RISK ASSESSMENT

1.1 Risk Assessment

Objective of the Study

Quantitative Risk Assessment (QRA) study for M/s. Creative Carbon Pvt. Ltd. has been carried out based on data provided by **M/s. Creative Carbon Pvt. Ltd**.

The main objective of risk assessment -Quantitative Risk Assessment (QRA)is to identify and determine the potential damage or loss of life, property and environment and to provide a scientific argument for decision makers to provide and maintain the safety levels of the facilities to prevent or mitigate harm and loses. This is achieved by the following:

- Identification of hazards that could be realized from manufacturing processes, plant equipment and machinery, raw materials and products.
- Identify the potential failure scenarios that could occur within the facility.
- To Asses, the potential risks associated with identified hazards to which the plant and its personal and community outside may be subjected. Consequences analysis of various hazards is carried out to determine the vulnerable zones for each probable accident scenario.
- Evaluate the process hazards emanating from the identified potential accident scenarios.
- Analyse the damage effects to the surroundings due to such accidents.
- Conclusion and Recommendation to mitigate measures to reduce the hazard / risks.
- To provide guidelines for the preparation of On-site response plan.

Scope of the study

The project will undertake quantitative risk assessment (qra) study for the storage tank area.

Following listed material below are stored, used and handled in the premises.

Table 1 Chemical Storage

Name of Raw Material	Number of Tanks	Storage Facility / Packing	Storage / Packing Capacity (KL)	Storage condition
Methanol	2	Tank	25	NTP
Phenol	2	Tank	20	NTP
Formaldehyde	2	Tank	15	NTP

QRA study will include the following task:

- Hazard Identification
- Failure Scenario
- Consequence Analysis
- Dispersion Modelling
- Risk Assessment
- Evaluation of risk reduction options. and risk management plan

QRA study will include the following task:

- Hazard Identification
- Failure Scenario
- Consequence Analysis
- Dispersion Modelling
- Risk Assessment
- Evaluation of risk reduction options. and risk management plan

1.1.1 Methodology Adopted for Quantitative Risk Assessment (QRA)

Failure or ineffectiveness of the controls can lead to hazardous situation in any industry handling potentially hazardous materials. Following factors govern the severity of consequence of the loss of containment.

- Intrinsic properties; flammability, instability and toxicity.
- Dispersive energy; pressure, temperature and state of matter.
- Quantity present
- Environmental factors; topography and weather.
- Handling and storage facilities and procedures.
- Awareness, Training and Communication

The study has been carried out in accordance with the National and International codes of practices using Process Hazard Analysis Software Tool (PHAST) software. The latest version of the renowned PHAST software package of DNV is used for carrying out the risk analysis.

The full terms of potential hazardous scenarios and consequence events associated with the installation and operation was considered in the analysis.

Based on the operations to be carried at the plant, the Risk Analysis conducted to identify the affected distances and the damage of property and population from the identified scenarios considering the Maximum Credible Loss Scenario (MCLS) & Worst case scenario.

Maximum credible loss scenarios have been worked based on the inbuilt safety systems and protection measures to be provided for the operation of the facility & the Worst case scenario i.e. 100% catastrophic rupture have been worked out based on failure of the inbuilt safety system.

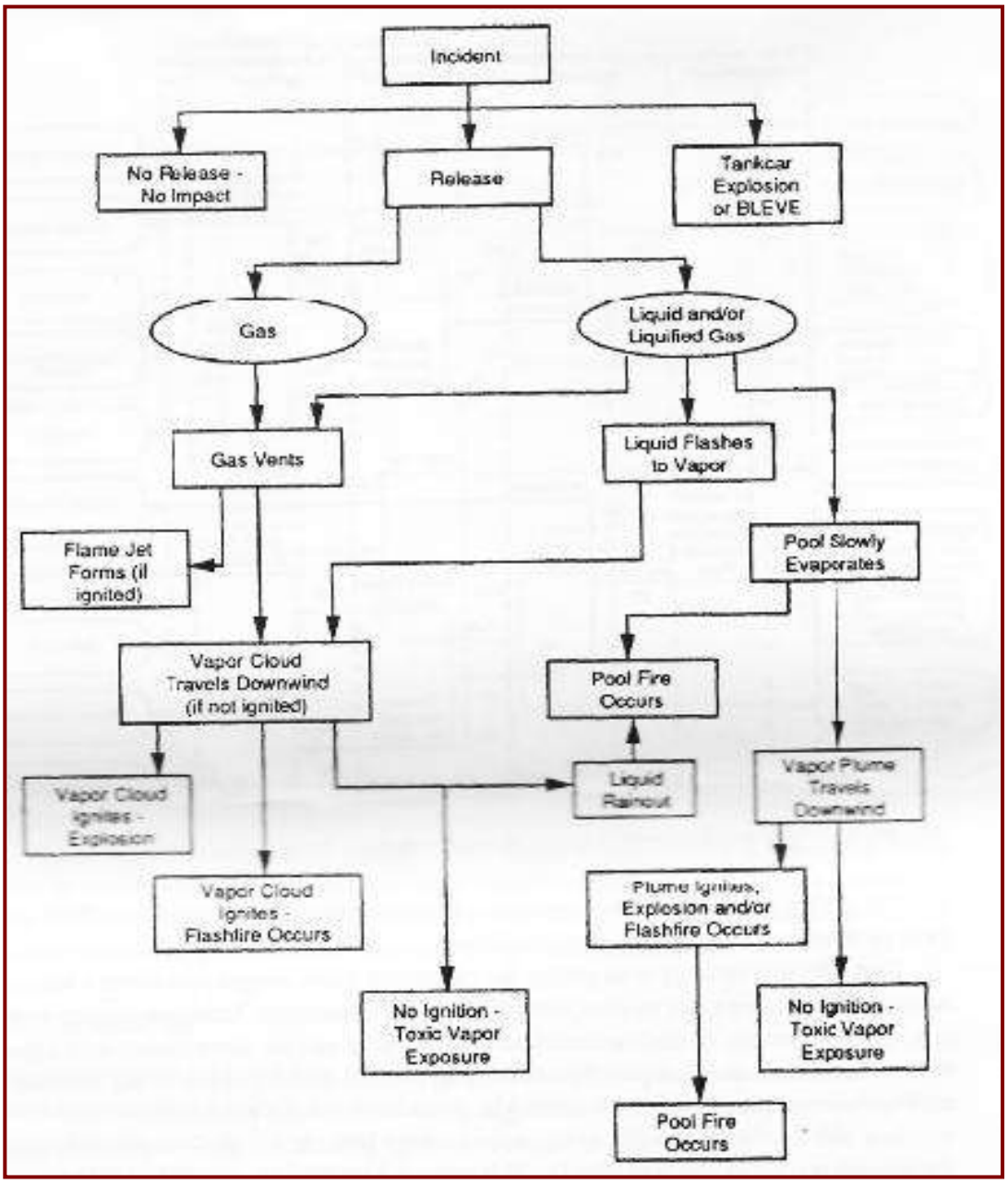
The Worst Case Scenario assumed as catastrophic rupture, as per the guidelines suggested by DNV – UK, and maximum inventory at the time of failure.

Consequence analysis and calculations are effectively performed by computer software using models validated over a number of applications. Consequence modelling is carried out by PHAST (version 6.53) of DNV Software, UK.

PHAST uses the Unified Dispersion Model (UDM) capable of describing a wide range of types of accidental releases. The Model uses a particularly flexible form, allowing for sharp-edged profiles, which become more diffuse downwind.

PHAST contains data for a large number of chemicals and allows definition of mixtures of any of these chemicals in the required proportion. The calculations by PHAST involve following steps for each modelled failure case:

- Run discharge calculations based on physical conditions and leak size.
- Model first stage of release (for each weather category).
- Determine vapour release rate by flashing of liquid and pool evaporation rate.
- Dispersion modelling taking into account weather conditions.
- In case of flammable release, calculate size of effect zone for fire and explosion.
- The hazardous materials considered in this study are mostly flammable liquids.


Incident
No Release - No Impact
Release
Tankcar Explosion or BLEVE
Gas
Liquid and/or Liquified Gas
Gas Vents
Liquid Flashes to Vapor
Flame Jet Forms (if ignited)
Pool Slowly Evaporates
Vapor Cloud Travels Downwind (if not ignited)
Pool Fire Occurs
Vapor Cloud Ignites - Explosion
Liquid Rainout
Vapor Plume Travels Downwind
Vapor Cloud Ignites - Flashfire Occurs
Plume Ignites, Explosion and/or Flashfire Occurs
No Ignition - Toxic Vapor Exposure
No Ignition - Toxic Vapor Exposure
Pool Fire Occurs

1.1.2 Software Used

PHAST has been used for consequence analysis include discharge and dispersion calculations.

Other Factors Considered For Risk Assessment

Metrological Condition

The consequences of released toxic or flammable material are largely dependent on the prevailing weather conditions. For the assessment of major scenarios involving release of toxic or flammable materials, the most important meteorological parameters which affect the atmospheric dispersion of the escaping material include crucial variables such as wind direction, wind speed, atmospheric stability and temperature. Rainfall does not have any direct bearing on the results of the risk analysis; however, it can have beneficial effects by absorption / washout of released materials. Actual behaviour of any release would largely depend on prevailing weather condition at the time of release.

For the present study we used the metrological data of the Ahmedabad.

Atmospheric Parameters

The wind speed and wind direction data which have been used for the study is summarized below:

Wind Speed : 1.5&5 m/s

Atmospheric Stability : D and F

Weather Category

One of the most important characteristics of atmosphere is its stability. Stability of atmosphere is its tendency to resist vertical motion or to suppress turbulence. This tendency directly influences the ability of atmosphere to disperse pollutants emitted into it from the facilities. In most dispersion scenarios, the relevant atmospheric layer is that nearest to the ground, varying in thickness from a few meters to a few thousand meters. Turbulence induced by buoyancy forces in the atmosphere is closely related to the vertical temperature gradient.

Temperature normally decreases with increasing height in the atmosphere. The rate at which the temperature of air decreases with height is called Environmental Lapse Rate (ELR). It will vary from time to time and from place to place. The atmosphere is said to be stable, neutral or unstable according to ELR is less than, equal to or greater than Dry Adiabatic Lapse Rate (DALR), which is a constant value of 0.98°C/100 meters.

Pasquill stability parameter, based on Pasquill – Gifford categorization, a meteorological parameter, describes the stability of atmosphere, i.e., the degree of convective turbulence.

Pasquill has defined six stability classes ranging from `A' (extremely unstable) to `F' (moderately stable). Wind speeds, intensity of solar radiation (daytime insulation) and nighttime sky cover have been identified as prime factors defining these stability categories.

When the atmosphere is unstable and wind speeds are moderate or high or gusty, rapid dispersion of pollutants will occur. Under these conditions, pollutant concentrations in air will be moderate or low and the material will be dispersed rapidly.

When the atmosphere is stable and wind speed is low, dispersion of material will be limited and pollutant concentration in air will be high. In general, worst dispersion conditions (i.e. contributing to greater hazard distances) occur during low wind speed and very stable weather conditions.

