Chapter-6
Risk Assessment & DMP

6.1 PUBLIC CONSULTATION

Public Hearing is now not applicable as Industrial estate (PCPIR including Dahej-II) obtained EC from MoEFCC. Please refer **Annexure-12.**

6.2 RISK ASSESSMENT

Risk (R) is thus defined as function of possibility of occurrence of hazard (f) and magnitude of its consequence (D).

Risk (R) = f (Hazard, Probability, Consequence)

In most of the applications, however, risk may be defined as

Risk (R) = Probability (f) X Consequence (D)

6.3 METHODOLOGY

The methodology includes,

- Hazard Identification (Identify sources and causes of hazards).
- Hazard Analysis (Analyze how hazards will occur and affect).
- Risk Analysis (Estimate risk i.e. hazard occurring per unit time).
- Risk Assessment (Compare the risk with acceptable criteria - legal, social or political - and decide whether the risk is lesser or higher than that criteria), and
- Risk Management (Form organization to carry out above exercises and to monitor, control, review and keep the risks within permissible limits).

The above procedures are broadly divided into four steps as under…

1. Hazard identification,
2. Assortment of potential loss scenarios,
3. Modeling of release source on DNV's PHAST Micro 6.54,
4. plotting the contour on lay out

6.3.1 HAZARD IDENTIFICATION

It is an identification of sources of hazards and their causes.

It is qualitative. In simple term, it means listing of unsafe conditions, actions, situation etc.

Hazard identification is the first and important step.

If hazards are identified and removed, risks are prevented. If risks are prevented, accidents are prevented. If accidents are prevented, injuries and losses are prevented and that is the object of safety.

Base on project specific detail provided by client & referring MSDS of hazardous chemicals to be handled at site associate hazards have been identified.

Unit has proposed to manufacture fine chemicals & pesticide intermediates @ 377 MT/Month at this location. This involves storage of some of the raw material at the site which can lead to uncontrolled release of hazardous material causing hazard. On the basis of this, the important hazards that can lead to accident in the proposed project are given below …

1) Health Hazards
2) Fire & Explosion Hazards
3) Biological Hazards

Based on nature & scale of industry Important Hazardous Events from Fire & Explosion are summarised as under…

1) **Explosion**: Release of energy in a rapid and uncontrolled manner gives rise to explosion.
2) **Deflagration:** It is an explosion with a resulting shock wave moving at a speed less than the speed of sound in unreacted medium
3) **Detonation:** It is an explosion with a resulting shock wave' moving at a speed more than the speed of sound in unreacted medium
4) **BLEVE :** Boiling liquid expanding vapour explosion (BLEVE), also referred as a fireball, is a combination of fire and explosion with an intense radiant heat emission within a relatively short time interval.

   When a tank or pressure vessel containing liquid or liquefied gas above its boiling point (so heated) fails or ruptures, the contents release as a turbulent mixture of liquid and gas, expanding rapidly and dispersing in air as a cloud. When this cloud is

ignited, a fireball occurs causing enormous heat radiation intensity within a few seconds.

5) **Confined and Unconfined Vapour Cloud Explosion (VCE) :**

An unconfined vapour cloud explosion (UVCE) occurs in open at a distance from the point of vapour release and threatens a larger area. A large release of flammable vapours and cloud formation explodes when spark or friction is available. Though it is a rare possibility but has more potential to damage.

A confined vapour cloud explosion (CVCE) occurs in a confined place (e.g. vessel, pipe, building, pit etc.) while UVCE occurs in an open area. The peak pressures of CVCE are much higher than that of UVCE.

6) **Jet Fire:** 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.

7) **Flash Fire:** A flammable gas release gets ignited at the farthest edge resulting in flash-back fire

8) **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.

9) **Shock wave** is a pressure wave moving through a gas. A shock wave in open air and combined with wind wave is called 'blast wave'.
Shock-waves due to explosion can cause damage to buildings breaking windows.
People can be blown over or knocked down, buried under collapsed material or injured by flying fragments
People in the vicinity of over-pressure may die and injuries due to indirect effects are also serious.

Relationships between Fire Types and Potential Vulnerabilities

Fire type	Potential Vulnerability		
	Engulfment	Radiation	Inside Building
Flash fire	✓	×	Possibly
Jet fire	✓	✓	✓
Pool fire	✓	✓	✓
Fireball/BLEVE	✓	✓	Possibly

Consequences of Fire/Heat Wave

Thermal Radiation (kW/m^2)	**Effect**
1.2	Received from the sun at noon in summer
2	Minimum to cause pain after 1 minute
Less than 5	Will cause pain in 15 to 20 seconds and injury after 30 seconds' exposure
Greater than 6	Pain within approximately 10 seconds; rapid escape only is possible
12.5	• Significant chance of fatality for medium duration exposure. • Thin steel with insulation on the side away from the fire may reach thermal stress level high enough to cause structural failure. • Wood ignites after prolonged exposure.
25	• Likely fatality for extended exposure. • Spontaneous ignition of wood after long exposure. • Unprotected steel will reach thermal stress temperatures that can cause failure.
35	• Significant chance of fatality for people exposed instantaneously. • Cellulosic material will pilot ignite within one minute's exposure.

Consequences of Overpressure

Explosions generate overpressures and drag forces that in turn result in damage to buildings and structures, and generate missiles (fragments of damaged structures, window glass shards, or loose objects). The effects of overpressure on humans are normally categorized as follows:

- Direct or Primary: injury to the body as a result of the pressure change
- Secondary: injury as a result of fragments or debris produced by the overpressure impacting on the body
- Tertiary: injury as a result of the body (especially the head) being thrown by the explosion drag and impacting on stationary objects or structures

Type of injury	Peak pressure (psi)	Impact velocity (m/s)
Skin laceration threshold	1-2	15
Serious wound threshold	2-3	30
Serious wound 50% probability	4-5	55
Serious wound 100% probability	7-8	90

Probability of fatality (%)	Peak overpressure (psi)* (Duration 400 milliseconds)
1	35-45
50	45-55
99	55-65

Probability of eardrum rupture (%)	Peak overpressure (psi)
1 (threshold)	2.4
10	2.8
50	6.3
90	12.2

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)

Types of Exposure: This may be brief or prolonged. Individual susceptibility to exposure depends on age, sex, pregnancy, smoking, alcohol intake and general state of health.

Permissible and Threshold Limits of Exposure and Dosage

Various limits, values or dosages are assigned to indicate permissible or lethal limit etc. as under…

(1) Permissible Exposure Limits (PELs)

- Specifies the maximum amount or concentration of a chemical to which a worker may be exposed.
- Generally defined in three different ways

1. **Ceiling Limit (C):** the concentration that must not be exceeded at any part of the workday
2. **Short-Term Exposure Limit (STEL):** the maximum concentration to which workers may be exposed for a short period of time (15 minutes)
3. **Time-Weighted Average (TWA):** the average concentration to which workers may be exposed- for a normal, 8-hour workday & 40 hourwork week.

(2) Threshold Limit Values (TLVs)

-Prepared by ACGIH (**American Conference of Governmental Industrial Hygienists**) volunteer scientists

-Denotes the level of exposure that nearly all workers can experience without an unreasonable risk of disease or injury

-An advisory limit; not enforceable by law

-Generally can be defined as ceiling limits, short-term exposure limits, and/or time-weighted averages

-Usually equivalent to PELs

(3) Excursion Limit - ACGIH

-This limit is applicable to those substances which have no TLV-STELs.

-Excursions in worker exposure levels may exceed 3 times the TLV-TWA for no more than a total of 30 minutes during a workday, and under no circumstances should they exceed 5 times the TLV-TWA, provided that the TLVTWA is not exceeded.

(4) Recommended Exposure Limits (RELs)

-Recommended by NIOSH (National Institute for Occupational Safety and Health)

-Indicates the concentration of a substance to which a worker can be exposed for up to a 10 hour workday during a 40-hour work week without adverse effects, however, sometimes based on technical feasibility

-Based on animal and human studies

-Generally expressed as a ceiling limit, short-term exposure limit, or a time-weighted average

-Often more conservative than PELs and TLVs

(5) Workplace Environmental Exposure Limits (WEELs)

-Developed by AIHA (American Industrial Hygiene Association) volunteers

-Advisory limits; not enforceable by law

-Typically developed for chemicals that are not widely used or for which little toxicity information is available

(6) Company-Developed Limits

-Developed by company scientists

-Advisory limits; not enforceable by law

-Usually based on only short-term studies of animals

-Generally intended for internal company use and sometimes for the customers

(7) Lethal Dose or Lethal Concentration (LD orLC)

In experimental toxicology, it is common practice to determine the quantity of poison per unit of body weight of an experimental animal which will have a fatal effect (A scale commonly used is milligrams of poison per kilogram of body weight.)

LC_{50}/LD_{50} Lethal dose for 50 percent, the dose that kills one half of a group of test animals (usually ten or more).

6.3.2 MAXIMUM CREDIBLE LOSS SCENARIOS (MCLS)

Important aspects will be considered for the selection of release scenarios.

- → Flammability and the flash point of the material
- → Phase of material i.e. liquid or gas
- → Threshold quantity of the chemicals as prescribed in MSHIC Rule
- → Operating temperature and pressure of the material
- → Total inventory of the material

The properties of the important raw materials and the safety precautions to be taken to prevent an accident are detailed in 'Material Safety Data Sheets'. The details of storage of Hazardous chemicals along with measures taken during storage are given in Table 7.1.

6.3.3 SOFTWARE USED FOR CALCULATIONS

1. PHAST MICRO:

Phast is the most comprehensive software available for performing Process Hazard Analysis (PHA), Quantitative Risk Assessment (QRA) and Financial Risk Analysis (FRA). Our extensively validated software for consequence and risk analysis is used by governments and industry helping them to comply with local safety regulation and their own corporate best practice. Phast contains all the discharge, dispersion, effects and risk models you will need to accurately assess all your major hazards and associated risks. Phast Consequence provides you with comprehensive hazard analysis facilities to examine the progress of a potential incident from the initial release to its far-field effects.

TOXIC AND FLAMMABLE IMPACT

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

DISCHARGE

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

DISPERSION

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

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

FLAMMABLE EFFECTS

For releases of flammable material Phast calculates

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

TOXIC EFFECTS

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

PHAST RISK

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

Phast Risk allows you to quickly identify major risk contributors so that time and efforts can be directed to mitigating these highest risk activities. Based on effects calculations and population vulnerabilities, Phast Risk can integrate over all scenarios and weather conditions to estimate the total risk. The established individual and societal risk indicators are predicted by Phast Risk across your facility and surrounding area using the classical QRA

methodology. Risk ranking reports can be produced at points of strategic importance to show the relative influence of the various failure scenarios and their contribution to both the individual and societal risk metrics.

A key benefit of Phast Risk is the ability to identify major risk contributors and differentiate these from incidents with worst case consequences which might otherwise dominate the safety reviews. Whilst medium scale incidents have lesser consequences, they may have a higher frequency, which, when combined with their hazardous effects, generate a higher level of risk. Time and effort directed to mitigating high consequence but often low frequency events may not be well spent. Phast Risk helps you direct this effort more effectively.

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

BENEFITS

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

FINANCIAL EXTENSION

The Financial Consequence extension is used to assess situations which present potential hazards not only to life but also to the environment, property and business and help quantifying their severity in financial terms. Phast Financial helps you to estimate the cost of a particular release of a given material under specified conditions. The Financial Risk

extension helps you to calculate the broader financial risks associated with accidents and can be used to help manage your business risk and assess appropriate levels of insurance.

BLAST EXTENSION FOR EXPLOSION RISK

The Blast extension permits more accurate explosion modeling and thus better risk predictions. It provides all the extra functionality required to assess overall risks taking account of protection provided by different types of structure and areas of congestion on your plant. Models supported include the Multi Energy and Baker Strehlow Tang explosion models and a number of industry standard vulnerability models

MULTI-COMPONENT EXTENSION

The multi-component extension to Phast provides greater accuracy for liquid or two-phase mixture releases compared to the standard pseudo-component approach. The composition of each component of the mixture is calculated throughout the discharge and dispersion phases of the release.

2. HAMS-GPS

HAMS-GPS Software Package is a professionally built Window based Software. HAMS-GPS enables from advanced Training to Research oriented HSE-Management Studies including Risk Assessment (including FAR, FN-Curve and ISO-Risk), Accident Analysis, ASCLAP-Distribution, Plume, Puff, Spill Pool evaporation dispersion modeling, Safety Audits, Emergency Management Planning and Control, PROBIT computations, Percent and Absolute Fatality, Injury computations, Fire (Pool Fires, Jet Fires) & Explosion (Vapor Cloud, BLEVE, Confined, Unconfined, Mechanical) Modeling, Explosion Prevention (Inerting, Static Charge development), DOW-Fire & Explosion computations, EIA, Developing and Establishing an Integrated System on EMS& OHSMS under International Standards, on Personal Health and Fitness and more.

Comprises of Expert Modules: Dispersion with PROBITS, Fire, Explosion, DOW-Index, Safety-Audit, ASCLAP, EIA, SMOD, Risk Assessment, EMP Evaluation, Accident Analysis (Database), Dispersion, PRTOBITs, Fire Analysis (Database), Limits curve, Absolute Fatality/Injury (Dispersions, Explosions and Fire-Balls), OHSMS- Evaluation against OHSAS-18001 (Database), House Keeping Evaluation, Unitcon (Unit conversion) and More.

Other releases: BLEVE, Oil/Gas well blow out scenarios, SWOT analysis, Safety manual review, QRA-review, Hydraulics, and Industrial Work Hygiene index (Database), HAZOP Study Software and More.

SMOD

Source Models: Liquid flow through a hole in a tank, Liquid flow through a hole under constant pressure, Liquid flow through a pipe, Vapor/gas flow through hole, Vapor/gas flow through a pipe, Flashing liquids stored above atmospheric B.Pt., pool evaporation by substrate heat conduction and wind, Tank dimensions, Dyke dimensions, LPG-bund computations. Options for converting Density, mass, force, latent heat, specific heat, pressure, temperature, computing vapor density, vol. Of vapor from P1T1 to P2 T, and Calculator.

DISPERSION WITH PROBITS MODULE

Plume, Puff, Spill Dispersions with tabular and graphic display with 5-User defined Isopleths in XY-Slice and Isoelevets in XZ-Plane at Y-Cross wind distance. Full 3-D "CAT-Scan" output possible with dispersion "Cake slicing in XY (Isopleths) and XZ (Isoelevets) Graphs. Graphics are in color as Custom color, Default color or BW. It is a complete CAT-Scan with Probits (PROBIT short for Probability Unit, is the percent Fatality and Injury due to exposure to any hazardous agent). This Advanced Dispersion provides for Mass and volumes of various concentration zones and concentration zone shells of Plumes, Puffs and Spill pool evaporation dispersions. Options for Conc. Conversion, computing: mol. Wt., IDLHTWA & LEL-UEL of mixtures, LEL-UEL at any temperature, LC-50 of man from animal data, LC/RIC of mixtures, weighted average, Temperature conversion and calculator.

