

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

Hospital Facilities /Factory Medical Officer & OHC

- Company will make formal agreements with nearby hospital 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 & Antidotes as prescribed by FMO, etc. shall be made available at conspicuous locations.

Ambulance Van & First Aid Box

An Emergency Vehicle shall be made available round the clock to be used as an Ambulance during emergency.

First Aid Boxes will be made available at Security gate, emergency room, ETP and process plants. Training will be given to employees for First Aid.

Plan for Periodic Medical Checkup

Periodic Medical Examination should be conducted as per the following schedule;

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

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

Details of Occupational Health Impacts and Safety Hazards

Occupational Hazards Identification	Occupational Health Impacts
Exposure to Toxic & Corrosive Chemicals	Toxication, Irritation,
Exposure to Chemical Dust, Spillage/ leakage, Overflow	Severe irritation to eyes & skin, Respiratory disorder, Fatality, etc.
Slip/trip, fall, electric shock, etc.	Body Injury, Burns, Skin sensitization, Fall Injury, Electrocutation, 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.

1.3.1 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 Gujarat Factories Rules. Location for samplings shall be identified. Ambient Air & Noise Monitoring shall be done as per GPCB 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.

1.3.2 Monitoring of the Occupational Injury & It's Impact on Workers

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

- Each workplace will be evaluated for the work conditions.
- Unsafe Act & 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.

1.3.3 Safety Trainings & 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.