1.1.3 Hazards & Damage Criteria of Materials

Definitions

Hazards associated with Flammable chemicals

The release of flammable gas or liquid can lead to different types of fire or explosion scenarios and will depend on the material released, mechanism of release, temperature and pressure of the material and the point of ignition. Types of flammable effects are as follows.

Pool fire

The released flammable material, a liquid stored below its normal boiling point, will collect in a pool. The geometry of the pool will be dictated by the surroundings. If the liquid is stored under pressure above its normal boiling point, then a fraction of the liquid will flash into vapor and the remaining portion will form a pool in the vicinity of the release point. Once sustained combustion is achieved, liquid fires quickly reach steady state burning. The heat release rate is a function of the liquid surface area exposed to air. An unconfined spill will tend to have thin fuel depth (typically less than 5 mm) which will result in slower burning rates. A confined spill is limited by the boundaries (e.g. a dyked area) and the depth of the resulting pool is greater than that for an unconfined spill.

Flash fire:

It occurs when a vapor cloud of flammable material burns. The cloud is typically ignited on the edge and burns towards the release point. The duration of flash fire is very short (seconds), but it may continue as jet fire if the release continues. The overpressures generated by the combustion are not considered significant in terms of damage potential to persons, equipment or structures. The major hazard from flash fire is direct flame impingement. Typically, the burn zone is defined as the area the vapor cloud covers out to half of the LFL. This definition provides a conservative estimate, allowing for fluctuations in modelling. Even where the concentration may be above the UFL, turbulent induced combustion mixes the material with air and results in flash fire.

Jet Fire:

Jet flames are characterized as high-pressure release of gas from limited openings (e.g. due to small leak in a vessel or broken drain valve). Boiling liquid expanding vapor explosion (BLEVE) or fireball: A fireball is an intense spherical fire resulting from a sudden release of pressurized liquid or gas that is immediately ignited. The best known cause of a fireball is a boiling liquid expanding vapor explosion (BLEVE). Fireball duration is typically 5 – 20 seconds.

Vapor cloud explosion:

When a large quantity of flammable vapor or gas is released, mixes with air to produce sufficient mass in the flammable range and is ignited, results a vapor cloud explosion (VCE). Without sufficient air mixing, a diffusion-controlled fireball may result without significant overpressures developing. The speed of flame propagation must accelerate as the vapor cloud burns. Without this acceleration, only a flash fire will result.

Hazards Associated with Explosives chemicals

Damage Criteria

Damage due to thermal radiations and overpressure have been arrived at by taking in to consideration the published literature on the subject. The consequences are then visualized by the superimposing the damage effects zones on the proposed plan site and identifying the elements within the project site as well as in the neighbouring environment, which might be adversely affected, should one or more hazards materialize.

Thermal damage

The effect of thermal radiation on people is mainly a function of intensity of radiation and exposure time. The effect is expressed in terms of the probability of death and different degrees of burn. The following tables give the effect of various levels of heat flux.

Fatal Radiation Exposure Levels

Table 2 Fatal radiation Exposure level

Radiation level kW/m^2	Fatality		
	1%	50%	99%
	Exposure in seconds		
4.0	150	370	930
12.5	30	80	200
37.5	8	20	50

Overpressure Damage

Table 3 Overpressure Damage Criteria

OVER PRESSURE (mbar)	MECHANICAL DAMAGE TO EQUIPMENTS	DAMAGE TO PEOPLE
300	Heavy damage to plant & structure	1% death from lung damage >50% eardrum damage >50% serious wounds from flying objects
100	Repairable damage	>1% eardrum damage >1% serious wounds from flying objects
30	Major glass damage	Slight injury from flying glass
10	10% glass damage	***

Hazards Associated with Toxic Materials

It is necessary to specify suitable concentration of the toxic substance under study to form the end-point for consequence calculations. American Industrial Hygiene Association (AIHA) has issued Emergency Response Planning Guidelines (ERPG) for many chemicals, describes the various scenarios:

- **ERPG-1** is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined, objectionable odour.
- **ERPG-2** is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing

irreversible or other serious health effects or symptoms, which could impair an individual's ability to take protective action.

- **ERPG-3** is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects.

Toxic limit values as TLV (Threshold Limit Value), STEL (Short Term Exposure Limit), Immediately Dangerous to Life or Health (IDLH) concentrations are issued by US National Institute for Occupational Safety and Health (NIOSH).

- **TLV:** Threshold Limit Value – is the permitted level of exposure for a given period on a weighted average basis (usually 8 hrs.for 5 days in a week).

- **STEL:** A Short Term Exposure Limit (STEL) is defined by ACGIH as the concentration to which workers can be exposed continuously for a short period of time without suffering from:
  - Irritation
  - Chronic or irreversible tissue damage
  - Narcosis of sufficient degree to increase the likelihood of accidental injury, impair self-rescue or materially reduce work efficiency.

The permitted Short Time Exposure Limit usually have maximum exposure for 15-minute.

- **IDLH**: IDLH is an acronym for Immediately Dangerous to Life or Health. This refers to a concentration, formally specified by a regulatory value, and defined as the maximum exposure concentration of a given chemical in the workplace from which one could escape within 30 minutes without any escape-impairing symptoms or any irreversible health effects. This value is normally referred to in respirator selection.

Physical and Chemical Properties of the Materials, Compatibilities & Special Hazard

SN	Name of Chemical	Hazard	BP	Flash Point ^0C	Flammability Limit (Vol. %)	TLV PPM	IDLH PPM	LC50	Target Actions	Carcigenicity	Antidotes
1.	Methanol	F/T	64.7	11	Lower: 6.7 % Upper: 36 %	200	6000	64000 ppm/4H	Kidneys, heart, central nervous system, liver, eyes	No	10 mg diazepam through injection Activated Charcoal
2.	Phenol	F/T	182	79	Lower: 1.7 % Upper: 8.6 %	5	250	316 mg/m3/4H;	Eyes,skin,inhalation,ingestion	No	No specific antidote but charcoal hemoperfusion can remove free phenol from blood
3.	Formaldehyde	F/T	101	50 - 78	Lower: 7 % Upper: 73 %	5	20 PPM	203 mg /M3	Eyes, skin	No	Milk, Activated Charcoal or water

FP = FLASH POINT
L E L = L O WER EXPLOSIVE LIMIT
UEL = UPPER EXPLOSIVE LIMIT
IDLH = I M MEDIATELY DANGEROUS TO LIFE OR HEALTH
H = HEALTH HAZARD
B P = B O ILING POINT
TLV = THRESHOLD LIMIT VALUE
P P M = PARTS PER MILLION
L C 5 0 = LETHAL CONCENTRATIO

Precautions to be taken during storage

Control measures for O Toluidine, P Toludiene, Nitro Benzene, Formaldehyde, HCl, Sulfuric acid Storages

- Stand by Tank provided in case of emergency transfer the material.
- Drain valve with metal plate blind provided.
- Dyke wall provided to all storage tanks, collection pit with valve provision.
- Tanker unloading procedure prepared and implemented.
- Caution note and emergency handling procedure are displayed at unloading area and trained all operators.
- NFPA label is provided on tanks.
- Required PPEs like full body protection PVC apron, Hand gloves, gumboot, Respiratory mask etc. provided to operator.
- Dedicated Airline respiratory system to be provided in this tank farm area to handle major spillage or leakage emergency.
- Neutralizing material kept ready for tackle any emergency spillage.
- Safety shower, eye wash provided near tank farm area.
- Level gauge provided on all storage tanks.
- Storage tank integrity to be checked

Table: - Transportation, Unloading and handling procedure For Methanol, Phenol & Formaldehyde

Sr.No.	Activity	Type of possible hazard	Control measures and handling procedures.
1	Transportation of Methanol, Phenol, Formaldehyde, by road tanker	Leakage, Spillage, Toxic release	• Training is provided to driver and cleaner regarding the safe driving, hazard of Flammable chemicals, emergency handling, use of SCBA sets administration. • TREM card will kept with TL. • SCBA set is kept with TL. • Instructions is given not to stop road tanker in populated area. • Clear Hazard Identification symbol and emergency telephone number is displayed as per HAZCHEM CODE. • Appropriate PPEs is kept with TL. • Emergency telephone numbers list of OFF site emergency agencies is provided in TREM CARD

2	Methanol, Phenol, Formaldehyde, Road tanker unloading at site.	Leakage, Spillage, toxic release	• Priority is 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 Licence, TREM CARD, Fire extinguisher condition, SCBA set condition, 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 is allowed be started. **Following precautions is adopted during unloading** • Wheel stopper is provided to TL at unloading platform. • Tanker unloading procedure is followed according to check list and implemented. • Flexible hose connection is done at TL outlet line and checked for no leakage. • Every time rubber gasket is changed. • The quantity remaining in the hose pipeline is drained to a small container, which is subsequently transferred to the main storage tank thus ensuring complete closed conditions for transfer from road tanker. • All TL valves is closed in TL.
3	Methanol, Phenol, Formaldehyde, Storage tank safety	Leakage, Spillage, Toxic release.	• Storage tank is stored away from the process plant. • Tanker unloading procedure is prepared and implemented. • Caution note and emergency handling procedure is displayed at unloading area and trained all operators. • NFPA label is provided. • Required PPEs like full body protection PVC apron, Hand gloves, gumboot, Respiratory mask etc. is provided to operator.

461.

Sr.No.	Activity	Type of possible hazard	Control measures and handling procedures.
			• Neutralizing agent is kept ready for tackle any emergency spillage. • Safety shower, eye wash with quenching unit is provided in acid storage area. • Material is handled in close condition in pipe line. • Dyke wall is provided to all storage tanks, collection pit with valve provision. • Double drain valve will provided. • Level gauge is provided on all storage tanks. • Safety permit for loading unloading of hazardous material is prepared and implemented. • TREM CARD is provided to all transporters and is trained for transportation Emergency of Hazardous chemicals. • Fire hydrant system with jockey pump as per TAC norms is installed.
4	Methanol, Phenol, Formaldehyde,transferred from storage tank to Day tank	Leakage, Spillage due to Line rupture, Flange Gasket failure, Toxic release.	• Double mechanical seal type pump is 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 is provided. • Flame arrestor is provided on day tank vent. • Over flow is provided for additional safety and it is connected to main storage tank. • NRV is provided on pump discharge line. • Flange Guard is provided to all flanges.
5	Methanol, Phenol, Formaldehyde,transfer from Day tank to reactor.	Leakage, Spillage due to Line rupture, Flange Gasket failure, Toxic release.	• Gravity transfer. • Double valve is installed on day tank outlet line. • Total quantity of day tank material is charged in to reactor at a time. • NRV is provided on day tank outlet line. • Flange guard is provided to pipeline flanges.

Table Drums Transportation, Unloading and handling procedure

Sr. No.	Activity	Type of possible hazard	Procedures.
1	Transportation of drums	Leakage, Spillage, fire, explosion, Toxic release	• Training will be provided to driver and cleaner regarding the safe driving, hazard of Flammable chemicals, emergency handling, and use of SCBA sets. • TREM card will kept with TL. • SCBA set 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.