FIRE MODULE

Pool fire, liquid jet fire, Turbulent and diffusion jet fires with PROBITs. Graphics are in color as Custom color or Default color or BW. Options for density conversion and calculator.

RISK ASSESSMENT

FAR, FN-Curve, ISO-Risk, Individual Risk computations. Graphics are in color as Custom color or Default color or BW.

SCENARIO DEVELOPER

This module enables development of maximum Credible Loss Scenarios (MCLS) also called Maximum credible Accident Scenarios (MCAS) for QRA Study conforming to International guidelines under World bank Technical Ppers-55. This module provides for over 200 Chemicals and select parameters for Scenario development with options for user defined chemicals and parameter selections.

Table 6.1 Storage Details of Hazardous Chemicals

Sr. No.	Name of the material	Mode of Storage	Max Quantity To Be Stored (MT)
1	Acetic Acid	Tank	10 x 4
2	Acrylonitrile	Tank	10 X1
3	Caustic Soda Lye	Tank	25 x 2
4	Di Methyl Sulphate	Tank	15 x 2
5	Glycerol	Tank	30 x 2
6	HCl	Tank	15 x 2
7	Methanol	Tank	10
8	Sulphuric Acid	Tank	25 x 2
9	Toluene	Tank	10X2
10	Anhydrous Ammonia	Cylinder	1
11	Hydrogen gas	Cylinder	0.3

Table 6.2 Chemical Properties of the Hazardous Chemical

SR. NO.	NAME OF THE RAW MATERIALS	State	FP deg C	BP deg C	LEL%	UEL%	SP.GR. 20 deg C	VD vs air	LD50 mg/kgs Oral	LC 50	IDLH ppm	TLV	
												STEL	TWA
1	Hydrogen	Gas	-18	- 252.8	4.1	74.2	0.069	0.07	--	--	--	--	--
2	Acrylonitrile	Liquid	-1.11	73.3	3.1	17	0.806	1.8	27	333 ppm	85	10	2
3	Acetic Acid	Liquid	39	118.1	4	19.9	1.049	2.07	3310	5620 ppm	50	15	10
4	Caustic Soda Lye	Liquid	NA	140	NA	NA	1.53	0.62	NA	NA	--	2	2
5	Di Methyl Sulphate	Liquid	83.3	188 (Decomposes)	NA	NA	1.3322	4.35	205	45 ppm	7	-	0.1
6	Glycerol	Liquid	97	194	NA	NA	1.215	NA	8000	--	--	NA	NA
7	HCl	Liquid	NA	108.58	NA	NA	1.1 TO 1.9	1.267	900	3124	50	NA	NA
8	Methanol	Liquid	12	64.5	6	36.5	0.7915	1.11	5628	64000	6000	250	200
9	Para Hydroxy Toluene	Solid	118	265	NA	NA	1.048	7.6	890	--	250	--	10
10	Sulphuric Acid	Liquid	NA	270	NA	NA	1.84	3.4	2140	510	15 mg/m3	3	1
11	Toluene	Liquid	4.444	110.6	1.1	7.1	0.86	3.1	636	440	500	500	200
12	Anhydrous Ammonia	Gas	NA	NA	NA	NA	0.59	0.045	--	7338	300	35	25

NA : Not Available

6.4 TRANSPORTATION OF HAZARDOUS CHEMICALS

6.4.1 EMERGENCY ACTION PLAN FOR TRANSPORTATION

Role of Transporter

- "Tremcard" must be obtained from the respective supplier and to be kept on vehicle with driver.
- Emergency information panel shall be placed on the front sides and rear.
- The Driver must hold valid driving license for HMV .
- The driver must possess a certificate for transportation of hazardous goods.
- First-aid, Safety and fire appliances shall be kept in vehicle and maintained properly.
- In case of emergency, the driver should inform immediately to concern Transporter or Fire Brigade or Police or Ambulance.
- The tanker driver shall initiate emergency actions as per the TREMCARD.

INCASE OF EMERGENCY, DIAL POLICE (100), FIRE BRIGADE (101) AND AMBULANCE (102)

Role of Fire Brigade:

- On being received the emergency call the officer of fire brigade shall rush immediately to incident site with water tender and adequate fire squad to deal the emergency in case of fire, spillage as indicated under Tremcard.
- Assess the situation on arrival and decide whether the appliances and equipment he has, or will shortly have, are sufficient to control the fire.
- Rescue arrangement shall be made for injured persons.
- Due to sudden accident, panic situation may be controlled by use of P.A. System.
- Other emergency services i.e. police; hospital and local authority are to be informed through control room for follow up action.
- Serious injured person is to be sent immediately to the hospital as soon as possible
- Arrangement is to be made to stop leakage from the tanker.
- Arrangement is to be made to contain spilled material immediately by with inert materials like sand or earth.
- Stop smoking & other ignition source in vicinity.
- Mobilization of vehicles and crowd is to be controlled.
- Line of hose is to be laid down to tackle fire if occurs in the spilled or in the tanker.
- Stop the engine in case of running.
- Name and address of victims, who was rescued / given first-aid / sent to hospital, shall be noted and written in occurrence book and other copy is to be submitted to the nearest police station.

- On completion of operation incidence report is to be submitted to the CFO, Head Quarter.

Role of Medical Wing:

- At the time of emergency, providing quick and adequate medical relief to the victims of incidence will have to be given on top most priority.
- Provide emergency aid at site of incident by special unit equipped.
- Make arrangement for adequate stock of antidotes, life saving drugs &medicines.
- Make arrangement for ambulance, stretchers, First-aid kits etc.
- Get the details from first-aid post, casualty-receiving center & prepare report.

Role of Police:

- Control and regulate the traffic within the area of incident.
- Assist the fire brigade by cordoning off the affected area and help the fire fighting by supplementing fire fighting personnel to the extent possible.
- Assist the medical personnel in evacuating causalities.
- Prevent unauthorized entry into the affected area.
- Control general law and order.

Role of F.K. Fine Chemicals

- Provide the driver with a "TREMCARD" written in Gujarati, Hindi and English language that explained him emergency actions i.e. what to do in case of fire, spillage and contact telephone numbers.
- Provide the transport route of the carrier to the port. This route must stay constant all the time.
- Inform the local authorities along the route of what actions to take if an incident occurs and to avoid contaminating the area.
- If disposal is necessary, follow the disposal procedure as per guidelines of R&H.
- Investigate the incident and develop report to prevent recurrence.

"RUSH TO THE INCIDENT SITE IMMEDIATELY AS AND WHEN RECEIVE THE EMERGENCY CALL"

6.4.2 TRANSPORT EMERGENCY CARD (Road)

CARGO	Distillation Residue Semisolid Black cast crystalline semisolid form. Insoluble in water. This material is considered stable. Avoid contact with strong oxidizers.
NATURE OF HAZARD	Heated material can form flammable or explosive vapors with air. Closed containers may rupture via pressure build up when exposed to fire or extreme heat. Combustion generates toxic fumes.
PROTECTIVE DEVICES	Suitable respiratory protective devices. Use safety goggles. Chemical-resistant gloves, gumboot should be worn whenever this material is handled. Use chemically resistant apron. Eye wash bottle with clean water.
EMERGENCY ACTION	**Contact immediately F.K. Fine Chemicals** or Notify police, Fire Brigade & Ambulance immediately. **Telephone: Police- 100, Fire- 101, Ambulance-102 & 108.** Avoid contact with solid & vapors. Stop the Engine. No naked lights. No Smoking. Mark road & warn other road users. Keep public away from danger area. Stay upwind.
SPILLAGE	Appropriate protective equipment must be worn when handling a spill of this material. Shut off leak if without risk. Prevent semisolid entering sewers, basements & work pits. Evacuate the spill area. Eliminate all ignition sources including those beyond the immediate spill area. Ventilate the spill area. Contain spills immediately with inert materials (e.g. sand, earth). Transfer solids diking material to separate suitable containers for recovery or disposal. Avoid breathing vapor.
FIRE	Use the following extinguishing media when fighting fires involving this material. Foam, Carbon Dioxide (CO_2), Dry chemical powder (DCP), Water spray. Move containers promptly out of fire zone.
FIRST AID	(1) If substance got into the eyes, immediately wash out with plenty of water at least 15 minutes. (2) Move victim to fresh air. Give artificial respiration if breathing has stopped. If breathing is difficult, give oxygen. Get prompt medical attention. (3) Wash affected skin areas thoroughly with soap & water. Remove & wash contaminated clothing thoroughly. (4) Never give anything by mouth to an unconscious person. Do not induce vomiting. Careful gastric lavage may be indicated.
Additional information provided by Manufacturer or Sender:	
Name & Address of Company	F.K. Fine Chemicals

Emergency Contact Person	**Mobile No.**	**Residence No.**	
			F.K. Fine Chemicals

KINDLY CONTACT NEAREST POLICE STATION FOR REPORT & HELP

6.4.3 TRANSPORTATION, UNLOADING AND HANDLING PROCEDURE

SR.NO.	ACTIVITY	TYPE OF POSSIBLE HAZARD	MITIGATION MEASURES
1	Transportation of Chemicals like Hazardous Chemicals & Solvents by road tanker	Leakage& Spillage	• Check the source of leakage point. • Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. • Stop leak if you can do it without risk.
		Fire,& explosion,	• Use water spray to reduce vapors; do not put water directly on leak, spill area or inside container. • Keep combustibles (wood, paper, oil, etc.) away from spilled material.
		Toxic release	• Isolate the area • Isolate the container • Training will be provided to driver and cleaner regarding the safe driving, hazard of Flammable chemicals, emergency handling. • TREM card will be kept with TL. • Fire extinguishers will be kept with TL. • Flame arrestor will be provided to TL exhaust. • Instructions will be given not to stop road tanker in populated area. • Clear Hazard Identification symbol and emergency telephone number will be displayed as per HAZCHEM CODE. • Appropriate PPEs will be kept with TL.
2	Hazardous Chemicals & Solvents Road tanker unloading at project site.	Leakage& Spillage	• Check the source of leakage point. • Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. • Stop leak if you can do it without risk.
		Fire,& explosion,	• Use water spray to reduce vapors; do not put water directly on leak, spill area or inside container. • Keep combustibles (wood, paper, oil, etc.) away from spilled material.
		Toxic release	• Isolate the area • Isolate the container • Check the source of leakage point. • Spray the water on leakage • Priority will be given to Tanker to immediately

			enter the storage premises at site and will not be kept waiting near the gate or the main road. • Security person will check License, TREM CARD, Fire extinguisher condition; Antidote Kit, required PPEs as per SOP laid down. • Store officer will take sample as per sampling SOP from sampling point. • After approval of QC department unloading procedure will be allowed be started. **Following precautions will be adopted during unloading** • Wheel stopper will be provided to TL at unloading platform. • Static earthing will be provided to road tanker. • Tanker unloading procedure will be followed according to check list and implemented. • Flexible SS hose connection will be done at TL outlet line. • The quantity remaining in the hose pipeline will be drained to a small underground storage tank, which will be subsequently transferred by nitrogen pressure to the main storage tank thus ensuring complete closed conditions for transfer from road tanker. • All TL valves will be closed in TL. • Finally earthing connection and wheel stopper will be removed. • Only day time unloading will be permitted.
3	Hazardous Chemicals & Solvents Storage tank safety	Leakage& Spillage, Fire, Explosion Toxic release.	• Check the source of leakage point. • Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. • Stop leak if you can do it without risk. • Use water spray to reduce vapors; do not put water directly on leak, spill area or inside container. • Keep combustibles (wood, paper, oil, etc.) away from spilled material. • Isolate the area • Isolate the container • Check the source of leakage point. • Spray the water on leakage • SS storage tank will be provided as per IS code. • Dyke wall will be provided to storage tank. • Level transmitter will be provided with low level high level auto cut-off provision. • Vent will be connected to water trap and vent

			of water trap will be provided with flame arrestor. • Water sprinkler system will be provided to storage tank. • Fire hydrant monitor with foam attachment facility will be provided. • Dumping / Drain vessel/alternate vessel will be provided to collect dyke wall spillage material. • FLP type pump will be provided. • Nitrogen blanketing will be provided to storage tank. • Double static earthing will be provided to storage tank. • Double Jumper clip will be provided to all Solvent handling pipeline flanges.
4	Hazardous Chemicals & Solvents transfer from storage tank to Day tank	Leakage& Spillage due to Line rupture, Flange Gasket failure, Fire, Explosion, Toxic release.	• Double mechanical seal type FLP type pump will be provided. • Double on / off switch will provided at tank farm and process area near day tank. Pump auto cut off with day tank high level will be provided. • Flame arrestor will be provided on day tank vent. • Over flow will be provided for additional safety and it will be connected to main storage tank. • NRV will be provided on pump discharge line. • Double Jumper clip will be provided to all solvent handling pipeline. • Double static earthing will be provided to day tank.
5	Hazardous Chemicals & Solvents transfer from Day tank to reactor.	Leakage, Spillage due to Line rupture, Flange Gasket failure, Fire, Explosion, Toxic release.	• Gravity transfer. • Total quantity of day tank material will be charged in to reactor at a time. • Static earthing will be provided to storage tank. • Double Jumpers will be provided to pipeline flanges.