Sr. No.	Activity	Type of possible hazard	Procedures.
2	Drums unloading at site.	Leakage, Spillage, fire, explosion, toxic release	• Priority will be given to truck 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 Licence, TREM CARD, Fire extinguisher condition; SCBA set 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. • Only day time unloading will be permitted.
3	Godown / warehouse safety	Leakage, Spillage, Fire, Explosion, Toxic release.	• FLP type light fittings will be provided. • Proper ventilation will be provided in godown. • Proper label and identification board /stickers will be provided in the storage area. • Conductive drum pallets will be provided. • Drum handling trolley / stackers/fork lift will be used for drum handling. • Separate dispensing room with local exhaust and static earthing provision will be made. • Materials will be stored as per its compatibility study and separate area will be made for flammable, corrosive and toxic chemical drums storage. • Smoking and other spark, flame generating item will be banned from the Gate.
4	Acids, Solvents, etc. transfer from drum to Day tank/ reactor	Leakage, Spillage due to Line rupture, Flange Gasket failure, Fire, Explosion, Toxic release.	• Acids and solvents transfer by vacuum or by pump only. • Static earthing will be provided. • SS flexible hose / conductive hose will be used.
5	Acids, Solvents, 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. • NRV will be provided on day tank outlet line. • Static earthing will be provided to storage tank. • Double Jumpers will be provided to pipeline flanges.

FACILITIES / SYSTEM FOR PROCESS SAFETY, STORAGE, TRANSPORTATION,

FIRE FIGHTING SYSTEM AND EMERGENCY CAPABILITIES TO BE ADOPTED.

PROCESS SAFETY:

- Flameproof equipments and fittings will be provided for handling of hazardous chemicals.
- Tanks and all pump motors will be properly earthed.
- Housekeeping of the plant will be as per prescribed norms. Floors, platforms, staircases, passages will be kept free of any obstruction.
- All hazardous operations will be explained to the workers. They will be periodically trained on the hazardous processes.
- Dedicated supply of firewater will be made available in the plant.
- Only authorized persons will be allowed inside the plant.
- All instrument and safety devices will be checked and calibrated during installation. They will be also calibrated, checked at a frequent interval. Calibration records will be maintained.
- All electrical equipments will be installed as per prescribed standards.
- All the equipments of the plant will be periodically tested as per standard and results are documented. All equipments undergo preventive maintenance schedule.
- Hydrant system will be pressured with a Jockey Pump.
- Pressure gauge will be provided on each tank.
- In addition to fire hydrant system, nos. of fire extinguishers will be also installed at different locations within premises.
- Retention basin will be provided to collect the contaminated water used during fire fighting.
- Adequate ventilation arrangement will be provided for safe and better working in the plant as per the standard.
- Process, equipments, plant involving serious fire hazards will be designed as per prescribed guideline.

STORAGE TANK SAFETY

- Fire load calculation will be done and as per fire load Hydrant System will be provided as per NFPA std. and Fire extinguishers will be provided as per fire load calculation.
- Spark arrestor will be provided to all vehicles in side premises.
- Flame proof type equipments and lighting will be provided.
- Lightening arrestor will be provided on the top of chimney.
- Raw material will be transferred by pump only in plant area and day tank will be provided. Overflow line will be return to the storage tank or Pump On-Off switch will be provided near day tank in plant.
- Jumpers will be provided on solvent handling pipe line flanges.
- Flexible SS hose will be used for road tanker unloading purpose and other temperature connection.

SAFE DESIGN AND MAINTENANCE

After studying the properties of the material to be stored, proper selection of the material construction, metal thickness, design, nozzles, connections, pipe lines, fittings, valves, pumps, lining, coating, jacketing, insulation, cladding etc. and colour coding are necessary.

HANDLING OF CORROSIVE CHEMICALS

Important corrosive substances are: Acids and alkalis
When in contact with human tissues, most corrosive substances will produce chemical burns, while certain other substances produce deep ulceration. Many corrosive substances have defeating action on the skin and may cause dermatitis.

The safeguards against these hazards are:

- Preventing or minimising contact between corrosive substances and skin, mucous membranes and eyes.
- Corrosive substances are not allowed to come in contact with materials that may react.
- All the containers, pipes, apparatus, installations and structures used for the manufacture, storage, transport or use of these substances are protected by suitable coatings, impervious to and unaffected by corrosives.
- All containers or receptacles are clearly labelled to indicate their contents and should bear the danger symbol for corrosives.
- A high standard of maintenance and good housekeeping is essential.
- Adequate ventilation and exhaust arrangement whether general or local, should be provided whenever corrosive toxic gases or dust are present.
- Personal protective devices are used depending upon the nature of work viz.
    - ✓ Corrosion-resistant and impervious suits, or hand-gloves, aprons etc.
    - ✓ Respirator, gas mask or self-contained breathing apparatus,
    - ✓ Barrier cream when exposure is not severe.
- First aid treatment facilities are provided and all concerned will be instructed to follow safe practices such as Prolonged washing with water, Removing contaminated clothing, Seeking immediate medical help.
- Safety showers and eye washers are provided.

EMPLOYEE SELECTION AND TRAINING:

Persons affected with asthma, bronchitis chronic lung conditions, and irritations of the upper respiratory tract are not employed where exposures to chlorine might occur.

Training classes for both new and old employees conducted periodically to keep them conscious and informed of the hazards.

They are instructed and trained to adopt preventive measures in case of emergency and to use safety equipment.

LEAKAGE TOOLS REQUIREMENT:

1. Do not use water directing on leak.
2. Keep "emergency kits' handy and in proper working condition to control leakage and train workers in their use.
3. Appropriate facility for chlorine absorption through caustic soda/lime/soda ash solutions will be established and maintained in the event of leakage.
4. The containers should not be immersed in same absorption media.
5. Self-breathing apparatus, gas mask and 'emergency kits' are located at strategic Points under working condition and to be easily accessible in the event of emergency.

STORAGE AREA:

Storage area should be cool, dry, well ventilated, clean and protected from external heat source.
It should be remote from elevators, gangways or ventilating systems.
Ventilation is sufficient to prevent accumulation of vapour pockets. All fan switches have been outside the storage area.
As far as possible, the building for the storage of chemicals is entirely of non-combustible construction and separate from other building.

PERSONAL PROTECTIVE EQUIPMENT :

Adequate-and suitable personal protective equipments will be provided e.g. gastight chemical goggles, self contained breathing apparatus, positive pressure hose masks, chemical cartridge respirators, hard hats, soft-brimmed hats or caps, safetytoed rubber boots, rubber gloves, rubber apron or rubber coat, sleeves and trousers legs, etc.

OCCUPATIONAL HEALTH PROGRAMME

Health hazards associated with the occupation are called occupational hazards. In chemical industry due to handling of toxic and hazardous chemicals there are possibilities of developing occupational diseases.

OCCUPATIONAL HEALTH

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

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 equipment shall be supplied to workers.

Work permit procedures for Hot Work, Excavation Work, Work on Electric System and Work at Height shall be followed. A qualified doctor has been appointed as FMO on retainer ship basis. Apart from him, require medical facilities applicable as per Gujarat Factories Rules and Factories Act are made available.

PROPOSED FACILITY TO BE MADE AVAILABLE AT OHC

A Room is provided & operated as OHC. The centre is 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. Nebuliser - 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

AMBULANCE VAN & FIRST AID BOX

An Emergency Vehicle from Guj- Govt-108 available round the clock to be used as an ambulance.

First Aid Boxes is made available at the different location in the plant. Training is given to employees for First Aid.

MEDICAL EXAMINATION

Unit carrys out the following checks to curb the problem:

i) Pre - employment medical check-up at the time of employment.
No person shall be employed for the first time without a certificate of fitness granted by the Factory Medical Officer.

ii) Periodic Medical examination is being conducted as per the following schedule;
Workers employed are examined by a qualified medical practitioner/ Factory Medical Officer, in the following manner:

(a) During employment, 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., LFT, Chest X-rays, Audiometry, Spirometry, Vision testing (Far & Near vision, color vision and any other ocular defect) ECG, Blood Pressure, Sugar, CBC, Lung Function test & routine urine test and other parameters as will be found necessary as per the opinion of Factory Medical officer.be carried out at frequent intervals, the records of which shall be documented.

All precautions shall be taken to avoid foreseeable accidents like spillage, fire and explosion hazards and to minimize the effect of any such accident and to combat any emergency at site level. Some of the preventive safety measures shall be taken to minimize the risk of accident with respect to Technical Safety, Organizational Safety and Personal Safety are listed below:

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.

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

- To keep air-borne concentration of toxic (if available) and hazardous chemicals below PE Land TLV.
- Protect general health of workers likely to be exposed to such chemicals

- 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.

(1) It is proposed that this EMP be formulated on the guidelines issued by Bureau of Indian Standards on OH&S Management Systems: IS 18001:2000 Occupational Health and Safety Management Systems.
(2) Proposed EMP will be incorporated in Standard Operating Procedure also.
(3) The proposed EMP will also include measure to keep air-borne 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 chemical
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

Workplace Monitoring Plan

- It is proposed that a Workplace Monitoring Plan to be prepared & implemented in o 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 to place a reasonably accurate exposure measuring device near the worker's area, within the worker's breathing zone, and have it operate for nearly the full shift. Client has proposed to study the exposure data when the plant is operative.
- Unit carries out indoor work environment monitoring on quarterly basis to check working condition of our employees. If any abnormalities observed, we will take corrective actions for the same

Health Evaluation of Workers

- It is proposed that management will devise a plan to check and evaluate the exposure specific health status evaluation of workers.
- 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.
- 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, will be maintained.

SAFETY ORGANIZATION

Construction and Erection Phase

A qualified and experienced safety officer shall be appointed. The responsibilities of the safety officer include identification of the hazardous conditions and unsafe acts of workers and advice on corrective actions, conduct safety audit, organize training programs and provide professional expert advice on various issues related to occupational safety and health. He is also responsible to ensure compliance of Safety Rules/ Statutory Provisions.

Operation and Maintenance Phase

When the construction is completed, the posting of safety officers shall be in accordance with the requirement of Factories Act and their duties and responsibilities shall be as defined thereof.

SAFETY CIRCLE

In order to fully develop the capabilities of the employees in identification of hazardous processes and improving safety and health, safety circles would be constituted in each area of work. The circle would consist of about five to six employees from that area. The circle normally shall meet for about an hour every week.

SAFETY TRAINING

Safety training shall be provided by the Safety Officers with the assistance of faculty members called from Professional Safety Institutions and Universities. In addition to regular employees, limited contractor labors shall also be provided safety training. To create safety awareness safety films shall be shown to workers and leaflets shall be distributed.

Some precautions and remedial measures proposed to be adopted to prevent fires are:

- Compartmentalization of cable galleries, use of proper sealing techniques of cable passages and crevices in all directions would help in localizing and identifying the area of occurrence of fire as well as ensure effective automatic and manual fire fighting operations;
- Spread of fire in horizontal direction would be checked by providing fire stops for cable shafts;
- Reliable and dependable type of fire detection system with proper zoning and interlocks for alarms are effective protection methods for conveyor galleries;
- Housekeeping of high standard helps in eliminating the causes of fire and regular fire watching system strengthens fire prevention and fire fighting; and Proper fire watching by all concerned would be ensured.

FIRE FIGHTING SYSTEM

HYDRANT SYSTEM

- Fire water reservoir
- Fire water pumps:
- Jockey pumps

- Fire pumps operation/status indication panel provided at on automatic
- Single hydrant points
- Double hydrant points
- D.G. set-500 KVA

FIRE EXTINGUISHERS

Adequate numbers of dry chemical powder type, chemical and mechanical foam type and Carbon dioxide type fire extinguishers shall be installed as per the requirement of fire risk in
all plants / sections / depts.

Based on the fire load the fire extinguisher will be installed

FIRE DETECTION SYSTEM:

Automatic detection of fire is essential especially for hazard, sensitive and unmanned area. Unit shall provide automatic fire detection system which includes heat, smoke detector to give audio / visual alarm / signal locally as well as in the permanently manned area. This in turn helps in early detection of the fire and to start fire-fighting activity at early stage.

FIRE ALARM

200 V AC operated fire alarm, with manual call points shall be provided in plant call points location to start, activate alarm, siren shall be indicated in site plant provided in ECC, control rooms and OHC. Zone indication is received at main gate. To identify problem area and communicate to main gate security officer, coordinate with OHC / fire station, to organize help to respective zones with ambulance and fire tender.

Flame proof Electric Fittings

All electrical fittings provided in sensitive areas are flame proof and intrinsically safe.

Tools and Tackles

In chemical industry, it is customary to use non-sparking type tools (spanners, wrenchesetc).
Electrical hand tools like torches; lamp etc. to be used in the hazardous area should be flame proof type. All tools should be of approved quality and make and will be purchased with test certificates

1.1.4 Consequence Analysis

Introduction

The consequence analysis is carried out to determine the extent of spread (dispersion) by accidental release which may lead to jet fire, pool fire, tank fire resulting into generating heat radiation, overpressures, explosions etc.

In order to form an opinion on potentially serious hazardous situations and their consequences, consequence analysis of potential failure scenarios is conducted. It is quantitative analysis of hazards due to various failure scenarios. In consequence analysis, each failure case is considered in isolation and damage effects predicted, without taking into the account of the secondary events or failures it may cause, leading to a major disastrous situation. The results of consequence analysis are useful in developing disaster management plan and in developing a sense of awareness among operating and maintenance personnel. It also gives the operating personnel and population living in its vicinity, an understanding of the hazard they are posed to.

Selected Failure Cases

Earlier, it was the practice to select a particular item in a unit as failure scenario, e.g. rupture of reactor outlet pipe. Such selection is normally subjective on following parameters:

- Properties of material namely Toxic or Flammable.
- The likely severity of consequence in the event of accidental release based on inventory, operated pressure & operated temperature.
- The probability of failure of various equipments such as valves, flanges, pipe, pressure vessels etc. used in the plant.

Size of Release: For accidental releases identified for consequence analysis considering hole size is 10mm (Small Leak), 50mm (Medium Leak) and 100mm (Large Leak) leakage. The hole size when the size of the tank is known, assume that a large hole would empty the tank in 5 minutes and a small hole would empty the tank in 30 minutes. Using STREAM, it is then possible to determine what hole sizes would result in the calculated mass flow rates for small and large holes. The calculated hole sizes should be used unless they are larger than those specified in paragraph 19 HSE UK Guideline (250/75mm), in which case the default 100mm and 50mm holes should be chosen.

Taking this factor into consideration, a list of selected failure cases was prepared based on process knowledge, inventory, engineering judgment, and experience, past incidents associated with such facilities and considering the general mechanisms for loss of containment. Cases have been identified for the consequence analysis.

EFFECT OF RELEASE

When hazardous material is released to atmosphere due to any reason, a vapor cloud is formed. Direct cloud formation occurs when a gaseous or flashing liquid escapes to the atmosphere.

1. Dispersion of hydrocarbon vapor with wind till it reaches its lower flammability limit (LFL) or finds a source of ignition before reaching LFL, which will result in a flash fire or explosion.

2. Spillage of liquid hydrocarbons will result in a pool of liquid, which will evaporate taking heat from the surface, forming a flammable atmosphere above it. Ignition of this pool will result in pool fire causing thermal radiation hazards.
3. A fireball or BLEVE (Boiling Liquid expanding Vapor Explosion) occurs when a vessel containing a highly volatile liquid (e.g. LPG, Propylene etc.) fails and the released large mass of vapor cloud gets ignited immediately. It has damage potential due to high intensity of radiation and generation of the overpressure waves, causing large scale damage to nearby equipment and structures.
4. Catastrophic failure of tanks/ pressurized vessels, rotary equipment and valves etc. can result in equipment fragments flying and hitting other equipment of the plant.
5. Release of toxic compounds results in the toxic vapour cloud traveling over long distances, affecting a large area, before it gets sufficiently diluted to harmless concentration in the atmosphere.
6. The material is in two phases inside the containment - liquid &vapor. Depending on the location of the leak liquid or vapor will be released from the containment. If vapor is released a vapor cloud will form by the mixing of the vapor and air. The size of the vapor cloud will depend on the rate of release, wind speed; wind direction & atmospheric stability will determine the dispersion and movement of the vapor cloud.
7. If liquid is released there will be some flashing as the boiling point of liquid is below the ambient temperature. The vapor formed by immediate flashing will behave as vapor release. The liquid will fall on the ground forming a pool. There will be vaporization from the pool due to the heat gained from the atmosphere & ground.
8. There will be dispersion and movement of vapor cloud formed by evaporation of liquid.

The behaviour of material released by loss of containment depends on the following factors:

1. Physical properties of the material
2. Conditions of material in containment (pressure and temperature)
3. Phase of material released (liquid or gas)
4. Inventory of material released
5. Weather parameters (temperature, humidity, wind speed, atmospheric stability)

1.1.5 Consequence Analysis

1. Methanol Storage Tank

Scenario details		10 mm leak			50 mm leak			100 mm leak			Catastrophic Rupture		
Weather Category		1.5 F	1.5 D	5 D	1.5 F	1.5 D	5 D	1.5 F	1.5 D	5 D	1.5 F	1.5 D	5 D
Flash Fire Envelope (m)													
Conc. (ppm)	LFL	5	5	4	11	11	11	16	16	17	12	12	14
	LFL Fraction	17	14	6	44	37	31	56	54	50	13	14	37
Thermal Damage Distance by Pool Fire (m)													
Radiation	4	38	38	38	10	10	10	10	10	11	10	101	10

Scenario details		10 mm leak			50 mm leak			100 mm leak			Catastrophic Rupture		
Weather Category		1.5 F	1.5 D	5 D	1.5 F	1.5 D	5 D	1.5 F	1.5 D	5 D	1.5 F	1.5 D	5 D
Intensity (KW/m^2)					2	2	3	8	8	0	1		5
	12.5	25	25	28	68	69	74	72	73	79	66	66	74
	37.5	NR	NR	NR	45	45	45	48	48	48	41	41	43
Thermal Damage Distance by Jet Fire (m)													
Radiation Intensity (KW/m^2)	4	15	16	13	54	55	46	84	84	73	NR	NR	NR
	12.5	NR	NR	11	43	43	38	68	69	60	NR	NR	NR
	37.5	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Maximum Distance at Overpressure Level (m)													
Overpressure (bar)	0.02068	21	21	NR	66	54	55	90	91	84	139	143	141
	0.1379	12	12	NR	45	34	35	57	58	56	35	35	35
	0.2068	11	11	NR	43	33	34	55	56	55	28	28	29

NR- NOT REACHABLENH-NO HAZARD

The results for100mm leakand catastrophic case are superimposed on plot plan and presented in below figures. The results for only credible scenarios are presented.

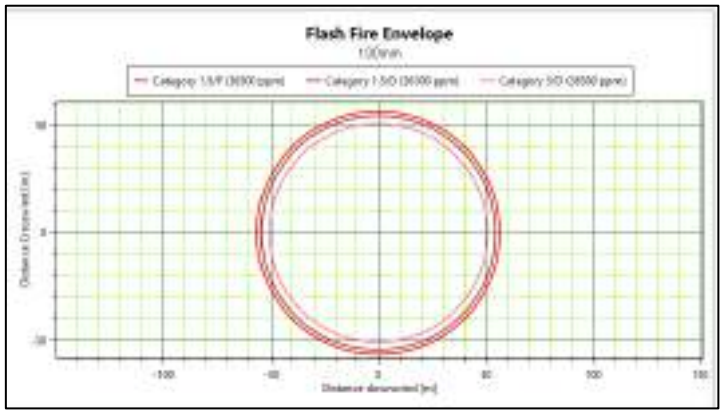


Figure 1 Flash Fire in case of 100mm Leak of Methanol Storage Tank

Figure 2Flash fire envelope in case of 100mm leak of Methanol Storage Tank

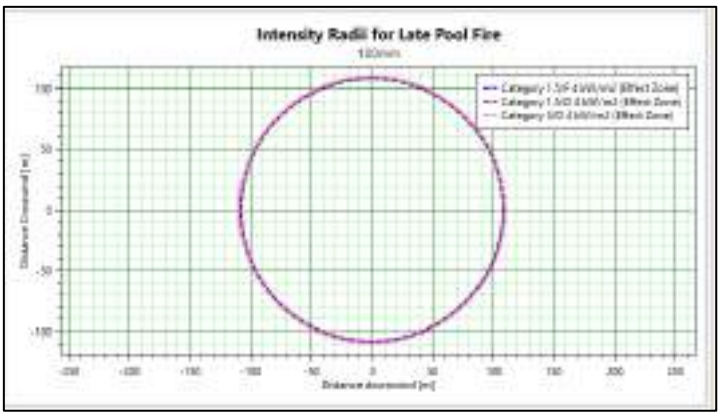


Figure 3 Late pool Fire intensity radii in case of 100mm leak of Methanol Storage Tank

Figure 4 Late pool Fire in case of100 mm leak of Methanol Storage Tank

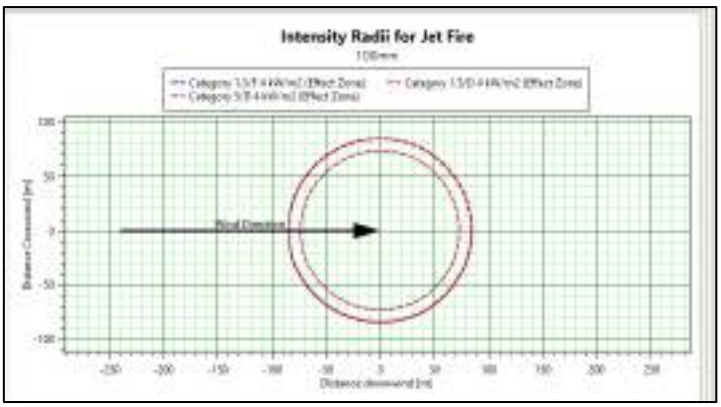


Figure 5 Jet Fire Intensity radii in case of 100 mm leak Methanol Storage Tank

Figure 6 Jet Fire in case of 100 mm leak Methanol Storage Tank

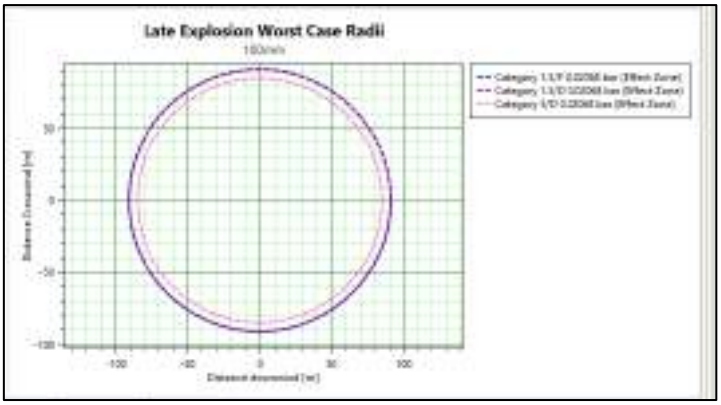


Figure 7 Late Explosion worst case radii in case 100mm leak of Methanol Storage Tank