6.5 SCENARIOS

Table – 6.3 Possible Accident Scenarios

Sr. No.	Name of the material	Mode of Storage	Max Quantity To Be Stored (MT)
Hazards : Fire & explosion & toxic Release			
1	Acrylonitrile	Tank	10
2	Methanol	Tank	10
4	Toluene	Tank	10
5	Hydrogen gas	Cylinder	0.3
6	Drum Storage	Drum	20
Hazards: Toxic Release			
1	HCl	Tank	15
2	Sulphuric Acid	Tank	25
3	Acetic Acid	Tank	24
4	Caustic Soda Lye	Tank	25
5	Anhydrous Ammonia	Cylinder	1

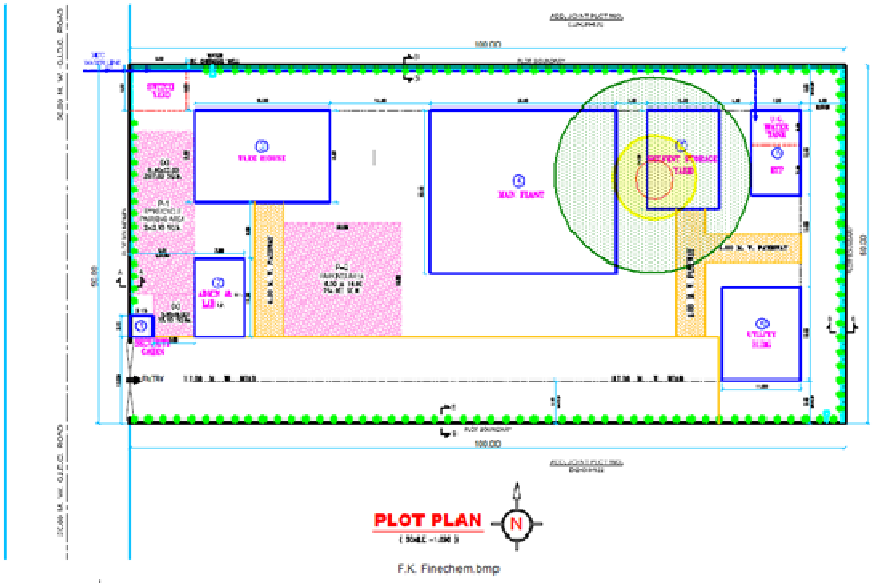
Tank on Fire for 10 KL Acrylonitryle storage tank

Tank on Fire Simulation for 10 KL Acrylonitryle tank.			
Scenario : TANK ON FIRE			
In put Data		**Results of Computations**	
Stored quantity	10 KL.	**Max. IHR at flame centre height**	12.50 Kw/m^2
Pool diameter	1.30(m)	**Flame centre height**	7.12 meter
Pool liquid depth	1.6 (m)	**Maximum Flame width**	4.12 meter
Wind speed	1.97 m/s	**Mass burning rate liquid**	5.1 kg/ m^2/min.
Liquid Density	869 kg/m^3	**Flame burnout time**	8.35 Hrs.

Incident Intensity of Heat Radiation (IHR) at ground level KW /m^2	**IHR- Isopleths Distance (Meters)**	**Effect if IHR at Height of Simulation**
37.5	1.5	Damage to process equipment. 100 % Fatal in 1 Min. 1 % fatal in 10 sec.
25.0	1.6	Min. to ignite wood (without flame contact). 100 % fatal in 1 Min. Significant injury in 10 sec.
12.5	3.0	Min. to ignite wood (with flame contact). 1 % fatal in 1 min. 1 st deg. burn in 10 sec.
4.0	4.7	Pain after 20 secs. Blistering unlikely.
1.6	6.9	No discomfort even on long exposure.

Results

- In the 2.8 meter radius area is considered as 100% fatality in 1 min.
- In 3.1 meter radius area is considered as 1st deg. Burn in 10 sec. and 1 % fatal in 1 minute.
- In the 5.5 meter radius area will give pain after 20 seconds. Blistering unlikely.
- In the 8.6 meter radius area is considered as safe area and no discomfort even on long exposure.



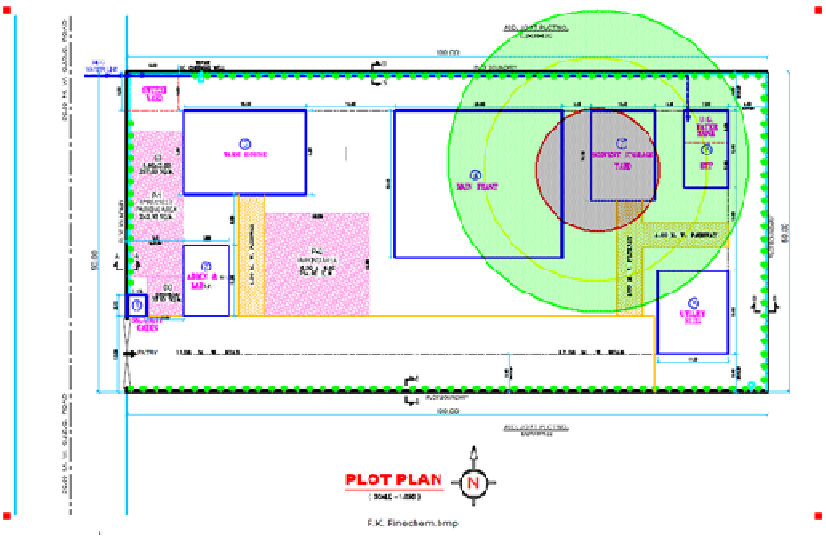
Pool Fire for Acrylonitryle storage tank catastrophic failure

For Acrylonitryle (ACN) Storage Tank			
Scenario : POOL FIRE			
In put Data		**Results of Computations**	
Stored quantity	10 KL.	**Max. IHR at flame centre height**	77.07 Kw/m^2
Pool diameter	10.0(m)	**Flame centre height**	22.44 meter
Pool liquid depth	1.0 (m)	**Maximum Flame width**	11.37 meter
Wind speed	1.97 m/s	**Mass burning rate liquid**	5.2 kg/ m^2/min.
Liquid Density	869 kg/m^3	**Flame burnout time**	8.33 Hrs.

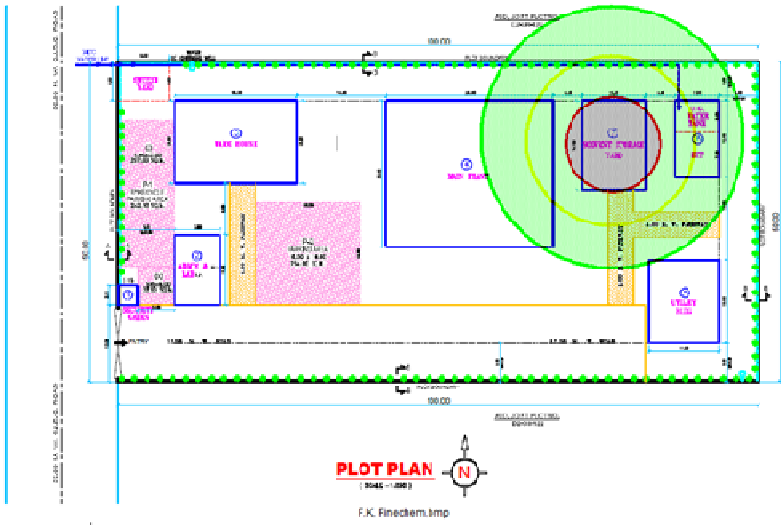
Incident Intensity of Heat Radiation (IHR) at ground level KW /m^2	**IHR-Isopleths Distance (Meters)**	**Effect if IHR at Height of Simulation**
37.5	5.4	Damage to process equipment. 100 % Fatal in 1 Min. 1 % fatal in 10 sec.
25.0	6.6	Min. to ignite wood (without flame contact). 100 % fatal in 1 Min. Significant injury in 10 sec.
12.5	9.3	Min. to ignite wood (with flame contact). 1 % fatal in 1 min. 1 st deg. burn in 10 sec.
4.0	16.4	Pain after 20 secs. Blistering unlikely.
1.6	25.9	No discomfort even on long exposure.

Results

- In the 9.8 meter radius area is considered as 100% fatality in 1 min.
- In the 16.9 meter radius first degree burn in 10 sec.
- In the 29.6 meter radius area will give pain after 20 seconds. Blistering unlikely.
- In the 46.7 meter radius area is considered as safe area and no discomfiture even on long exposure.



Catastrophic Rupture : Methanol Tank		
Input Data		
Stored quantity - 10 KL		
Molecular weight - 33.05		
Wind speed – 1.97 m/s		
Density (Air) – 0. 810 g/cm^3		
Results indicate		
Pool Fire Scenario		
Radiation Level (KW/m^2)	**Distance in meter**	**Effect if IHR at Height of simulation**
4	19.3	This level is sufficient to cause personnel if unable to reach cover within 20s; however blistering of the skin (second degree burn) is likely; 0: lethality
12.5	10.6	This level will cause extreme pain within 20 seconds and movement to a safer place is instinctive. This level indicates around 6% fatality for 20 seconds exposure.
37.5	6.4	This level of radiation is assumed to give 100% fatality as outlined above.
Fireball Scenario		
Radiation Level (KW/m^2)	**Distance in meter**	**Injury Type**
4	24.5	Pain after 20secs.
12.5	14.5	1st degree Burn
37.5	8	100% Fatal
Flash Fire Scenario		
Radiation Level (KW/m^2)	**Distance in meter**	**Effect if IHR at Height of simulation**
4.0	11	This level is sufficient to cause personnel if unable to reach cover within 20s; however blistering of the skin (second degree burn) is likely; 0: lethality
12.5	6	This level will cause extreme pain within 20 seconds and movement to a safer place is instinctive. This level indicates around 6% fatality for 20 seconds exposure.
37.5	3	This level of radiation is assumed to give 100% fatality as outlined above.



Release of Ammonia

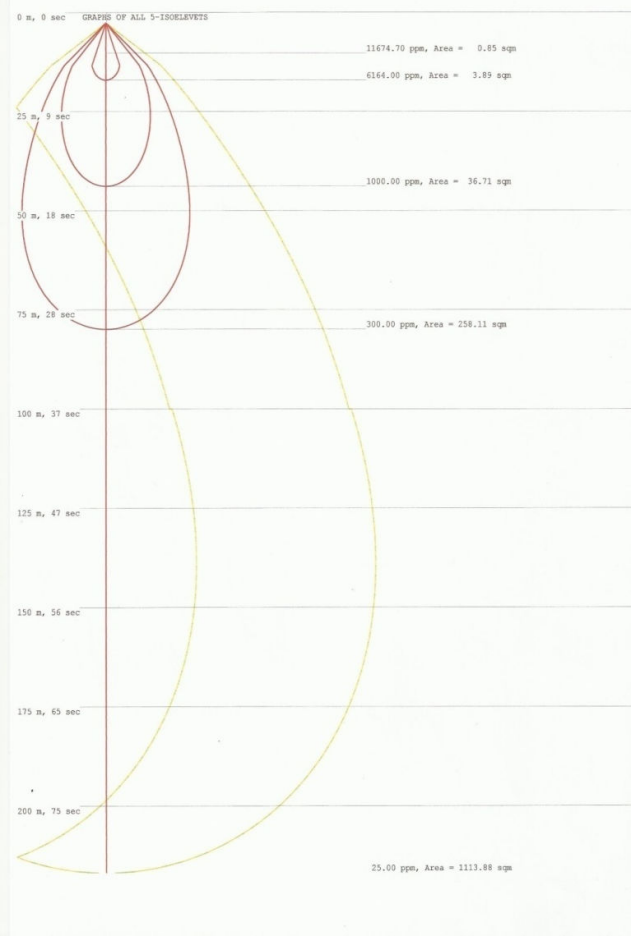
Catastrophic Rupture	
Input Data	
Stored quantity - 1 MT	
Molecular weight - 17.03	
Wind speed – 1.97 m/s	
Vapor Density (Air=1) – 0.597	
Results indicate	
LC50 – 6164 ppm	**17.06 meter**
IDLH – 300 ppm	**79.88 meter**
TWA/ TLV – 35 ppm	**216.79 meter**

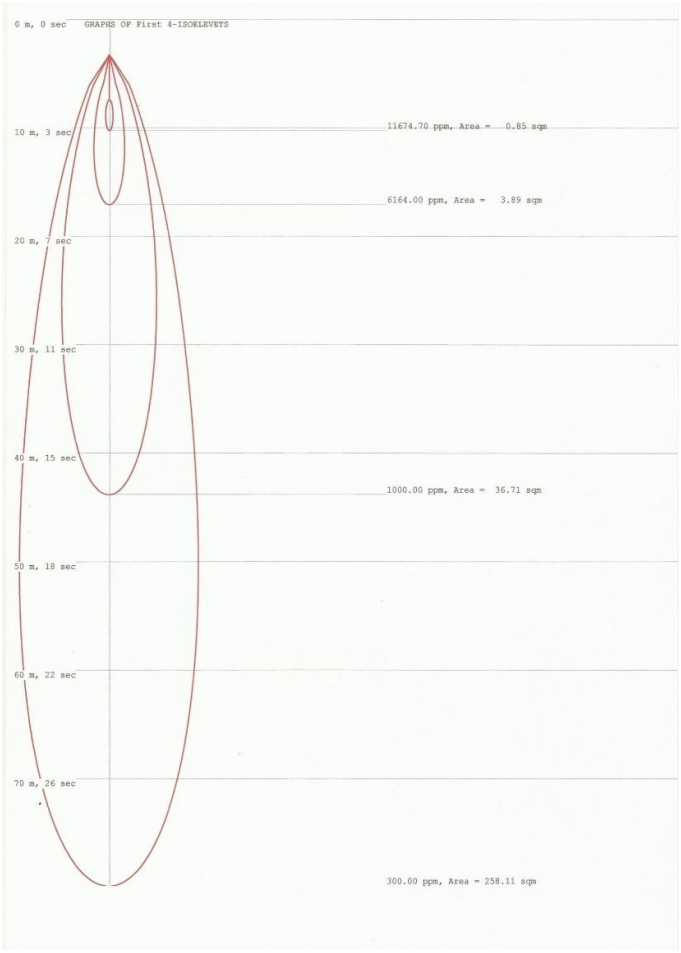
Safety Precaution:

- Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material.
- Do not ingest. Do not breathe gas/fumes/ vapor/spray.
- In case of insufficient ventilation, wear suitable respiratory equipment.
- If ingested, seek medical advice immediately and show the container or the label.
- Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, reducing agents, acids, alkalis, moisture.

- Store in a segregated and approved area.
- Keep container in a cool, well-ventilated area.
- Keep container tightly closed and sealed until ready for use.