Figure 8 Late Explosion worst case radii in case 100mm leak of Methanol Storage Tank

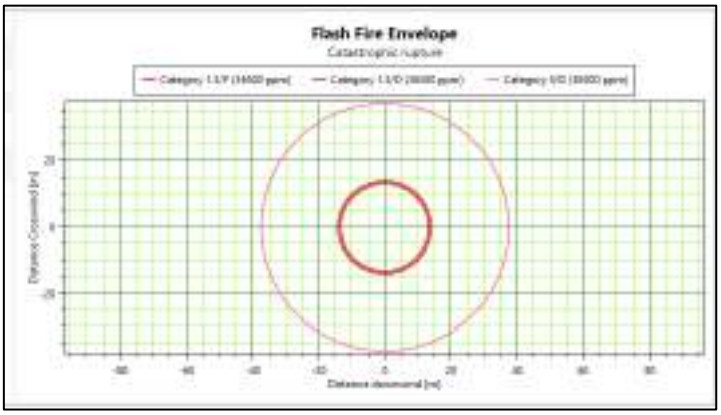


Figure 9 Flash Fire envelope in case of catastrophic rupture of Methanol Storage Tank

Figure 10 Flash Fire in case of catastrophic rupture of Methanol Storage Tank

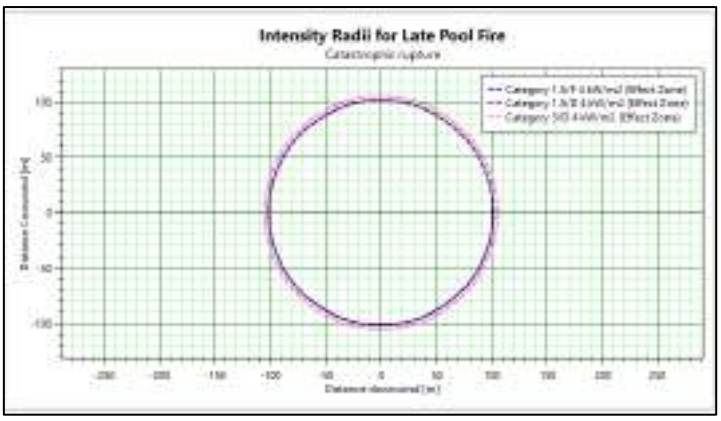


Figure 11 Late Pool Fire intensity radii in case catastrophic rupture of Methanol Storage Tank

Figure 12 Late Pool Fire intensity radii in case catastrophic rupture of Methanol Storage Tank

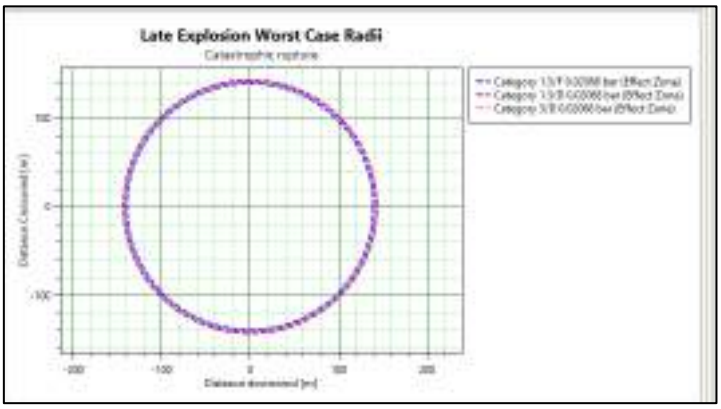


Figure 13 Late Explosion worst case radii in case catastrophic rupture of Methanol Storage Tank

Figure 14 Late Explosion worst case radii in case catastrophic rupture of Methanol Storage Tank

2. Phenol Storage Tank

Scenario details		10 mm leak			50 mm leak			100 mm leak			Catastrophic Rupture		
Weather Category		1.5 F	1.5 D	5 D	1.5 F	1.5 D	5 D	1.5 F	1.5 D	5 D	1.5 F	1.5 D	5 D
Flash Fire Envelope (m)													
Conc. (ppm)	**LFL**	5	4	4	22	22	23	35	37	37	307	39	93
	LFL Fraction	8	8	4	27	28	30	40	43	46	544	45	161
Thermal Damage Distance by Pool Fire (m)													
Radiation Intensity (KW/m^2)	**4**	38	38	41	72	72	81	75	38	83	71	70	80
	12.5	20	20	24	37	37	39	38	41	41	33	33	36
	37.5	-	-	-	-	-	-	-	-	-	-	-	-
Thermal Damage Distance by Jet Fire (m)													
Radiation Intensity (KW/m^2)	**4**	24	24	20	95	94	82	164	165	143	NR	NR	NR
	12.5	19	19	16	75	76	63	130	130	109	NR	NR	NR
	37.5	16	16	13	62	62	52	107	108	89	NR	NR	NR
Maximum Distance at Overpressure Level (m)													
Overpressure (bar)	**0.02068**	NR	NR	NR	93	89	97	162	156	164	477	413	449
	0.1379	NR	NR	NR	34	33	43	55	54	64	339	112	130
	0.2068	NR	NR	NR	30	30	39	49	48	58	337	94	118

NR- NOT REACHABLENH-NO HAZARD

The results for 100mm leakand catastrophic case are superimposed on plot plan and presented in below figures. The results for only credible scenarios are presented.

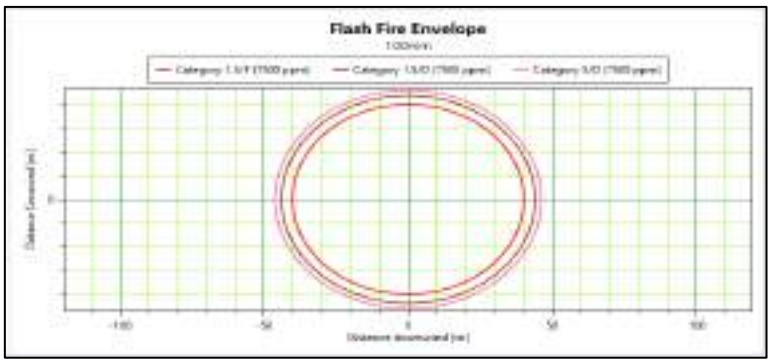


Figure 15 Flash fire envelope in case of 100 mm leak of Phénol Storage Tank

Figure 16 Flash Fire in case of 100 mm Leak of Phenol Storage Tank

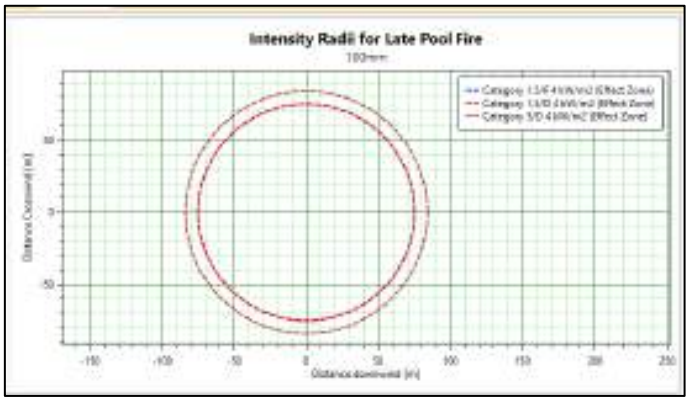


Figure 17 Late Pool Fire intensity radii in case of 100 mm leak of Phenol Storage Tank

Figure 18 Late Pool Fire in case of 100 mm leak of Phenol Storage Tank

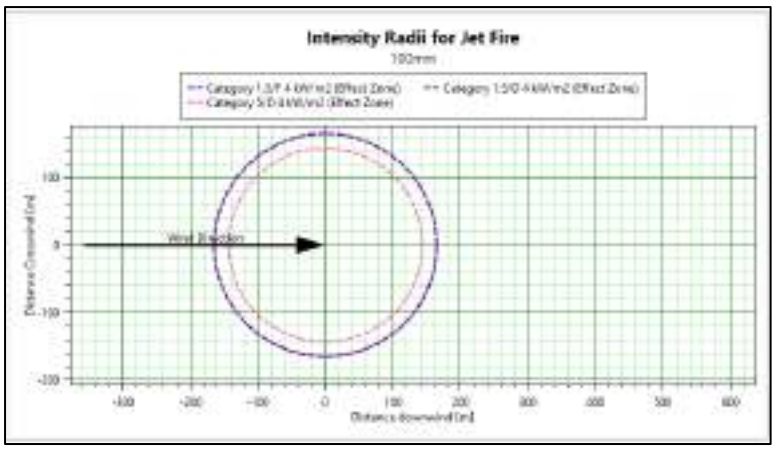


Figure 19 Jet Fire Intensity radii in case of 100 mm leak Phenol Storage Tank

Figure 20 Jet Fire in case of 100 mm leak Phenol Storage Tank

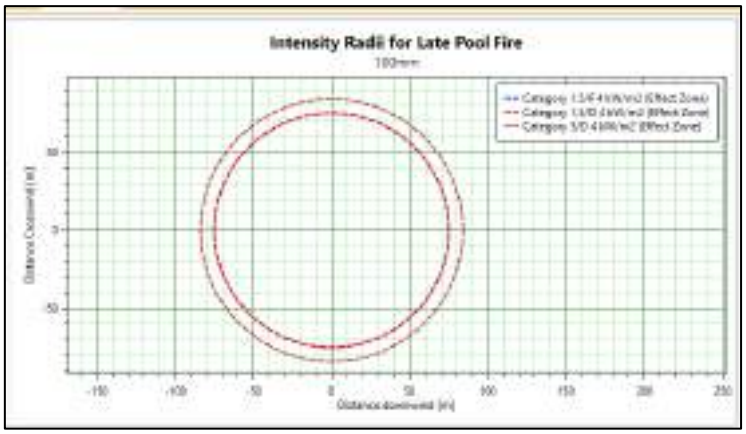


Figure 21 Late Explosion worst case radii in case 100mm leak of Phenol Storage Tank

Figure 22 Late Explosion worst case radii in case 100mm leak of Phenol Storage Tank