Scenario:



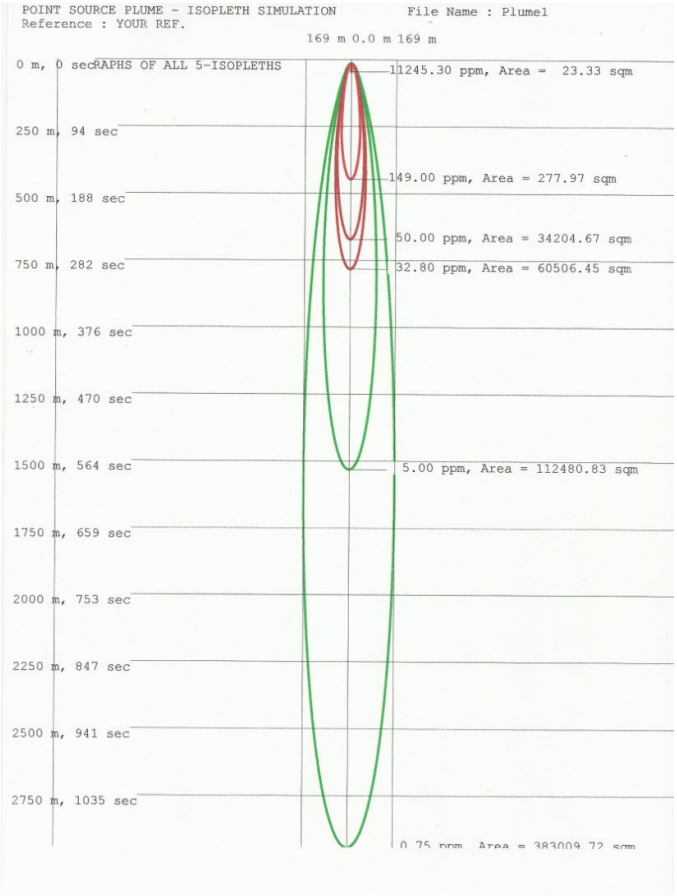

0 m, 0 sec GRAPHS OF First 4-ISOELEVETS
10 m, 3 sec
11674.70 ppm, Area = 0.85 sqm
6164.00 ppm, Area = 3.89 sqm
20 m, 7 sec
30 m, 11 sec
40 m, 15 sec
1000.00 ppm, Area = 36.71 sqm
50 m, 18 sec
60 m, 22 sec
70 m, 26 sec
300.00 ppm, Area = 258.11 sqm

Spill Pool evaporation modules for HCl Storage Tank catastrophic failure

Catastrophic Rupture	
Input Data	
Stored quantity - 15 MT	
Molecular weight - 36.46	
Wind speed – 1.97 m/s	
Vapor Density (Air=1) – 1.25	
Results indicate	
LC50 – 149 ppm	**44.69 meter**
IDLH – 5 ppm	**1532.66 meter**
TLV – 5 ppm	**2943.00 meter**

Results:

LC50 (149 ppm) area up to 44.69 meter, Immediate danger to life and health (5 ppm) concentration area up to 1532.66 meter and TLV (5 ppm) area up to 2943 meter. Therefore 1532.66 meter area in wind direction is considered as evacuation area.



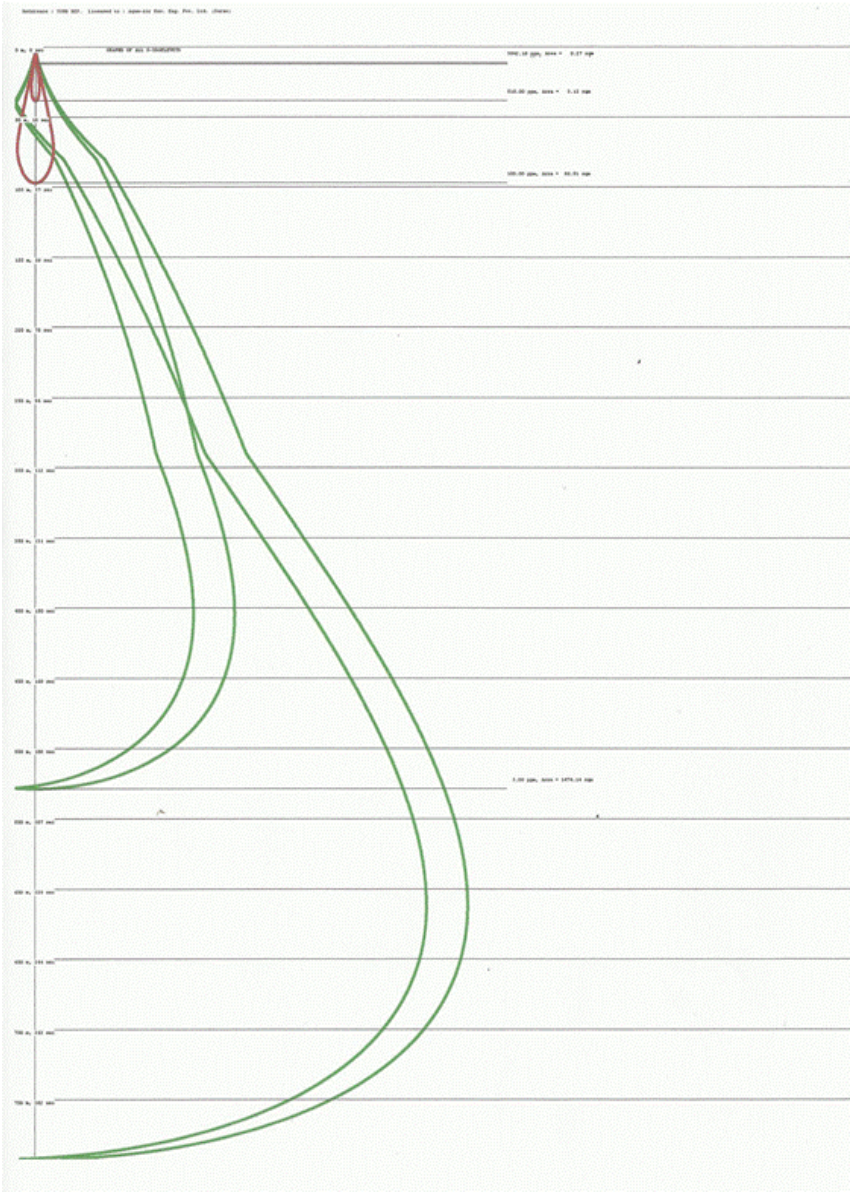
Release of Sulphuric Acid

Spill pool evaporation module for Sulphuric Acid due to Catastrophic Rupture of 10 MT Storage Tank	
Input Data	
Stored quantity - 25 MT	
Molecular weight - 98.08	
Wind speed – 1.97 m/s	
Failure Mode: Catastrophic failure of 4" bottom nozzle and loss of containment	
Vapor Density (Air=1) – 3.4	
Release rate: 1000 g/s	
Results indicate	
LC50 – 510 mg/m^3	**38.26 meter**
IDLH – 3 ppm	**528.56 meter**
TLV –1 mg/m^3	**792.29 meter**

Results:

- LC50 (510 mg/m^3) area is up to 38.26 meter,
- IDLH (3 ppm) concentration area is up to 528.56 meter and
- TLV (1 mg/m^3) area is up to 792.29meter.

Scenario:



Mitigation measures for sulphuric acid leakage:

- ✓ Isolate the source if possible without risk.
- ✓ If leakage is small, dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.
- ✓ Absorb with DRY earth, sand or other non-combustible material.
- ✓ Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift.
- ✓ Use water spray to reduce vapors.
- ✓ Prevent entry into sewers, basements or confined areas.
- ✓ Neutralize the residue with a dilute solution of sodium carbonate.

Preventive measures to avoid sulphuric acid leakage:

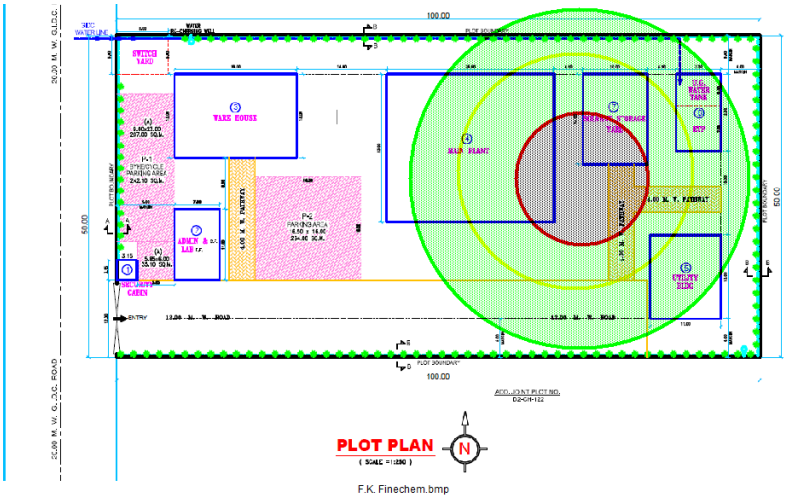
- ✓ A dike will be provided to accommodate the full quantity in tank.
- ✓ Periodic testing of storage tank will be done by competent person.
- ✓ Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective TLVs. Storage tank vent is connected to scrubber system.
- ✓ Flange guard provided to prevent splash of material.
- ✓ Level interlock
- ✓ Keep container dry. Never add water to this product.
- ✓ In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label.
- ✓ Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, organic materials, metals, alkalis, moisture.
- ✓ Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.
- ✓ While handling always use face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent.
- ✓ Ensure that eyewash stations and safety showers are proximal to the work-station location.

Release of Acetic Acid:

Catastrophic Rupture of Tank		
Input Data		
Stored quantity -24 KL		
Molecular weight -60.05		
Wind speed – 1.97 m/s		
Density (Air) –1.049 g/cm^3		
Results indicate		
Pool Fire Scenario		
Radiation Level (KW/m^2)	**Distance in meter**	**Effect if IHR at Height of simulation**
4	103.2	This level is sufficient to cause personnel if unable to reach cover within 20s; however blistering of the skin (second degree burn) is likely; 0: lethality
12.5	67.2	This level will cause extreme pain within 20 seconds and movement to a safer place is instinctive. This level indicates around 6% fatality for 20 seconds exposure.
37.5	42	This level of radiation is assumed to give 100% fatality as outlined above.

Scenario : Toluene Pool Fire

Basis: Catastrophic Rupture unloading arm (4”) of road tanker and Resultant Pool Fire due to static charge.		
Basic Input Data		
Stored quantity	10 KL	
Molecular Weight	92.1	
Vapor Density (Air=1)	3.14	
Wind speed	1.97 m/s	
Temperature	Room Temperature	
Pressure	Atmospheric Pressure	
Consequence Results		
Radiation Level (KW/m^2)	**Distance (meter) (Category 1.5/F)**	**Effect if IHR at Height of simulation**
4	85	**This level is sufficient to cause personnel if unable to reach cover within 20s; however blistering of the skin (second degree burn) is likely; 0: lethality**
12.5	60	This level will cause extreme pain within 20 seconds and movement to a safer place is instinctive. This level indicates around 6% fatality for 20 seconds exposure.
37.5	28	This level of radiation is assumed to give 100% fatality as outlined above.



No.	Impacting Activity	Identified Aspect	C	P	C X P	Remarks
2	Storage of corrosive Material **(Hydrochloric Acid)** In HDPE Tank	Spill	3	3	9	Moderate
		Collapse of storage tank	5	2	10	Moderate
		Leakage-Fumes	3	3	9	Moderate

Mitigation Measures

Dyke wall will be having sufficient size.
Periodic checking of tanks.
Level gauge will be provided.
Overflow with return line from Receiver to st. tank will be provided.
Good ventilation in the area.
Vent line will be provided at sufficient height.
Tanks will be kept on sound foundation.
Alkaline sand will be kept in sufficient quantity.
Good housekeeping will be maintained. SBA set; Canister mask and airline mask will be provided.
Eye washer & shower will be provided.

Scenario Hydrogen (UNCONFINED JET FIRE)

This scenario considers release of Hydrogen:

Results indicate:

Unconfined Jet Fire for Hydrogen Pipeline catastrophic failure		
SCENARIO : UNCONFINED JET FIRE		
Input Data		
Stored quantity		60 Kg
Wind speed		1.97 m/s
Gas Density		67 kg/m^3
Incident Intensity of Heat Radiation (IHR) at ground level KW /m^2	**IHR- Isopleths Distance (Meters)**	**Effect if IHR at Height of Simulation**
37.5	8.5	Damage to process equipment. 100 % Fatal in 1 Min. 1 % fatal in 10 sec.
25.0	10.6	Min. to ignite wood (without flame contact). 100 % fatal in 1 Min. Significant injury in 10 sec.
12.5	14.8	Min. to ignite wood (with flame contact). 1 % fatal in 1 min. 1 st deg. burn in 10 sec.
4.0	29.0	Pain after 20 secs. Blistering unlikely.
1.6	41.6	No discomfort even on long exposure.

Results

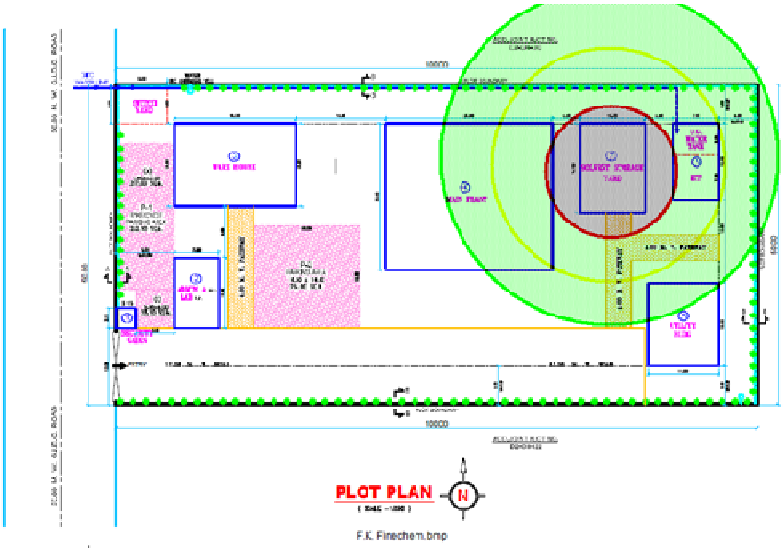
- In the 8.5 meter radius area is considered as 100% fatality in 1 min.
- In the 14.8 meter radius first degree burn in 10 sec.
- In the 29 meter radius area will give pain after 20 seconds. Blistering unlikely.
- In the 41.6 meter radius area is considered as safe area and no discomfort even on long exposure.

Flash Fire Scenario:

Flash Fire simulation for Hydrogen gas -pipeline catastrophic failure		
SCENARIO : FLASH FIRE		
Input Data		
Stored quantity	60 Kg	
Heat of combustion	42267 Kj/kg	
Fuel-Air volume ratio in Flash fire cloud	0.600	
Stochiometric Fuel-Air Mixture	0.029	
Wind speed	1.97 m/s	
Gas Density	0.067	
Incident Intensity of Heat Radiation (IHR) at ground level KW /m ^{2}	**IHR- Isopleths Distance (Meters)**	**Damage effects**
37.5	11.0	100 % Fatal. Min. to ignite wood (without flame contact)
25.0	18.0	Significant injury. Min. to ignite wood (without flame contact).
12.5	31.0	Min. to ignite wood (with flame contact). 1 st deg. burn.
4.0	43.0	Pain after 20 secs. Blistering unlikely.
1.6	83.0	No discomfort even on long exposure.

Results

- In the 11.0 meter radius area is considered as 100 % fatality in 1 min. and first degree burn in 10 sec.
- In the 31.0 meter radius first degree burn in 10 sec.
- In the 43.0 meter radius area will give pain after 20 seconds. Blistering unlikely.