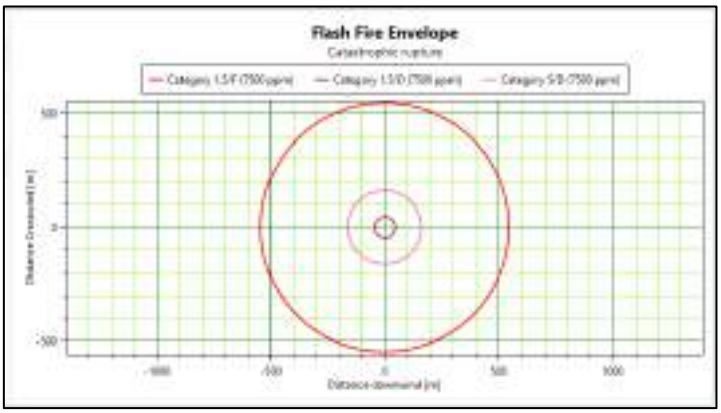


Figure 23 Flash fire in case of catastrophic rupture of Phenol Storage Tank

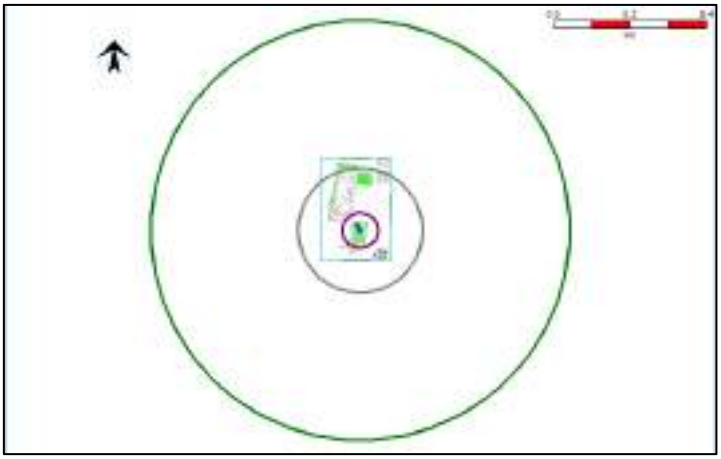


Figure 24 Flash fire in case of catastrophic rupture of Phenol Storage Tank

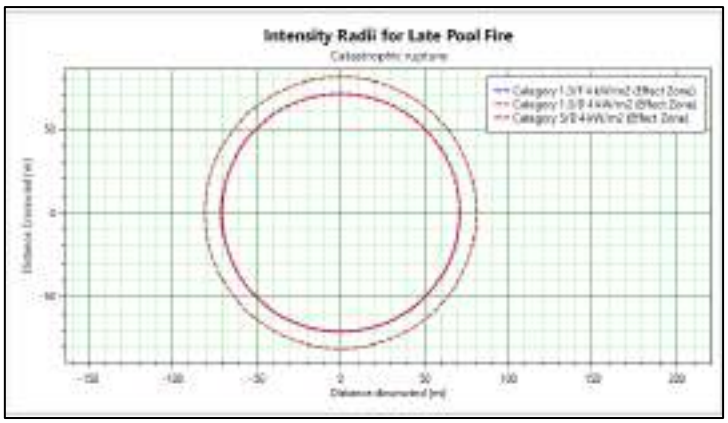


Figure 25 Late Pool fire intensity radii in case catastrophic rupture of Phenol Storage Tank

Figure 26 Late Pool fire in case catastrophic rupture of Phenol Storage Tank

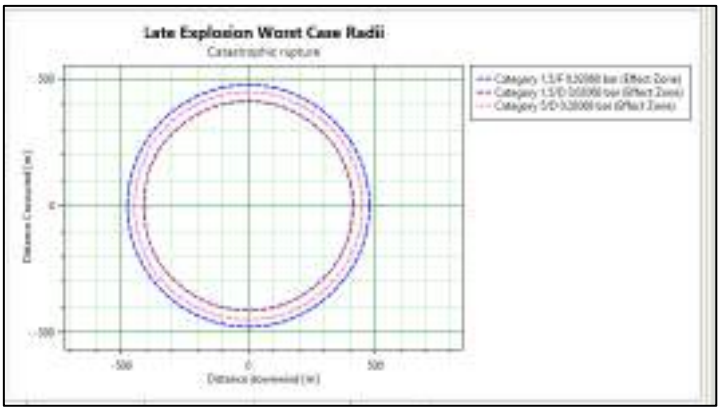


Figure 27 Late Explosion worst case catastrophic rupture of Phenol Storage Tank

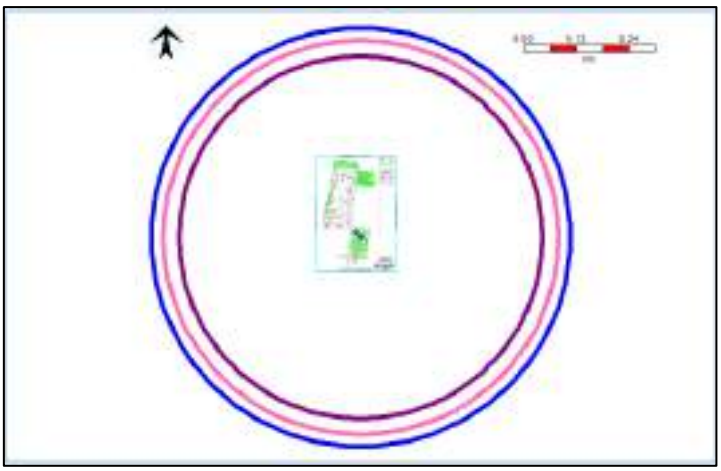


Figure 28 Late Explosion worst case catastrophic rupture of Phenol Storage Tank

3. Formaldehyde Storage Tank

Scenario details		10 mm leak			50 mm leak			100 mm leak			Catastrophic Rupture		
Weather Category		1.5 F	1.5 D	5 D	1.5 F	1.5 D	5 D	1.5 F	1.5 D	5 D	1.5 F	1.5 D	5 D
Flash Fire Envelope (m)													
Conc. (ppm)	LFL	18	15	5	13	12	7	14	13	9	82	91	63
	LFL Fraction	29	29	12	41	35	18	40	33	21	135	134	97
Thermal Damage Distance by Pool Fire (m)													
Radiation Intensity (KW/m^2)	4	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
	12.5	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
	37.5	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Thermal Damage Distance by Jet Fire (m)													
Radiation Intensity (KW/m^2)	4	17	17	13	36	36	29	40	41	33	NR	NR	NR
	12.5	-	-	11	29	30	23	34	34	34	NR	NR	NR
	37.5	-	-	-	-	-	-	-	-	-	NR	NR	NR
Maximum Distance at Overpressure Level (m)													
Overpressure (bar)	0.02068	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
	0.1379	NR	NR	N	NR	NR	NR	NR	NR	NR	NR	NR	NR

Scenario details		10 mm leak			50 mm leak			100 mm leak			Catastrophic Rupture		
Weather Category		1.5 F	1.5 D	5 D	1.5 F	1.5 D	5 D	1.5 F	1.5 D	5 D	1.5 F	1.5 D	5 D
				R									
	0.2068	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR

NR- NOT REACHABLE; NH-NO HAZARD

Results of consequence analysis

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

Chemical/ Scenario	Effect distance in meters at specific weather condition		
	At radiation level (jet/pool fire)	At overpressure	At lfl/lfl fraction
Methanol	110	143	56
Phenol	165	477	544
Formaldehydes	41	Nr	135

In above qra study we found that this industry stored hazards material like corrosive and toxic acids and flammable chemicals etc. In case of any leakage or fire the damage distance and affected area. The risk of release and fire of hazardous material is highest in worst case scenario of release of phenol i.e. 544 m in 1.5/f weather condition.

Follow disaster management plan/procedure in case of any spillage, release and fire of hazardous material. Provide specific active and passive fire fighting system.

Proposed Control Measures

To prevent fatalities, injuries and to reduce damage to buildings and contents follow Workplace Emergency Planning & Preparedness procedure:

1. Onsite emergency response plan will be prepared and implement.
2. Trained employees will be deployed for operation.
3. Adequate personal protective equipment will be provided to all working personnel.
4. Fire hydrant system and fire extinguishers will be installed.
5. Regular training programs will be conducted for enhancement of employees' competence.
6. Earthing and bonding will be provided to all the storage tanks and pipeline to prevent accumulation of static charge.
7. Safe operating procedures will be developed and implemented.
8. National / International engineering standards in the Design, Construction and testing of the storage tanks, equipment and other hardware will be adhered.
9. Visual display signage will be provided.

10. Material safety sheet and SOP will be displayed.
11. Safety appliances and equipment (Self-contained breathing apparatus, safety shower etc.) will be provided.

Mitigation Measures

General

Measures and Recommendations are as follows:

- Periodic maintenance of all protective and safety equipment
- Periodical training / awareness should be given to work force at the project as refresh courses handle many new emergency situation
- Periodic mock drills should be conducted so as to check the alertness and efficiency of the DMP and corresponding records should be maintained
- Signboard including emergency phone numbers and actions to be taken in case of emergency should be installed at various locations
- Necked flame, welding, smoking should be strictly prohibited at the site
- All major units / equipments shall be provided with smoke / fire detection and alarm system
- Impurities should be controlled to obviate abnormal corrosion
- These measures should be backed up by relief systems such that the combination of vessel design, protection, quality control and relief eliminates the possibility of complete vessel failure
- Co-ordination with local authorities such as fire, police, ambulance, district administration and nearby industries should be ensured to manage / control meet any eventuality
- All employees should wear cotton clothes to eliminate the hazard of static electricity
- Safety shoes should not have nails and steel toe caps
- All maintenance work should be carried out under Safety Work Permit system.
- All hot work should be conducted only at the times and in the places specifically authorized and under a Safety Work Permit system
- All vehicles moving in the jetty area and within the terminal should have spark arrestors (mufflers)

Specific Recommendations Storage Tank:

- Review the suitability of active fire protection for this tankage system for protection against 37.5 KW/m², 12.5 KW/m² and 4.0 KW/m² radiation intensity.
- The active fire protection system provided for storage tanks are to be regularly checked for prompt action on actuation.
- As the control room may not be exposed to LFL, but may be partially subjected to blast overpressures, based on the prevailing site conditions and presence of ignition sources, ensure suitable mitigation by early leak detection and automated inventory isolation.
- All the storage tanks should be provided with sufficient dyke area to accommodate the accidental spillage.
- The inspection and checking of foam protection system should be done periodically and should be the prevailing practices
- A wind direction pointer should be installed at storage site, so that in an emergency the wind direction can be directly seen and downwind population cautioned
- Tank and tank dike have in-built design safety features;
- A comprehensive Safe Operating Procedure (SOP) from operational point of view; and
- Thorough training on Tank Farm Operation for the personnel and safety features (PPE), Escape training, HSE training, MSDS understanding, etc.)

Design Safety of Storage Tank:

- Storage tank should be designed, constructed and commissioned in accordance to the international and Indian codes – EN 14620, BS 7777 and OISD 194.
- The tank should be designed for the higher seismic load as region falls in the moderate seismic zone.
- After completion of the tank construction, the integrity of the tank should be checked by Hydro test (Min 125% of hydraulic load of the Tank at full capacity), Vacuum Box test / Global test for the welding joints
- Purging and drying with regassified Nitrogen and dew point of at least 60°c should be achieved before introducing the LNG into the tanks
- Tank should be equipped with three independent Level transmitters which should be configured to trip the receipt pump to avoid over flow of the tanks
- Secondary containment should be provided to hold the total liquid volume in case of over flow of the primary containment
- Pressure safety valve, pressure relief valve and reserved capacity relief valve should be provided to ensure the high pressure protection of the tank. All these three barriers should act independently and each barrier should get the signal from independent pressure sensors to make the system more reliable
- The low pressure integrity of the tank should be protected by Vacuum control valve and vacuum relief valve. Similar to the High pressure protection system, Vacuum protection should also have independent pressure sensing element.
- The Appurtenances and piping should be from the top of the tank penetrating through the tank dome to eliminate the possible leaks from the tank shell.
- The outer concrete tank should be pre-stressed and should withstand credible fire load in case of external fire in the adjacent areas

Operational Safety of Storage Tank:

- The tank base heating system should be monitored continuously to avoid any damage to the tank bottom due to moisture
- The field personnel and Panel operator should monitor all the critical parameters of tanks and associated facilities proactively
- Alarms should be provided to alert operator in case of any deviation from operating limits.
- All the tank fire fighting facilities should be checked once in a week
- All the piping / valves associated with tank integrity should be checked through LO / LC system.
-

Asset Integrity Tests of the Tanks:

- Thermography of the tanks should be carried out once in a year to map the temperature profile of the outer tank and ensure the tank integrity
- Civil RCM (Reliability Centered Maintenance) for the tanks should be carried out to ensure the integrity of the civil concrete structures.

- Equipments which are vital for tank integrity / safety should be listed as SCE (Safety Critical Equipments) and the performance of these equipments should be tracked / monitored regularly

References

1. Quantitative Risk Assessment-M.J Borysiewiez, M.A. Borysiewiez, L.Garanty, A. Kozubal.
2. Guide to Manufacture, Storage and Import of Hazardous Chemicals Rules (MSIHC), 1989 issued by the ministry of environment and forests, (MoEF) Govt.of India as amended up to date.
3. Guideline for QRA from the- "PURPLE BOOK"
4. World Bank Technical papers relating to "Techniques for assessing Industrial Hazards".
5. Major Hazard Control by ILO.
6. Risk Management Program guidelines by EPA (US)
7. World Bank Technical Paper no. 55 – Technical ltd. For assessing hazards – A Manual.
8. DNV based PHAST Software version 7.02

1.2 Occupational Health

- Plan and fund allocation to ensure the occupational health & safety of all contract and casual workers.
- Details of exposure specific health status evaluation of worker, if the workers' health is being evaluated by pre-designed format, chest x rays, Audiometry, Spirometry, Vision testing (Far & Near vision, colour vision and any other ocular defect), ECG, during pre-placement and periodical exam nations give the details of the same. Details regarding last month analyzed data of above mentioned parameters as per age, sex, duration of exposure and department wise.
- Details of Occupational & Safety Hazards. What are the exposure levels of hazards and whether they are within Permissible Exposure Level (PEL), if these are not within PEL, what measures the company has adopted to keep them within PEL so that health of the workers can be preserved.
- Annual report of health status of workers with special reference to Occupational Health and Safety.

1.3 Disaster Management Plan

1.3.1 Introduction to Disaster Management Plan

The proponent M/s Creative Carbon Pvt. Ltd., a proposed project located at Survey No. 688, 689, 691 & 698, Village: Kanera, Taluka: Kheda,District: Kheda. M/s Creative Carbon Pvt. Ltd. is promoted by Mr. Vinu Patel. The promoter's plan is to manufacture synthetic resins.

A Disaster Management Plan is prepared to meet any grave emergency which can occur due to Natural Disasters such as Floods, Earthquakes, or due to Man-Made Disasters such as Acts of war and Fires, Power failures, etc.

An Action Plan has been drawn to fix responsibility and actions to be taken by various groups to meet and contain the disaster within shortest possible time and with minimum loss to men, material and property. It is the responsibility of all the individuals in their respective areas to ensure the success of this plan. This plan shall be circulated for benefit / training of all individuals residing in the premises.

1.3.2 Objective

The objective of the plan is to handle emergency situation that may arise due to spillage and fire while handling plant & equipment and any adverse effect on employees and public at large is minimized and normalcy is restored within shortest possible time.

The Disaster Management Plan is aimed to ensure safety of life, protection of environment, protection of installations, restoration of production and salvage operations in this same order of priorities. For effective implementation of the Disaster Management Plan, it will be widely circulated and personnel training given through rehearsals/drills.

Disaster management plan/Emergency Response Plan (action plan) has been drawn to fix responsibility & actions to be taken by various groups to meet & contain the emergency within shortest possible time & with minimum loss to men, materials, machines & property. It is responsibility of all individuals in their respective areas to ensure success of this plan. This plan will be circulated for benefit / training of all individuals working.
The major functions & objectives to formulate the plan are:

i) To mobilize the available / trained manpower and handle the emergency from:

- On-site (within factory)
- Off-site (through outside agencies).
- To ascertain urgently the likely area of influence and take actions for warnings, control of disaster with minimum damage to men, material, machines and evacuation of employees / public, identify the persons affected / dead, arrange first aid / medical help to the victims.
- Inform relatives of the casualties; provide authoritative information to News Media & others; preserve relevant records & equipments needed as evidence in any subsequent inquiry.
- Approach District Administration / Civil authorities etc. in order to ensure prompt relief for execution of Emergency Response Plan.
- This document sets out the Disaster management plan/emergency plans for all levels of accident ranging from a local incident within the site boundary to a situation that requires outside support.

The objectives of the Disaster management plan /emergency plan are:

- To protect lives of working personnel and nearby population.
- To contain the hazards and to control their spread.
- To minimize the impact on the environment.
- To minimize the loss to plant and production.

7.3.2 Definition and scope

A major emergency is defined as one, which may affect one or several sections of the plant and possibly extend beyond the factory boundaries. It may cause serious injuries, loss of life or extensive damage to property.

The Disaster Management Plan has been prepared in order to provide proper guidance to plant operating personnel to confidently handle any accidental spillage or fire / explosion or

any natural calamity or sabotage. With this objective, comprehensive information has been assembled in the materials used, about its hazardous properties, fire hazards, safety appliances, safety measures incorporated in the plant, emergency procedures and finally regarding the constitution & responsibility of Emergency Rescue Team (Emergency Response & Management Team / Task Force).

1.3.3 Methodology

A major emergency occurring at a plant is one that may cause serious injuries, loss of life, extensive damage to property or environment or serious disruption inside or outside the plants. This may demand the rescue and relief measures on a war footing to handle it effectively and quickly. Within the high-risk technology industries, the need for well-planned measures should be self-evident.

No matter how well a process is controlled and safeguarded by instruments and process safety procedures, it is inevitable that there is a residual risk, which is capable of causing a variety of emergencies.

The Factories Act, 1948 as amended in the year 1987 under section 41B requires that every occupier shall draw up a Disaster Management Plan and detailed disaster control measures for his plant and make them know to the employees and to the general public living in the vicinity of the plant.

Its objective is to reduce the severity of loss following particular hazardous incidents. At the same time, must be clearly understood that it is not a substitute for maintaining good standards for working consistently with the requirements of safety and health inside the plants.

1.3.4 Level of disasters

The QRA has already indicated distances. The Guidelines (NDMA Guidelines) categorize the levels of disasters into L0, L1, L2, & L3 based on the ability of various authorities to deal with them. In short, in order to facilitate the responses and assistances to States and Districts, the levels of disasters have been defined as follows.

L0 level denotes normal times which will be utilized for close monitoring, documentation, prevention and preparatory activities. Training on search and rescue, rehearsals, evaluation and inventory updation for response activities will be carried out during this time.

1. **L1 level** specifies disaster that can be managed at the District level, however, the State and Centre will remain in readiness to provide assistance if needed.
2. **L2 level** disaster situations are those which require assistance and participation of State, mobilization of its resources for management of resources.
3. **L3 level** disaster situation is in case of large scale disaster where the State and District authorities have been overwhelmed and require assistance from the Central Government for reinstating the State and District machinery as well as for rescue, relief, other response and recovery measures. In most cases, the scale and intensity of the disaster as determined by the concerned technical agencies like Indian meteorological department (IMD)/ Indian National Centre for Ocean Information Services (INCOIS) are sufficient for the declaration of L3 disaster.

1.3.5 Information on risk evaluation preliminary hazard analysis

The Disaster Management Plan describes the Organization & procedures for dealing with potential accidents arising from the operations of **M/s. Creative Carbon Pvt. Ltd.**

Experience of accidents that have occurred in various other similar plants was considered in the preparation of this Plan especially material while handling synthetic organic chemical unit identical to this plant. This plan will need periodic review & modification following emergency exercise, or include any new information relating to changes to the facilities.

This Plan is needed to respond to a variety of emergencies / disasters:

i) Disasters due to emergency on account of:

a. Fire or explosion
b. Spillage
a. Fire or explosion: The organization is handling Synthetic organic chemical industry unit, the fire, mainly due to fire in process equipments and electrical equipments such as transformers, DG sets etc.
b. Spillage: Accidental spillage/leakage of material while handling of chemicals causing engulfment of workers.

ii) Disaster due to natural calamities such as:

a. Flood
b. Earth quake
c. Storm / cyclone
d. Heat Waves

a. Flood

The southwest monsoon brings a humid climate from mid-June to mid-September. The average annual rainfall is around 674 mm (26.5 in).The nearest water body from the facility is Khari River which is 2.5 Kms away from the site.The heavy rainfall and water released from the Khari River may increase water level in the river bed creating flood situation.

b. Earth quake

This zone is classified as Moderate Damage Risk zone which is liable to MSK VII and also 7.8. The IS code assigns zone factor of 0.16 for Zone 3.

A. Storm / cyclone

Cyclones make impact by killing people, damaging property, crops and infrastructure. The area falls under category in which wind speed is 48-50m/sec. So the chances are there for storm & cyclone.

B. Heat Waves

During summer time, the temperature ranges between 24 °C and 42 °C,leading to severe heat wave conditions. This results in loss of life of many people particularly, homeless, gardeners, daily wagers who work out under direct sun, auto drivers, etc.

iii) Disaster due to external factors such as:

a. Sabotage, Civil Riots or War, Terrorism, air raid, etc.

Sabotage, Civil Riots or War, Terrorism: No solution can be offered to eliminate either terrorist threats or planted bombs, but one can be well or badly prepared to cope with them when such incidents happen. It is essential for organizations to design and implement both good physical security and a comprehensive bomb threat response plan.
The condition which create emergency.

- Flood - The probability of the flood is moderate and intensity is low to moderate
- Earthquake - This zone is classified as Moderate Damage Risk zone which is liable to MSK VII and also 7.8. The IS code assigns zone factor of 0.16 for Zone 3.
- Cyclone causes stampede in crowd.
- Storms causes stampede in crowd.
- Bombarding during terrorist attack or war.
- Political Violence- Kheda is politically an active city ever since the struggle for independence. The political culture of Kheda has been rapidly undergoing change and political violence cannot be ruled out.

Recommendations

Flood:

- Introduce better flood warning systems
- Modify homes and businesses to help them withstand floods nearby river side.
- Construct buildings above flood levels
- Protect wetlands and introduce plant trees strategically
- Put up more flood barriers.