Mitigation Measures

Fleet will be maintained in good condition.

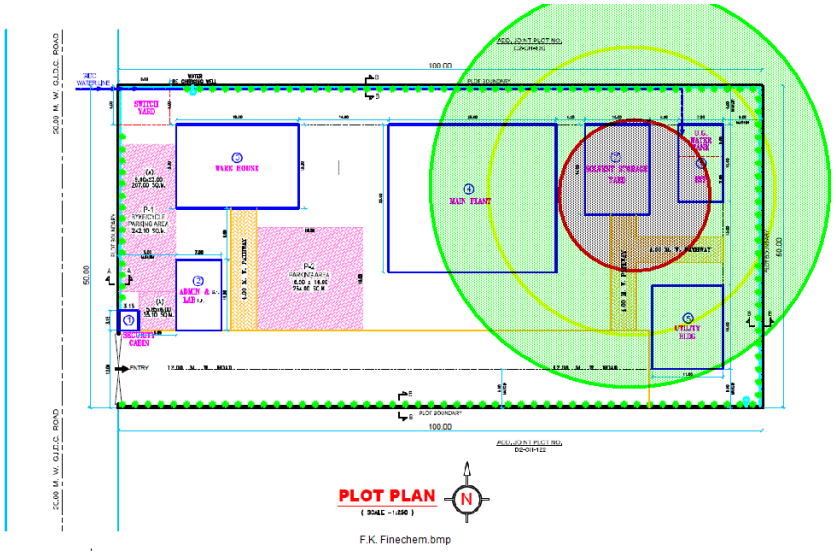
Train driver will be employed.
Good road condition will be maintained.
Tonner will be transferred only when Tonner with Valve protecting cap.
Continuous monitoring system for chlorine will be installed and maintained.
Stored and used under Shed to protect from direct sun light.
Certified Cylinder will only be utilized.
Hot work will be performed under safety work permit only.
FFE in sufficient quantity will be provided.
Well-trained fire staff with Fire hydrant system as per TAC guideline will be deployed.
Flame proof electrical connection will be provided.

On site Off site Emergency plan will be revised, amended and rehearsed on regular basis.

Unconfined Pool Fire Simulations for Drum Storage Area

Catastrophic Rupture		
Input Data		
Stored quantity - 20 MT		
Wind speed - 2.00 m/s		
Density (Air) – 0.867 g/cm^3		
Results indicate		
Pool Fire Scenario		
Radiation Level (KW/m^2)	**Distance in meter**	**Effect if IHR at Height of simulation**
4	68.2	This level is sufficient to cause personnel if unable to reach cover within 20s; however blistering of the skin (second degree burn) is likely; 0: lethality
12.5	45.8	This level will cause extreme pain within 20 seconds and movement to a safer place is instinctive. This level indicates around 6% fatality for 20 seconds exposure.
37.5	22.40	This level of radiation is assumed to give 100% fatality as outlined above.

Fire Ball Scenario		
Radiation Level (KW/m^2)	**Distance in meter**	**Injury Type**
4	72.0	Pain after 20secs.
12.5	59.1	1st degree Burn
37.50	24.2	100% Fatal



6.5.1 OTHER OPERATIONAL RISK & MITIGATION MEASURES

No.	Impacting Activity	Identified Aspect	Impact Scoring			Remarks
			Consequences C	Probability P	Final Score C X P	
1	Boiler Operation	Explosion cause due to temperature /pressure build up	--	--	--	Significant Impact - Catastrophic Incident

Mitigation Measures

Standard and necessary fittings to be provided regular inspection to be carried out.
Conditioning monitoring of the boiler by using NDT Techniques like inspection of deposits in tubes of different sections, hardness testing, Dye penetrate and ultrasonic testing of weld joints.
Trivi test; by increasing drum pressure
Destructive testing of sample tubes during overhaul of boiler.(tensile test)
Regular monitoring of tube thickness, tube scanning and advance techniques like LFED (Low frequency Electrodynamic Device.)
Hydro testing of boiler once in a year
Ensuring proper protection by periodic checks
Furnace draft control to avoid explosion
Acoustic sensors to detect the sound of the tube leak in the furnace.
Alarms and monitoring and controls to maintain the water chemistry.
Alarms and monitoring metal temperature of pressure parts.(Water chemistry,pH value, unwanted chemicals such as Silica)
Regular house keeping reports and checks.

2	Chemical Transfer through Pipeline/Drum	Toxic gas release	2	3	6	Moderate
		Fire	3	3	9	

Mitigation Measures

For Pipe lines…

- Regular inspection of pipelines and vessels.
- The damaged pipes, flanges to be replaced regular painting of pipe lines.
- Safe practice is to pump to the measuring tank and an overflow line returning to the tank.
- The pipelines will be well laid, giving adequate support, provision for maintenance, and painted for correct identification.
- The pipelines will be of various materials, depending upon the nature of chemicals handled.
- Pipelines carrying flammable material will be properly bonded and earthed.
- Isolation valves should be provided for easy control in case of breakage and maintenance.

- Sensors, Remotely operated Valve
- Fire detector, Adequate Firefighting system (Extinguisher) will be provided.

For Drums…

- While handing liquids from drums, the material can be emptied by sucking into a measuring vessel or by pumping out, using a small pump that could go into the bung opening.
- Air pressure should not be used, more so with toxic or corrosive liquids. Transfer by vacuum and using necessary PPE is the best procedure.
- Solids can be discharged into reactors by drum titters or emptied onto specially designed screw conveyor.
- Cut drums should not be invariably used. They can cause plenty of accidents, as workers are not careful to hammer down the sharp edges.
- Partially used drums must be covered, special protection should be taken to preserve the chemical and the product identified

Dangerous chemicals require elaborate cleaning to really wash out the traces of harmful ingredients.

No.	Impacting Activity	Identified Aspect	C	P	CXP	Remarks
3	Electricity	Burning Injury, Electric Shock Fire by short circuit	3	4	12	Major

Impact on Human body

Approximate threshold shock voltages at 50 c/s are as under:

Threshold of feeling	10 to 12 V
Threshold of pain	15 V
Threshold of severe pain	20 V
Threshold of hold-on	20 to 25 V
Threshold of death	40 to 50 V
Range of fibrillation	60 to 2000 V

Mitigation Measures

Proper earthing and double earthing. General earthing for big power station, upto 0.5 ohm

Use of electric shock guard (ELCB)

Use of approved insulated tools, rubber mats, shockproof gloves and boots, tester, fuse puller or tong,

D.O. rod, discharge rod, safety belt, hand lamp, wooden or insulated ladder and not wearing metal ring,

chain etc.

Switches on the live line. Fused switches and air-current breaks should be used.

Good insulated and tested wiring.

Use protective relays, circuit breakers and rated fuses to control the current and to isolate the faulty equipment speedily and automatically.

Isolation of machine/equipment before use.

Safety tags and safety warning notices.

Auxiliary room, battery room and control room to be separated

Guard on transmission lines to prevent fault due to birds.

Use of grounding mat of low ohmic value and all non current-carrying parts to be connected to the grounding grid by duplicate earth and segregated non current carrying metallic parts to be electrically bonded.

Temperature sensitive alarm and protective relays to make alert and disconnect equipment before overheating

Interlocks to put into and out of service equipment correctly.

Generators and motors with fire proof doors automatically actuated by fire detectors.

Flame and shock detectors and central fire annunciation system for fire safety.

Prevent higher humidity and temperature near electric installations.

Earthing and bonding of solvent carrying pipelines and equipment

No.	Impacting Activity	Identified Aspect	C	P	CXP	Remarks
4	Bad House Keeping	Injury, Fire, Chemical hazards	3	4	12	Major

Mitigation Measures

Regular inspection of plant on day-to-day basis, Proper placement of materials.

It includes proper placement and use of hand tools, materials, equipment, clear and unobstructed workplaces, aisles stairs etc.,

Speedy disposal of waste, scrap, splashes and obstructions, safe means of handling goods or articles, fenced platforms, floor-openings and wall openings to prevent fall accidents, removal of possibilities of falling bodies, provision of sufficient containers for waste collection, avoidance or fencing of sharp edges, corners etc.,

Safe and efficient cleaning methods, good lighting, colour and ventilation, proper marking and identification, protective equipment to cleaners and maintenance men, special areas for storage of raw materials, finished product, tools and accessories, racks for hand tools or implements above work-benches, under bench drawer for storage of small personal possessions, devices on machines to prevent deposit of oil, water etc.,

Cleanliness of surrounding floors, drainage, channels etc,

Special cleaning gangs with necessary cleaning materials and equipment, daily and weekly cleaning schedules, regular arrangements for removal of waste and emptying of waste containers, prevention of debris and clutter under benches and machine parts and special precautions depending upon the nature of industry.

No.	Impacting Activity	Identified Aspect	C	P	CXP	Remarks
5	Structural Collapse	Injury	-	-	-	Significant

Mitigation Measures

Structural stability to be obtained from Chartered engineer, load bearing capacity to be checked, regular inspection of plant.

Bridges, footbridges, pontoons, walkways, gangways and workplaces should possess sufficient buoyancy, strength and stability

Assessment of stability of the ground.

While putting heavy structure, supports (props) should be given to prevent toppling.

In erection work load should be ascertained for centre of gravity and its transfer at the slinging point.

No.	Impacting Activity		Identified Aspect	C	P	CXP	Remarks
6	Process operation	Hydrogenation Vaccum Pressurize Reaction Chlorination Distillation Condensation	Fire Spill Rupture	--	--	--	Significant Impact

Mitigation Measures

All Vessels will be well designed to withstand the pressure, temperature and the reaction carried out inside it.

All Vessels will be provided with pressure gauges and temperature indicator.

Jacket cooling system through Brine water / Plant water / Tower water circulation provided on all vessels.

All vessels will be hydraulically pressure tested and record is maintained in Form No. 11.

All the plants, departments will be provided with fire extinguishers as per requirement.

Process area provided with flameproof electrical fittings and pumps. Plant declared "Fire Zone". No smoking board displayed in plants. Fire extinguishers will be provided. All the pipelines are bounded and ear-thing provided.

Workers / Supervisors / Officers working on process will be well trained in safe operating procedures.

All plants will be provided with eye washer cum safety shower.

MEASURES TO PREVENT SUCH ACCIDENT

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

Following precautions will be adopted during unloading

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

Following precautions will be adopted Storage of such chemicals

- Storage tank will be stored away from the process plant.
- Tanker unloading procedure will be prepared and implemented.
- Caution note and emergency handling procedure will be displayed at unloading area and trained all operators.
- NFPA label will be provided.
- Required PPEs like full body protection PVC apron, Hand gloves, gumboot, Respiratory mask etc. will be provided to operator.
- Neutralizing agent will be kept ready for tackle any emergency spillage.
- Safety shower, eye wash with quenching unit will be provided in acid storage area.
- Material will be handled in close condition in pipe line.

- Dyke wall will be provided to all storage tanks, collection pit with valve provision.
- Double drain valve will provided.
- Level gauge will be provided on all storage tanks.
- Safety permit for loading unloading of hazardous material will be prepared and implemented.
- TREM CARD will be provided to all transporters and will be trained for transportation Emergency of Hazardous chemicals.
- Fire hydrant system with jockey pump as per TAC norms will be installed.

For Storage tank farm area

- Under N2 pressure storage.
- Safety valve provided and storage facility to ensure safe release of HC in case of over pressure.
- Dyke with separate fencing area is provided.
- SOP prepared
- Road tanker unloading procedure prepared
- Work permit followed
- PPEs used
- Safety shower, eye wash provided.
- NFPA labeling system adopted for storage tanks.
- Level indicator at local.
- Alarm for high level & high pressure.
- Automatic fire fighting indication provided for around the storage area
- Sprinkler system will be provided

6.6 OCCUPATIONAL HEALTH & SAFETY

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

The industrial planner, therefore, has to properly plan and take steps to minimize the impacts of industrialization and to ensure appropriate occupational health and safety including fire plans. All these activities again may be classified under construction and erection, and operation and maintenance.

Health of all the employees in plant area will be regularly monitored by outside physician. If any abnormality will found necessary treatment will also being given time to time. Necessary history cards, records will also be maintained which is up-dated time to time.

6.6.1 OCCUPATIONAL HEALTH

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

6.6.1.1 CONSTRUCTION AND ERECTION

The occupational health problems envisaged at this stage can mainly be due to constructional accident and noise. To overcome these hazards, in addition to arrangements to reduce it within TLV's, necessary protective equipments shall be supplied to workers.

6.6.1.2 OPERATION AND MAINTENANCE

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

- Industrial Safety Helmet;
- Face shield
- Zero power plain goggles with cut type filters on both ends;

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

6.6.1.3 HOSPITAL FACILITIES

It is proposed that client will make formal agreements with nearby hospital having facilities to attend fire and toxic effect cases for attending the affected persons in the emergency arising out of accidents, if any.

6.6.1.4 FACTORY MEDICAL OFFICER (FMO)

A qualified doctor will be appointed as FMO on retainer ship basis. Apart from him, Paramedical Staff will be employed.

6.6.1.5 PROPOSED FACILITY TO BE MADE AVAILABLE AT OHC

One Room is proposed to be provided to be operated as OHC. The centre will be equipped with following medical equipments:—

1. Examination Table

2	Dressing Tables	For performing Dressing
3.	Glucometer	For measurement of Blood Sugar
4	Vision chart	To evaluate vision acuity
5.	Nebulizer	For relieving coughs & Breathing Difficulty
6.	Infra red light	for relieving muscular pain
7.	Suction machine	For cleaning airway
8.	Autoclave machine	For sterilizing cotton &dressing material
9.	Weighing Machine	For measuring body weight
10.	Medical Oxygen Cylinder kit	
11.	Sphygmomanometer	To measure blood pressure
12.	Refrigerator	To preserve medicines
13.	Thermometer	

6.6.1.6 AMBULANCE VAN

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

FIRST AID BOX

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

6.6.1.7 PERIODIC MEDICAL EXAMINATION

It is proposed that client will ensure that…

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

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

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

(C) In periodic and pre-medical examinations, various parameters will be checked. Viz., LIVER FUNCRION TESTS, Chest X-rays, Audiometry, Spirometry, Vision testing (Far &

Near vision, color vision and any other ocular defect) ECG and other parameters as will be found necessary as per the opinion of Factory Medical officer.

(2) No person shall be employed for the first time without a certificate of granted by the Factory Medical Officer.

6.6.1.8 EMP for the Occupational Safety & Health hazards so that such exposure can be kept within permissible exposure level (PEL)/Threshold Level value (TLV) so as to protect health of workers.

1. It is proposed to formulate and implement an EMP for Occupational Safety and Health with following aims…

- To keep air-borne concentration of toxic and hazardous chemicals below PEL and TLV.
- Protect general health of workers likely to be exposed to such chemicals
- Providing training, guidelines, resources and facilities to concerned department for occupational health hazards.
- Permanent changes to workplace procedures or work location to be done if it is found necessary on the basis of findings from workplace Monitoring Plan.

2. It is proposed that this EMP be formulated on the guidelines issued by Bureau of Indian Standards on OH&S Management Systems: ISO 18001:2000 Occupational Health and Safety Management Systems
3. Proposed EMP will be incorporated in Standard Operating Procedure also.
4. **The proposed EMP will also include measure to keep air-born concentration of toxic and hazardous chemicals below its PEL and TLV, like…**
   a. Leak Surveys
   b. Separate storage for toxic chemicals
   c. Exhaust Ventilation
   d. Proper illumination
   e. On-line detectors toxic chemicals like Chlorine and Bromine
   f. Close processes to avoid spills and exposures
   g. Atomization of process operations to hazards of manual handling of chemicals
   h. Supply of proper PPEs like Air mask, Berating canisters, SCBA sets, On-line breathing apparatus at the places where there is possibility of presence of toxic chemicals
   i. Decontamination procedure for empty drums and carboys.
   j. Regular maintenance program for pumps, equipment, instruments handling toxic and corrosive chemicals

k. Display of warning boards

l. Training to persons handling toxic and corrosive chemicals

6.6.1.9 WORKPLACE MONITORING PLAN

- It is proposed that a Workplace Monitoring Plan to be prepared & implemented in consultation with FMO and industrial hygienists.
- Each workplace must be evaluated to identify potential hazards from toxic substances or harmful physical agents. Air-borne concentration of toxic chemicals will be measured and record will be kept.
- The current state-of-the-art exposure measurement model is as follows: For purposes of measuring worker exposure across a single shift it is sufficient t o place a reasonably accurate exposure measuring device on the worker , within t he worker 's breathing zone, and have it operate for nearly the full shift. Client has been proposed to study the exposure data when the plant is operative.

6.7 HEALTH EVALUATION OF WORKERS

1. It is proposed that management will devise a plan to check and evaluate the exposure specific health status evaluation of workers
2. Workers will be checked for physical fitness with special reference to the possible health hazards likely to be present where he/she is being expected to work before being employed for that purpose. Basic examinations like Liver Function tests, chest x ray, Audiometry, Spirometry Vision testing (Far & Near vision, color vision and any other ocular defect) ECG, etc. will be carried out. However, the parameters and frequency of such examination will be decided in consultation with Factory Medical Officer and Industrial Hygienists.
3. While in work, all the workers will be periodically examined for the health with specific reference to the hazards which they are likely to be exposed to during work. Health evaluation will be carried out considering the bodily functions likely to be affected during work. The parameters and frequency of such examination will be decided in consultation with Factory Medical Officer and Industrial Hygienists. Plan of monthly and yearly report of the health status of workers with special reference to Occupational Health and Safety.

6.7.1 OCCUPATIONAL HEALTH PROGRAM

To which chemicals workers are exposed directly or indirectly	TLV/Permissible exposure levels as	What measures company have taken to keep these chemicals within PEL/TLV	How the workers are evaluated concerning their exposure to chemicals during pre-placement and periodical medical monitoring	Measures to be taken in Emergency
Benzene	IDLH (NIOSH): 500 ppm PEL (OSHA): 1 ppm STEL(OSHA):5 ppm	Mechanical seal type pump for transferring material. Close transferring system Flange guard provided Earthing & Bonding Educate & train workers Standard work practices	Phenol levels in urine have been used as an index of benzene exposure Pathological changes in the hematopoietic system. The differential white blood cell count Abnormalities in the appearance of red cells Abnormalities in the platelets (anemia, leucopenia, aplastic anemia)	Spill control procedure in place and persons are trained on the same. It should be absorbed with suitable materials, such as dry sand or earth. That remaining must be flushed with large amounts of water. Remove all ignition sources. Ventilate enclosed places. Extinguishing Media: Carbon dioxide, dry chemical, or foam. Personal protective equipment like SCBA set, PVC Suit, Hand gloves etc Onsite/off site emergency plan
Chlorine	IDLH (NIOSH): 10 ppm PEL : 0.5 ppm STEL:1 ppm	Close transferring system Equipped Detector Adequate ventilation Standard practice for operating Valve Valve Protection. Flange guard provided Educate & train workers Standard work practices	Lung function test	Apply water spray or mist to knock down vapors. Vapor knockdown water is corrosive or toxic and should be diked for containment. Land spill: Provide Catch pit Absorb bulk liquid with fly ash or cement powder. Neutralize with dilute caustic soda (NaOH) or soda ash (Na2CO3). Emergency chlorine kit. Canister Mask **Firefighting:** Flammable gases will form explosive

				mixtures with chlorine. Dry chemical, carbon dioxide, water spray, fog or foam. Wear positive pressure breathing apparatus and full protective clothing. stop the flow of gas Spray cooling water on containers that are exposed to flames

6.7.2 MEDICAL SURVEILLANCE PROGRAM

Pre-employment Medical Check Up

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

Periodical Medical Check up

1. Lung Function test
2. Audiometry
3. Hematological Examination
4. Urine examination
5. Vision test
6. Colour blindness test
7. Biomarker in Blood & Urine

6.8 FIRE FIGHTING SYSTEM

M/s. F.K. Fine Chemicals management shall take in to consideration fire prevention measures at the project planning and during plant commissioning stage to avoid any outbreak of fire. But looking to the hazardous nature of process and the chemicals that shall be handled and processed, the chance of outbreak of fire cannot be totally ignored. Hence to tackle such a situation a good well laid fire protection system will be provided in the factory. Details of fire fighting are given below.

TOTAL NOS. OF FIRE EXTINGUISHERS

Sr. No.	**Type**	**Capacity**	**Nos.**	**Nos**	**Total Nos.**
1	DCP	10 Kg	60	80	128
2	DCP	05 Kg	20		
3	AFFF Foam	50 ltr.	30	30	
5	ABC	5 Kg	08	08	
7	CO2	4.5 Kg	10	10	

2. Fire Hydrant System Installed (Pipeline Dia 4", 5", 6")

1) Main Fire Pump Capacity: - 171 M^3 / hrs

2) Jockey Pump Capacity: - 25 M^3 / hrs.

3) Fire Hydrant Point: - 30 Nos.

(4) Fire Hose Pipe 15 mtr. :- 15 Nos.

(5) Fire Hose Pipe 30 mtr: - 15 Nos.

3. Safety Boxes Are installed at different 4 Location with Equipments for Emergency use Details given below

Sr. No.	Equipments Name	Quantity
1.	SCBA (Self Contained Breathing Apparatus) Sets 30 Minutes	03Nos
2.	ELSA (Emergency Life Support Apparatus)Sets 15 Minutes	04Nos
3.	Canister Gas Mask	09Nos
4.	Canister Cartridge	09 Nos.
5.	Helmets	10 Nos.
6.	Rubber Apron	06 Nos.
7.	Dust Mask	09 Nos.
8.	Air Line Mask	05 Nos.
9.	Gum Boots	05 Nos.

10.	F. F. E.	05 Nos.
11.	PEG Solution (400ml Bottle)	08 Bottle

4. Sand Buckets Stands: - 05 Nos. X 4 Buckets.

5. Eye Washer & Safety Shower: - 03Nos.

Eye Washer: - 5

6. O_2 , LEL & VOC Meter :- 01 Nos

7. LEL Fixed sensor with alarm installed at Boiler house for NG: - 02 Nos.

8. Ammonia Fixed sensor with alarm installed at Chilling plant: - 01 Nos.

9. For First Aid

1) Oxygen Cylinder 45 Ltrs: - 02 Nos.

2) Methelene Blue Injection: - 05 Nos.

3) Vitamine C Injection: - 05 Nos.

4) Milk of Magnesia 250 ml Bottle: - 01 No.

5) PEG Solution: - 10 Ltrs

General:-

- Physician Dr. Visit everyday for 2hrs from Monday to Saturday at Unit :-1
- Medical Checkup done every year for all employees by M.B.B.S. And also Visit 4 times in month.
- 2 nos. First Aid Box kept at different location at both units with required Medicine.
- Ambulance van available at Unit:-1 for both unit.
- New OHC center work is going on at Unit: - 1 for both units.

6.9 DISASTER MANAGEMENT PLAN

6.9.1 DEFINING THE NATURE OF EMERGENCY

LEVEL OF EMERGENCY CAN BE CLASSIFIED IN THREE CATEGORIES.

LEVEL - 1:

The incident or emergency which shall be 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 has to handle emergency.

LEVEL - 2:

When the incident or emergency will not controlled within 10 to 15 minutes, incident controller, site main controller reviews the situation and decides if situation is worsening.

a) Can affect other section of the same plant and necessitate shutdown of that sections.

b) And or Can affect other nearby plant / sections and necessitate shut down of that area.

c) And / Or affecting whole of premises and not outside the premises.

Then without delay declare On – Site Emergency and activate Siren as per code and give message to affected area for safe shut down.

LEVEL - 3:

After surveying Off – Site implications of level – 2 emergency if there is a likely hood of chlorine 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.

Raise level – 3 sirens and declare Off – Site emergency and activate as per Off – Site emergency plan.

6.9.2 OBSERVER

DUTIES OF OBSERVER

Any person noticing a fire, leakage of chemicals or an unusual occurrence will contact the security personnel a main gate and Plant Supervisor by:

1. Giving a telephone message
2. Sending message through a messenger
3. Rush personally

While giving the message, he will:

1. Identity himself
2. State briefly type of emergency
3. Location of Incident / accident
4. Severity of emergency

After giving message, he will return to the scene / area of emergency by taking all personnel protection measures, if possible and awaits instructions from Plant Supervisor (Incident Controller)**.**

6.9.3 LIST OF SAFETY APPLIANCES:

INTERNAL SAFETY SURVEY:

It will be conducted by a task force specially formed to identify various hazards in plant areas. Checking of Personnel Protective Equipment's shall be done for its workability. Checking of various Safety installation/facilities available at site shall be done for its workability.

PERSONAL PROTECTIVE EQUIPMENT:

Adequate numbers of Personal Protective Equipments will be available and spare stocks are also kept. Workers shall be trained to use above PPE'S.

Helmets	- Will be Issued to all
Safety shoes	- Will be Issued to all
Safety goggles	- Will be Issued to all
Face shield	- Nos.
Hand gloves	- pair
Apron, PVC suit	- Nos.

Safetybelts - Nos.

Ear plug/ear muff - Nos.

Required emergency safety appliances and PPEs shall be provided in emergency boxes in plants and ECC as per list.

6.9.4 STRUCTURE OF EMERGENCY MANAGEMENT SYSTEM

M/s. F.K. Fine Chemicals shall develop an emergency management team. The management structure includes the following personnel's;

- Chief Emergency Controller
- Incident Controllers and Deputy Incident Controllers
- Site Main Controllers
- Key Personnel's
- Essential Workers
- Assembly points
- Emergency control center
- Fire control arrangements
- Medical arrangements
- Other arrangements

6.9.5 CHIEF EMERGENCY CONTROLLER (CEC)

CEC will be Chief Manager in his absence, the Plant Supervisor will be the Chief Controller till any one of the designated Manager arrives at Site and assumes overall charge of the situation. His task will be to co-ordinate all internal and external activities from the Emergency Control Centre at Main Security Gate from where all operations will be directed. He shall:

1. Immediately on being informed of the emergency and its location, will arrive at the scene & handle the situation.
2. Relieve the Incident Controller from responsible of the Main Controller.
3. 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.

4. Exercise direct operational control of the unaffected section of the plant.
5. 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.
6. 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.
7. 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.
8. Arrange for relief of personnel when emergency is prolonged.
9. Issue authorized statement or press release to the news – media.
10. Ensure preservation of evidence for enquiries to be conducted by statutory authorities.
11. Authorize the sounding of “All Clear” and “Evacuation Siren”.
12. 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.
13. Nominate a person from advisory team, to maintain chronological log of event during the entire period of emergency.

6.9.6 INCIDENT CONTROLLER AND DEPUTY INCIDENT CONTROLLER

His primary duties are to take charge at the scene of the incident. In the initial stage he may be required to take decisions involving the operation of the other plants or to stop or continue any process and to take technical decisions to control the incident. The deputy incident controller should take the charge of incident controller, if he is not available due to any reason. As our factory is running 24 hrs, so each plants shift in charge are being nominated as I.C (after 'G' Shift) and they will be always available in the shift and can take charge till the arrival of IC.

Responsibilities/Duties of Incident Controller and Deputy Incident Controller:

- Shall take charge at the scene of incident.
- Required to take decisions whether to stop or continue any Process and take a control the incident or to isolate affected area of the plant and simultaneously inform / consult senior officers as per requirement.
- Shall immediately assess the gravity of risk and alert panel and field operators to start controlling their respective section.
- After assessing the level of emergency likely to exist, he shall ad emergency. As per the assessment of risk, if necessary inform concerned Senior Officer to declare major emergency and active on-site/off site emergency plan accordingly. As Per the situation ensure that Site Main Controller (SMC) will be informed.
- Will work under the direction of the SMC, but till his arrival he may have to execute following responsibilities.
- Ensure that all the Key Personnel are called.
- Direct for evacuation of plant and areas likely to be affected by the emergency.
- Shall communicate to the SMC the type of outside help needed.
- 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 fire fighting and rescue team and other emergency services.
- Depending on the incident, instruct partial or total shut down, isolations, depressurization, Nitrogen purging, fire fighting, rescue operations.
- Instruct upstream/down stream 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.

- Pressure evidences. This will be necessary for investigation for cause and concluding preventive measures.
- Send runners, if telephones are out of order.

6.9.7 SITE MAIN CONTROLLER (SMC)

SMC will have an overall responsibility for directing operations & calling outside help from Emergency Control Centers. He is required to take decisions after consultation with the Senior Manager available at site.

The Shift Engineer of non-affected Plant will act as SMC till arrival of the designated SMC at Emergency Control Centre (ECC). Until the arrival of SMC, he may have to execute following responsibilities.

- As soon as he received the information or comes to know about the incident, he shall proceed to Emergency Control Room (Control Room) and shall take charge of the incident. If Control Room gets affected due to unfavorable wind direction, Fire Control Room shall be used as alternate Emergency Control Room.
- He has overall responsibility for directing emergency action, operation and calling outside help.
- He shall ensure that all the Key Personnel are called.
- He shall assess the gravity of situation with the help of Incident Controller (IC), Plant Manager and Key Personnel and after quickly assess the situation, shall find out the of emergency from Incident Controller (l C), and declare the emergency**.**
- Level-l: Emergency - may be handled within the plant premises.
- Level-2: Emergency - On Site Emergency plant shag be activated.
- Level-3: Emergency - Action to be taken to operate Off-Site Emergency Plan.
- He shed 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.

- He shall direct for evacuation of plant and areas likely to be affected by the emergency.
- He shall continuously review and assess possible developments to determine most probable course of events and actions.
- He shall assess the situation and ensure that whatever resources needed is made available and utilized in a co-ordinate manner.
- He shall direct the safe shut down of plants in construction with incident controller and Key Personnel, if necessary.
- He shall check that all non-essential workers, visitors, contractors are evacuated to safe assembly points and head count is completed.
- He shall give instructions to the Incident controllers, Fire fighting and Rescue teams.
- He shall, if necessary arrange for evacuation of neighboring population.
- He shall ensure that search for casualties, within the affected area has been carried out and arrange for hospitalization of victims and additional medical help, if required.
- He shall ensure that liaison will be made with outside agencies such as Police Services, Fire Services, Expert on Health and Safety, Meteorological Office, District Emergency Authorities, Collector and Senior Inspector of Factories. Provide advice on possible effects to areas outside the factory.
- He shall arrange for up to date records of emergencies.
- He shall advice not to re-start the plants unless it is declared safe to start by competent authorities.

6.9.8 KEY PERSONNELS

Key Personnel are required to provide and to implement the decisions made by the SMC in the light of information received on the developing situation at the time of emergency. As necessary, they will decide the actions needed to shutdown plants, evacuate personnel, carryout emergency engineering work, arrange for supplies of equipments, utilities, carryout environment monitoring, provide catering facilities, liaise with police, fire brigade and other local authorities, relative of casualties, hospital, press & neighboring industries. Action at assembly points, outside shelters and mutual aid center under the direction of the SMC. All

the key personnel and other called in so to assist shall report to the ECC. They shall be available at any time on duty or on call or on oil duty or holiday.

6.9.9 ESSENTIAL WORKERS

A task force of essential trained workers (expert's team) is available to get the work done by the Incident Controller and the Site Main Controller. Such work will include:

1) Fire fighting and spill control till a Fire Brigade takes the charge.
2) To help the Fire Brigade and mutual aid teams, if it is so required.
3) Shutting down plant and making it safe.
4) 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.
5) Provision of emergency power, water, lighting, instruments, equipments, materials, etc.
6) Movement of equipment, special vehicle and transport to or from the scene of the accident.
7) Search, evacuation, rescue and welfare.
8) The injured is given First Aid.
9) Moving tankers or other vehicles from area of risk.
10) Carrying out atmospheric test and pollution control.
11) Manning of assembly points to record the arrival of evacuated personnel. Manning for outside shelters and welfare of evacuated persons there.
12) Assistance at causalities reception areas to record details of causalities.
13) Assistance at communication centers to handle outgoing and incoming calls and to act as messengers if necessary.
14) 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.
15) Informing surrounding factories and the public as well as directed by the Site Main Controller.
16) Any special help required.

6.9.10 ASSEMABLY POINT

In affected & vulnerable plants, all nonessential workers (who are not assigned any emergency duty) are evacuating the area & report to a specified Assembly Points. Each assembly Point will be clearly marked by a Conspicuous notices & provided with an identification numbers e.g. Assembly Point No. 1, 2 and so on. Assembly Points are located at a safe place, well away from area of risk and least affected by the down wind direction. To ensure that workers do not have to approach the affected area to reach the Assembly Point proper location and numbers have been marked at Assembly Points. Each Assembly Point in manned by a nominated person to record the names and dept. Further telephone to communicated SMC has been provided at each assembly Points. At each Assembly Point duties of Assembly Point In-charge has been also displayed in brief Before reaching an Assembly Point or subsequently, if it is required to pass through an affected area or due to presence of toxic substances. Suitable PPE's including respirators, helmet etc., are issued & made available with workers.

6.9.11 EMERGENCY CONTROL CENTER

The Emergency Control Center is the place or room from where the operations to handle the emergency are directed and coordinated. Main Control Room will be earmarked/identified as the Emergency Control Room. Fire Control Room shall be earmarked/identified as the alternative Emergency Control Room to be operated in case of unfavorable wind direction. Adequate Telecommunication System will be available in the Emergency Control Room i.e. Hot Lines, Intercom Walkie-Talkies & External Phones.

The ECC center shall be equipped with the following facilities.

1. Internal and external telephone including STD facility
2. Telephone directory
3. Telephone nos. of mutual aid centers
4. Factory layout plan
5. Map of the area
6. Employee blood group and their address
7. Messengers / Runners for sending messages
8. Adequate numbers of PPE'S

6.9.12 FIRE CONTROL ARRANGEMENTS

6.9.12.1 FIRE FIGHTING, GAS LEAK CONTROL AND RESCUE OPERATION

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

1. Incident Controller will be the only person to direct the fire fighting and Emergency operation.
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.

B) Role of EHS Representative:

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

C) Fire crew members

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

6.9.13 MEDICAL SERVICES

The roles of Medical officers are as follows;

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

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

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

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

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

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

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

6.9.14 OTHER ARRANGEMENTS

Other arrangements include external transport, cranes, generator sets to supply emergency power, environment monitoring equipment, rescue items etc. when available resources do not meet the requirement.

STANDARD OPERATING PROCEDURE (EMERGENCY)

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

6.9.15 COMMMUNICATION SYSTEM

After the assessment of risk & their possible environmental impact and after making an organization for the preparedness to control the emergency, the next most essential step is to make us ready for Communication at the time of emergency. Communication System is a Crucial Factor while handling emergency.

Company will have quick & effective Communication System through which, any situation, which can lead to emergency, can be informed or known to.

i. All working inside the plant.
ii. Key Personnel outside during normal working hours & during off-duty hours.
iii. Outside emergency services, Statutory and Local Authorities and
iv. Neighboring facilities and public leaving in vicinity.

Each and every section, Plant & Department of the Factory shall be connected by internal telephones. External Phone at Office and Residence and Mobile shall be also available with Key Personnel and top executive of the factory. Hot lines shall be provided with mutual aid Partner through the Emergency Control Center. The Communication System begins with raising the alarm declaring the emergency, Telephone messages and Procedure to communicate the emergency to other persons & General Public.

6.9.16 RAISING THE ALARM

As soon as incident takes place inside the factory and is noticed by someone, the first step is to raise the nearest manual emergency bell to alert the nearby people. Next, he/she informs the security persons to raise the emergency siren located at the factory gate. The security personnel sound the siren, raising and lowering the sound three times in a 10 second "ON", 5 second "OFF" sequence. All the security employees shall be trained for operating the siren to announcing the emergency. In case of power failure, manual bell shall be also provided.

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

6.9.17 DECLARING THE MAJOR EMERGENCY

Major emergency has to be declared after sufficient and through check because the declaration of major emergency puts many agencies on action and it may disturb the running system, which may be Costly at, time or its Consequence may be Serious. Therefore major emergency must not be decided on whims or immature judgment or without proper thought. Looking to all the above, we will have taken care to nominate the persons who can

declare the emergency; we will have selected them on the basis of their knowledge & experience. These persons will be technically qualified and experienced. They shall advice the Incident Controller or Site Main Controller regarding the type of emergency. On being convinced, the Site Main Controller or Incident Controller shall declare an ON-SITE emergency. The decision about major emergency shall be taken as early as possible and without wasting time so that control action can be started immediately.

6.9.18 TELEPHONE MESSAGES

After hearing the emergency alarm and during emergency or even while just receiving the emergency message on phone, Telephone operator should be precise, sharp, attentive and quick in receiving and noting the message and subsequently effective in further Communication A form to record emergency telephone calls shall be available with telephone operator or Person available in Emergency Control Center, who has to 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 shall also be given to authorities and external agencies to describe the type of emergency. All details of emergency shall be collected/delivered according to this format shall available with the telephone operator.

6.9.18.1 COMMUNICATION OF EMERGENCY & STATUTORY INFORMATION

6.9.18.2 COMMUNICATION OF EMERGENCY

An effective system to communicate emergency shall be available.

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

a) Information to Workers

All personnel inside the factory shall be informed by the sounding of the siren or in case of electricity by ringing the bell.

b) To key personnel outside during normal working hours

The key personnel outside the factory premises shall be informed as per the need by external telephones or runners.

c) To the outside Emergency Services and the Authorities

Once the emergency is declared, it is essential that the outside emergency services should be informed in the shortest possible time. Responsibilities shall be fixed as per the Incident/Emergency Command structure/plan to contact outside agencies for help and to communicate to the all the Government and other Authorities such as Fire Brigade, Police, District Emergency Authorities, Factory Inspectorate & Hospital etc. In case of major emergency, outside agencies like mutual aid, hospitals, policies, Factory Inspector, Collector, Fire-brigade etc. shall be informed by telephone or by sending special messenger from emergency control center.

d) To neighboring factories and the General Public

A major emergency will affect areas outside the works and it is essential that neighboring factory and General Public, should be informed to enable them to take prompt action to protect their own workers and to take whatever measures may be possible to prevent further escalation of the emergency due to effects on their own installations, at the same time, they may be able to provide assistance as part of a prearranged mutual aid plan. Further responsibilities shall be fixed to inform the neighboring factories and the General Public leaving in the vicinity. The neighboring units shall be informed about an emergency through external telephones or runners. The general public shall be informed about an emergency using loudspeaker on scooter or rickshaw or car. Help from police shall be sought if required.

6.9.19 STATUTORY INFORMATION

a) Information to Workers

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

b) To the outside emergency services and authorities

Statutory information in the form of booklet shall be given to outside emergency services and authorities.

c) To neighboring firms and the general public

Statutory information in the form of booklet will be given to neighboring units and the general public of the villages in the vicinity of the unit.

6.9.20 ACTION ON SITE

The activities related to emergency time activities shall be divided into two parts. These are

- Pre-emergency activities
- Post-emergency Activities

6.9.21 PRE-EMERGENCY ACTIVITIES

6.9.21.1 INTERNAL SAFETY SURVEY

A safety committee shall be constituted as per Factories Act. The nominated members of the committee shall be assigned the responsibility to conduct safety survey once in a month before safety meeting. The internal safety survey includes –

- Identify various hazards in the factory
- Check whether protective equipments are in sound working condition
- Check various safety installations located at various plants for proper working
- Check sprinklers, showers, etc. in all plants
- Suggest extra modifications/ requirements to make systems more reliable
- Check presence of toxic gases by the help of dragger tube

Frequency of Internal Safety Survey: Once in a month

6.9.21.2 THIRD PARTY SURVEY

A safety survey shall be carried out once in a year by an external agency. It shall include –

- Inspection of building, structures for strength and stability
- Identify and study the hazards inside individual plants and within the factory premises.
- Check safety system for its adequacy.

- Suggest modifications or additions in the operating practices and safety system, if necessary.

Frequency of Third Party Safety Survey: Once in a year

6.9.21.3 PRESSURE VESSEL TESTING/ EXAMINATION

- To prepare list of pressure vessels in the plant with details of operating conditions and manufacturing details.
- To carry out preventive maintenance of valves & fittings on all pressure vessels (valves, pipelines, pressure gauge, temperature recorders and emergency vent lines)
- To arrange for testing and examination of all pressure vessels as per the rules of Factories Act by govt. certified competent person on due date.
- To maintain record of testing and certificates issued by competent person and make them available to Factory Inspector at the time of inspection.
- Frequency of Pressure Vessel Testing / Examination: Twice in a year

6.9.21.4 NON-DESTRUCTIVE TESTING (NDT)

- To prepare list of equipment and pipelines in the plant which require NDT as per the rules of Factories Act.
- To arrange for Non-Destructive Testing (NDT) as per the rules under Factories Act by govt. certified competent person on due dates.
- To maintain record of testing and certificates issued by competent person and make them available to Factory Inspector at the time of inspection.
- Frequency of Non-Destructive Testing : Once in a year

6.9.21.5 SAFETY RELIEF VALVES TESTING

- To prepare list of Safety Relief Valves installed on various equipment and pipelines in the unit along with detailed specifications.
- To prepare schedule for testing and calibration as per the rules under Factories Act by govt. certified agencies on due dates.
- To maintain record of testing and certificates and mark dates of testing and calibration on the valves.

- To carry out repairs/replacement as suggesting by the testing authority.
- Frequency : Twice in a year

6.9.21.6 FIRE SYSTEM TESTING

- To prepare list of various fire-fighting equipment (Fire Extinguishers, etc.) installed at various locations in the unit along with detailed specifications.
- To prepare schedule for testing of all these equipment and check operability
- To maintain record of testing and mark dates of testing on the equipment.
- To carry out repairs/replacement of defective equipment
- Frequency: Once in a month

6.9.21.7 MUTUAL AID SCHEME

- To prepare Mutual Aid Scheme and enter into agreement with the neighboring units for getting or extending help during emergency
- To appoint coordinator for follow-up under mutual Aid Scheme
- To review the scheme once in a year with coordinators of neighboring units w.r.t. scope of help, type of aid, contact persons, etc.
- To include the scheme in mock drills

6.9.21.8 MOCK-DRILLS

- To conduct minor mock drills to train employees about their role/duties during emergency.
- To refresh training to the employees for fire fighting, spill control, use of personal protective equipments etc.
- To check whether various members of emergency control committee remember their role / duties properly and to find out the faults and points of improvement in their performance.
- To check whether the various equipment for emergency control are operating satisfactorily and find and rectify the draw-backs if any.
- To conduct major mock-drills with permission from the authorities

Mock drills shall be regularly conducted in our unit by our Emergency Control Organization and the findings are compiled to analyze whether employees are familiarized with the emergency control procedures and what sort of training is required to be given.

6.9.21.9 SAFETY TRAINING

To organize regular training for the employees for handling of safety equipment, use of personal protective equipment, first-aid, etc. by internal/external faculty, as well as by sending persons outside to attend safety programs etc. The topics covered in safety training will be –

- Training on fire fighting
- Training on spill control
- Training on toxic release control
- Training on good housekeeping
- Training on use of PPE

The records of the training programs shall be maintained by the Safety Committee. New topics will be included in the safety training programs year by year to upgrade safety knowledge among the workers.

Frequency: Once in a year

6.9.21.10 PERSONAL PROTECTIVE EQUIPMENT

- To procure adequate number of personal protective equipment (aprons, hand gloves, safety goggles, helmets, nose masks, safety belts, gas cartridges, self-breathing apparatus, safety shoes etc.) suitable for plant operations and maintain records of use.
- To have proper system for issuing the PPE and disposal of used PPE
- To train the workers about proper use of PPE.
- To check the fresh air blowers provided at confined spaces for fresh air to workers.

6.9.21.11 COMMUNICATION

- To maintain internal/external telephones in working order
- To check alarms / siren / loudspeakers for workability

- To provide manual emergency bells at various location for use during power failure
- To periodically check wind cock for wind direction
- To check lightning arrestors installed at different locations for physical condition and proper earthing connection.

6.9.21.12 EMERGENCY LIGHTS

- To keep sufficient number of emergency torch/ batteries in ECC as well as at production site.
- To maintain the DG set available in the factory as stand-by for power failure. The D.G. set will set to start functioning within two minutes of failure of electricity.

6.9.21.13 EMERGENCY CONTROL ROOM

It is necessary to maintain the Emergency Control Room and keep it equipped with all necessary items, documents, telecommunication systems, PPE etc. required in case of an emergency.

6.9.21.14 ASSEMBLY POINTS

- To fix assembly points in the factory for non-essential workers
- To fix assembly points for plant emergency staff and coordinators
- To maintain record of no. of workers gathered at the assembly points at the time of emergency. The Safety Committee shall nominate a person for this duty.

6.9.21.15 LIAISON WITH STATE AUTHORITIES

- To liaison with civil authorities, local hospitals, Fire-Brigade, Collector, factories Inspector, Police, etc regarding emergency activities and need for external aid.
- To keep the details regarding name, address & telephone numbers of various govt. authorities and neighboring units available and update the details from time to time.
- To inform about Mock-drill in advance and if required conduct mock-drill in presence of any of these authorities.
- To submit report of Mock-drill conducted and the out comings with photograph to Factories Inspector.

6.9.21.16 HOSPITAL FACILITIES

- To equip Occupational Health Centre with First-Aid and medicines
- To keep Health records (esp. blood-group records) of all employees
- To liaison with hospitals in the area of the unit
- To keep list of blood donors ready for reference
- To update arrangements with neighboring units for emergency first aid.

6.9.21.17 OUTSIDE SHELTER

- To reserve space in nearby schools/hospitals/buildings for temporary shelter during emergency
- To arrange for clothing, food, medicine in temporary shelter

6.9.21.18 STATUTORY INFORMATION

Statutory Information about chemicals handled in the unit, manufacturing process, the hazards in the unit, methods of prevention and control, first aid measures etc. shall be given to

- Workers
- Public and Neighboring units
- Government authorities & outside emergency services

6.9.21.19 PROTECTIVE DEVICES & ENGINEERING MAINTENANCE

- Installation of safety valve and pressure gauges on vessels used for high pressure operations.
- Installation of temperature indicators on reactors, temperature switch or alarm at critical reactors
- Maintenance of cooling water systems and pumps. To keep standby pump at cooling tower.
- Installation of overhead water tank for emergency. To keep it filled and regular cleaning of the same
- Periodic cleaning of heat transfer surfaces (jacket, reactors, shell & tube heat exchangers, boilers)

- To keep minimum inventory of hazardous materials with records
- To maintain good housekeeping and ensure safety compliance

6.9.21.20 LIST OF SUPPLIERS OF SAFETY EQUIPMENT

- To prepare and preserve list of suppliers of safety equipment e.g. first aid box, medicines, fire extinguishers, PPE, communication, self breathing apparatus, chlorine kit, etc.
- To check all supplies every three months.
- To update the list and keep it ready-to-refer location in the plant as well as at ECC

6.9.21.21 FIRE PREVENTION PLAN

- List of major work-place fire hazards
- Potential ignition sources
  - Sparks from electrical fitting / motors
  - Sparks from welding operations
  - Ignition system of boiler house
  - Sparks from static electricity
- Fire prevention & control measures
- Use of flameproof electrical fittings and electric motors wherever necessary.
- No welding shall be done anywhere in the plant without prior permission from safety officer and necessary precautions from in charge of the area.
- Ignition system of boiler should be provided with guard.
- All vessels and pipeline should be properly earthed to prevent static electricity
- The vent lines of all vessels and tanks holding flammable materials should be provided with flame arrestors
- Fire extinguishers shall be provided at all critical locations in the unit

6.10 POST EMERGENCY ACTIVITIES

These activities are to be carried out after an emergency is over so as to establish the cause of the emergency and decide the measures to be taken to prevent its re-occurrence. These activities are –

1. Collection of records of accident, injury, damage to property, buildings, equipment, material and loss of production
2. Conducting enquiries and concluding preventive measures
3. Making insurance claim for the materialistic loss / damage
4. Implementation of enquiry report's recommendations
5. Rehabilitation of affected persons within and outside the plant
6. Restarting the plant and normalizing the operations.

6.11 EMERGENCY TIME ACTIVITIES

The probable emergency situation that can arise in the unit and the corresponding control actions are describes below.

6.11.1 FLAMMABLE RELEASES

Source / Incident – Fire involving spilled combustible material near or in flammable storage areas

Control action –

1. Any one who notices fire shall sound emergency alarm.
2. SMC/IC who is at site, shall immediately rush to the scene and assess the situation. For fire due to spillage of combustible material, he activates the on-site plan as -
   - He cuts off electric supply to that area and evacuates all the persons to safe assembly points.
   - He calls in DIC (if DIC is not present there) and asks essential workers to fight fire with dry chemical / CO_2 fire extinguisher or sand.
   - He inform fire brigade telling them in briefly about kind of fire and type of extinguishers required.
   - He informs mutual aid teams and asks for necessary help.
   - He arranges first-aid / hospitalization for the affected persons.
   - Fire officer on reaching the site, takes charge of the fire-fighting operations.
   - Mutual aid teams shall be asked for help in the form of first-aid, transport etc.
   - If fire is growing, fire officer informs IC who alerts neighboring units and through SMC gets more fire-fighting help.

- Fire fighting shall be continued till fire is fully overcome
- After extinguishing fire, fire officer cools the entire area with water spray and checks that no re-ignition shall be likely. After that, he declares the area safe.
- 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

6.11.2 TOXIC RELEASES

Source / Incident – Pressure release due to failure of

- Stuffing box gland packing
- Pressure release valve
- Vessel / pipeline failure

Control action –

1. Any one 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 vessel / rupture disc/gland packing will be attended by maintenance department.
- 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

6.11.3 CHEMICAL SPILL/LEAKAGES

Most of the storage tanks shall be located in Storage Tank area. Dyke walls of sufficient size will be connected around the tank yard. Neutralizing material shall be kept nearby. For dilution, water connection will be provided on all sides of tank farms. Sand buckets shall be provided for covering spillage of flammable / corrosive materials.

6.11.4 EVACUATION & TRANSPORTATION

All non-essential workers shall be evacuated from incident area and adjacent areas to safe assembly points. Assembly points shall be clearly marked and assembly point in-charge will also be designated. The assembly point in-charge will be a well-trained supervisor who shall keep record of persons arriving at the assembly point and direct them for proper gathering. He shall also inform the ECC about the persons gathered at the assembly point. Those in need of medical treatment shall be transported to first-aid center / hospital as the case may be. In case of major emergency all non-essential workers shall be transported to temporary shelter.

6.11.5 SAFE CLOSE-DOWN

As per the instructions from IC or SMC, some parts or full of the plant shall be closed down by the essential workers. The procedure for safe shut-down and start-up will be given in safety manual given to all workers.

6.11.6 USE OF MUTUAL AID

Mutual aid from neighboring units shall be called up as and when required. The aid shall be taken under the supervision of SMC.

6.11.7 HELP OF EXTERNAL AUTHORIES

Outside authorities such as Police, District Emergency Authority (DEA), Factory Inspector, Disaster Management Centre, GIDC officer, Industries Association, Regional Pollution Control Board, nearby hospitals etc. shall be informed of the on-site and off-site emergency plans and called in as per need.

6.11.8 MEDICAL TREATMENT

Injured workers shall be located and given prompt first-aid by essential workers and key personnel. Those requiring medical treatment shall be taken to the hospital / outside medical center.

6.11.9 ACCOUNTING FOR PERSONNEL

Through daily muster rolls and with the help of shift-in-charge the head count shall be undertaken to find out whether persons are missing and if so immediate search shall be carried out to locate them. The list shall include company employees, contract workers as well as visitors. Help from local authority or fire-brigade shall be taken if required. This list shall be kept with time keeper / security officer at any time and shall be used to account for personnel. Injured shall be taken to hospitals and their families/relatives shall be informed Casualties would be identified, their families and local authority shall be informed.

6.11.10 ACCESS TO RECORDS

In order to inform families/relatives of injured/dead, up-to-date list of names and addresses of all the workers shall be maintained in addition to the muster roll where shift-wise attendance shall be marked. Such list includes health records. This list will be available at the ECC and one such copy shall be available at our head office.

6.11.11 PUBLIC RELATIONS

Our General Manager shall be the only nominated person to issue administrative statement about the accident or emergency to news/media. No other person shall divulge any information to any news / media person.

6.12 REHABILITATION

In case of Toxic release or chemical spillage, Senior Fire Brigade Officer would ensure that the incident area shall be safe and cleaned up of all mess. Then only, he would allow people to re-enter the location.

In case of fire, the Senior Fire-Brigade Officer shall ensure that the area is cooled down and there are no chances of re-ignition. IC shall arrange for clean-up of the area and then only people shall be allowed to re-enter the area for work.

Even when all clear has been given, great care shall be taken when re-entering affected areas and no work in connection with the salvage, collection of evidence or start up shall be taken up until a thorough examination of the area shall be carried out. The statutory powers of the Factory Inspector shall be kept in mind before any evidence is disturbed. Particular care shall be taken to avoid the introduction of possible sources of ignition, such as diesel engines, hand or power operated tools, flame cutting equipment, etc. until it shall be established that no flammable materials are present where they could be ignited.

6.13 OFF – SITE EMERGENCY PLAN

6.13.1 NEED OF THE OFF – SITE EMERGENCY PLAN

An off-site emergency plan shall be prepared to deal with those incidents which have the potential to harm persons or the environment outside the boundary of the factory premises. A major accident, major emergency and disaster may affect areas outside the plant. An explosion can scatter debris over wide areas and its effects of blasts can cover considerable distances. Wind can spread burning fumes of toxic gases. Thus the events like these described above can affect outside areas and combating them needs an Off-site Emergency plan.

Envisaging such a rare incident, an off-site emergency plan should be drawn up for the following purpose.

1. To provide basic information about the risk and environmental impact assessment related to the unit to local / district authorities, police, fire-brigade, surrounding units, and the general public. To appraise them of consequences and the protection

/ prevention measures and control actions and to seek their help to communicate with public in case of major emergency. The information from all industries shall enable district authorities to educate public about what could go wrong, and to train them of measures to be taken as an individual.

2. To enable district authorities to prepare off-site emergency plan (contingency) for the district or particular area and to organize rehearsals and initiate actions learnt from these incidents.

Our Emergency Plan shall be made after considering the all possible effects of incidents on the neighboring population and the remedial measures will be devised in consultation with the local authorities and emergency services.

6.13.2 STRUCTURE OF THE OFF-SITE EMERGENCY PLAN

IC → SMC Essential Workers (Implementing Action plan, Informing nearby Public)	District Authorities (Collector, Factory Inspector, Police) Information, Evacuation	→ Mutual Aid teams, outside services, voluntary organizations (Fire-fighting, Gas leak control, First-aid, Shelter, Hospitalization, Transportation)

6.13.3 ROLE OF FACTORY MANAGEMENT

The Off-Site emergency Plans are dovetail so that the emergency services shall be summoned at the appropriate time and shall be provided with accurate information and a correct assessment of the situation. The responsibility for this is with the Site Main Controller. The Site Main Controller shall provide a copy of our On-Site and Off-Site Emergency Plan to the District authorities, the Factories Inspectorate and the Emergency Services, so that on the basis of information and such authorities can make their emergency preparedness plan to formulate and execute the District / Area off Site Emergency Plan. Further on the advice of the authorities we can also modify our plan to make our plan more effective and perfect.

6.13.4 ROLE OF EMERGENCY CO-ORDINATION OFFICER (ECO)

The various emergency services will co-ordinate by the Emergency Co-ordination officer (ECO), who will likely to be a Collector. The ECO will liaise closely with the Site Main Controller. The Emergency Control Centre of the factory can be utilized by the ECO to keep liaison with the Site Main Controller.

6.13.5 ROLE OF THE FIRE AUTHORITIES

The control of fire is normally the responsibility of the senior fire officer who would take over the handling of fire from the IC on arrival at the site.

- The senior fire brigade officer may also have similar responsibility for other events such as explosion and toxic releases. Fire authority having major hazard units in the area shall- Familiarize themselves with the location and site of all stages of flammable materials, water and foam supply points, firefighting equipment.
- Act as observer of an on-site exercise involving only site personnel

6.13.6 ROLE OF THE HEALTH AUTHORITIES

Health authorities, including Doctors, Surgeons, Hospitals, and Ambulances so on, have a vital part to play following a Major Accident and they should form an integral part of any emergency plan. In case of major fires, injuries will be the result of the effects of thermal radiation to a varying degree, and the knowledge and experience to handle this type of injuries cases may be generally available in most of the hospitals. But in case of major toxic releases, the effects vary according to the chemical, which has leaked, and it is important for health authorities that might be involved in dealing with the aftermath of a toxic release to be familiar with the treatment appropriate to such casualties. Major Off-Site incidents are likely to require medical equipment and facilities additional to those available locally and a Medical 'Mutual Aid' scheme should exist to enable the assistance of neighboring authorities to be obtained in the event of an emergency.

6.13.7 ROLE OF TELEPHONE DEPARTMENT

The communication system between the factory and the various above role-playing authorities must be effective. The ineffective public telephone system will not be useful in emergency. Therefore, telephone department should maintain the phones and if required

temporary telephone connection may be provided to various above authorities to deal the emergency.

6.13.8 ROLE OF POLICE AND EVACUATION AUTHORITIES

- To protect life and property
- To control traffic movement
- To inform people to remain indoors or evacuate
- To carry-out evacuation
- To identify dead, deal with casualties and inform relatives of dead or injured.

For evacuation, the following criteria are useful:

a) In case of major fire, only houses close to fire and in the direction of smoke need evacuation

b) If fire is escalating and in turn threatening a store of hazardous material, it is necessary to evacuate people nearby if time is available; otherwise they should be informed to keep themselves indoor and shield from the fire.

c) For release of toxic gases, limited evacuation may be appropriate in downwind direction with windows closed and provides good protection. Toxic gases which are hazardous down to much lower concentration cover a long distance. This factor must be considered while deciding upon the need and extent of evacuation.

6.13.8 ROLE OF THE MUTUAL-AID AGENCIES

Mutual-aid arrangements shall be made in areas of fire & toxicity control, medical and transport & evacuation. All partners of mutual-aid shall extend all possible help in these areas.