Earthquake:

- Find a clear spot away from buildings, trees, and power lines. Drop to the ground.
- Don't Rush Indoors
- Stay Put remain there until the earth stops shaking
- Remain Calm until the earth stops shaking

Bridge Collapse:

- Immediately call ambulance
- Immediately call Police, NDRF & Municipal Commissionaire.
- Stop movement across bridge.
- Survey site and remove people from covered collapse material.

Cyclone/Storm:

- Immediately call ambulance & NDRF team.
- Provide shelter for the victims and provide first aid on site.
- Survey site and remove people from covered collapse material.

Terrorist Attack/ Political Violence:

- Don't be panic and threatened.
- Call the police, ambulance & District Collector.

The above are the summarized results of an analysis of hazard, risk and disaster impact in Kheda. For more study of risk criteria please refer, Gujarat State Disaster Management Plan.

The action plan responding to an emergency situation depends very much on the level of the emergency which, itself is defined by the consequences arising from the types of hazard identified.

1.3.6 Disaster preparedness

This section highlights the Organization for disaster preparedness. No plan will succeed without effective Disaster Management. Disaster Management Plan is a part and parcel of a good ON-SITE and OFF-SITE emergency plan, without which all resources, facilities etc., event available with us, cannot be put into services at a right time is the key factor in tackling an emergency.

It is not possible to envisage and detail every action which should be taken in emergency and to harness the basic elements of emergency preparedness such as Gravity of emergency, Communication of information, on-site action for process and emergency controls, Mobilization of internal and external resources for fire and spillage etc. Emergency Organization is set up specifying duties and responsibilities of all to make best use of all resources and to avoid confusion while tackling the emergency.

Disaster Management Plan / On-Site Emergency Plan highlight the flow of information and co-operation among various action groups within the factory. Off-site Emergency Plan indicates various action groups at district levels which will get engaged in case of off-site emergency.

Emergency organization and arrangement include:

- Site Main Controller
- Incident Controller
- Service coordinator
- Assembly Points
- Emergency Control Centre
- Medical Services & First Aid
- Transport & Evacuation arrangements
- Other arrangements etc.

1.3.7 Emergency Organization

This section is devised to suggest the organization for emergency preparedness. Key personnel to combat emergency are nominated with specific responsibilities according to set procedures and making best use of the resources available and to avoid confusion. Such key personnel include Site Main Controller, Incident Controller;Services Coordination includes Fire & Safety, Security, Engineering Services (Maintenance), Environment, Lab (QC/QA), HR & Admin, Account & Finance, Store & purchase and Process.

1.3.8 Plant Assembly Points

The assembly points will be selected considering the distance from the hazardous place, wind direction, capacity to accommodate the required number of people and availability of the other resources in that area. In case of emergency, it will be necessary to evacuate all personnel from effective area except personnel who will be directly involved in dealing with the incident. On evacuation people will go to pre assigned assembly points i.e. near main gate and other selected points.

1.3.9 Emergency Control Centre (ECC)

The emergency control center shall be situated in the plant, from which the operation to handle the emergency are directed and coordinated. The center will be equipped with all necessary emergency equipment, communication arrangement to receive and transmit information and directions from and to the incident controller and areas of the works as well as outside.

The emergency contact numbers for the mutual aids like nearest police station, fire station, hospital, ambulance service etc. & list of emergency team members and various activity

coordinators will be displayed at the emergency control center, security gate and other prominent locations.

Emergency Control Centre Will Contain the Following Facilities:

a. Adequate number of telephones for external & internal communication
b. Plans of the location
c. Stationeries
d. Copies of the on-site and off-site emergency plans
e. Firefighting equipment such as Fire extinguisher, fire hoses & nozzles etc.
f. Safety equipments such as SCBA, gum boots, gloves, goggles, cover all etc.

Trained personnel will always be available in these areas who can rush to the emergency point in shortest time. Warning system will always be kept in working order.
Fire extinguishers of suitable types and hydrants will be provided at almost all the places of plant. The office building will act as a ECC.

1.3.10 Medical Services and First Aid

M/s. Creative Carbon Pvt. Ltd. will set up a First-Aid Centre in the Factory premises & will arrange pre-employment & periodic medical examination of the employees.

An emergency vehicle will be available for evacuation and transportation of people to hospital, H.J. Doshi Hospital, which is approx. 7.6 Km from the plant.

The First aid team will play critical role in attending the victims in case of any accident.
First Aid boxes & list of trained first-aider will be available at security Check Post.

In case of any medical assistance other than first aid, the Admin In-charge/ Site- SHE representative will arrange for a vehicle to shift the casualty to the company accredited hospital, or call an ambulance to mobilize the casualty to the medical center/ hospital.

First Aid boxes & first-aider list will be kept at security cabin. In case of any medical assistance other than first aid, the Admin in charge/ Site- SHE representative arrange for a vehicle to shift the casualty to the below mentioned hospital, or call an ambulance to mobilize the casualty to the medical center.

1.3.11 Transport and Evacuation Arrangements

In a major emergency, it will be necessary to evacuate personnel from affected areas and to further evacuate non-essential workers from areas likely to be affected should the emergency escalate.

A siren will be provided to warn the people for the evacuation. The mode of siren for evacuation will be wailing pitch. On hearing the siren, people will disperse from the work area and will evacuate to safe assembly points. Proper instruction will be given to all the employees about the rising of siren and the emergencies. The same instructions will also be displayed at prominent places within the plant area.

The employees would proceed to the predetermined assembly points on hearing the siren and the support staff / security forces would be instructed to divert the people away from the affected area and towards the assembly points.

1.3.12 Communication and help from external emergency services

Communication is a critical factor in handling an emergency. To control the situation by the earliest possible action, the practice should be that any employee can raise an emergency alarm.

A siren will be provided to warn the people for the evacuation. The mode of siren for evacuation will be wailing pitch. Essential requirements are that there should be an adequate number of readily identified points from where the alarm can be raised and these needs to be clearly indicated by sign boards and by indications in the plans.

In areas where there will be high level of noise (as the case here), it may be necessary to install more than one audible alarm transmitted or flashing lights, Automatic alarms may be considered appropriate on sites.

The following help from external emergency services is shown below,

- Fire brigade of the nearest area shall help the plant fire control team during fire at site.
- Police station personnel shall help the company to maintain law & order, Traffic control & evacuation operations.
- Nearest Hospital or Nursing home shall render emergency medical services to the company for the first aid & medical treatment during emergency.
- District supply officer shall ensure continuous supply of essential items, medicines (Govt. Quota) and other emergency materials during emergency.

1.3.13 Other Arrangements

The details about Power Supply Interruption, Water Drainage, Electrical Supply etc. & Control arrangements shall be provided.

For Emergency, Plant Operations and Emergency Lighting provisions will be made according to requirements. DG set will be provided as backup.

Water Drainage

In order to avoid difficulties of storm water distribution proper drainage to the storm water/rain water runoff system will be designed so as to protect the plant equipments, Building & offices. No area will submerge in the flood as adequate height has been provided to all installations such as utility block, office building, Process plant, warehouses & storage area has been provided with individual dyke.

Electrical Supply

As the fire protection system is safety related, it is mandatory that any electrical power supply for the control, Operation or instrumentation of the system shall be from an assured supply. During monsoon season the electrical circuit (conduit wiring) sometimes comes in contact with wet or structure (in case of any breakage, loose fittings), in such case there is probability of current leakage.

Trade Waste Disposal

Organization will be more concerned for environment protection and pollution abatement at all times.

Provision will be made to dispose Solid wastes. The company will dispose off all solid waste in safe manner.

1.3.13.1 Emergency Action

Though it will be an impractical to describe all the foreseeable scenarios involving flammable/combustible materials and the suggested action for the same, some important ones are discussed here briefly. Even in identical incidents the right course of action may not necessarily be the same every time as the actual action will depend on the several factors, such as the place of incident, quantity of material involved, the amount of release, the nature of material, the wind direction, the wind velocity, temperature of surrounding, time of day, prevailing season and weather condition.

In case of Fire

In case of declaration of onsite emergency (Hearing of emergency siren), evacuate the area as per evacuation plan & exit signs on instruction of shift in-charge / incident controller as quickly as possible after safe shutdown of the plant. See that the wind direction is in opposite direction of assembly point by wind direction indicator. If not, change the assembly point.

Following are the general guideline for emergency action.

- Raise the alarm through nearest MCP
- Inform security and shift in charge.
- Carry nearest fire extinguisher & try to extinguish if possible.
- Assemble emergency team and inform other emergency members.
- Check the wind direction, then decide the assembly point and inform accordingly.
- Warn the people nearby.
- Attempt to isolate /extinguish the fire with the help of others with available appropriate extinguishers.
- Arrange fire hydrant hose and try to cool surrounding
- Cordon the area and try to shift the drum of flammable material.
- Used foam generating nozzle and create foam to extinguish fire.
- If fire beyond control call fire brigade after consultation with chief controller.
- Cool the surrounding or remove flammable material if possible.
- Take head count at site and inform to the chief controller.
- Also take head count at the assembly point and tally.
- Search for missing person if any.
- Call for mutual aid members for help, if require.
- Arrange for rescue, if required.

In Case of spillage of materials while unloading & loading activity and equipment inside the factory premises:

Special instruments for storing, Handling & emergency actions in case of spillage of materials are given separately in MSDS.
Following are the general guideline for action:

- Use PPE's like SCBA/Gas mask/Respirator & evacuate the area.
- Designated area will be provided for tanker parking.

In case of declaration of onsite emergency (Hearing of emergency siren), evacuate the area as per evacuation plan & exit signs on instruction of shift in-charge / incident Controller as quickly as possible after safe shut down of the plant. See that the wind direction is in opposite direction of assembly point by wind direction indicator. If not, change the assembly point.

In case of Flood / Earthquake:

In case of natural calamity like flood, Strom or earth quake (remote possibility) or war like situation the management may seek outside help. The help may be for firefighting, Evacuation (of surrounding population), Medical treatment, shelter, food, transport or communications.
Following are the general guideline for emergency action:

- Close main valve
- In case the cylinders are on the ground the same be shifted to storage shed to ensure that the floodwater shall not carry the cylinders.
- Switch off electricity (main).
- Assemble outside the office, away from Electric Poles & Wires.
- Evacuate the areas after initiating (communication in working condition) off site organization.

In case of War/Civil riots:

Following are the general guideline for emergency action:

- Intimate nearest police station & stimulate off site emergency plan
- Stop unloading / loading operations (if any)
- Intimate civil defense dept. about the situation
- Security persons shall protect & control law & order.

General action plan

- All personnel handling the emergency should wear PVC suit / alkali suit, gumboot, PVC hand gloves, PVC goggles.
- Isolate the sources of supply.
- Cordon off the area.
- Avoid the entry of unnecessary people.
- Start barricading the area with sand / earth.
- Flush the affected body parts with plenty of water and seek medical help.

1.3.13.2 Evacuation Plan

On hearing the siren all employees shall evacuate the area by safely closing down all operation as per instructions from their Incident Controller or in nighttime Shift supervisor. After gathering at assembly points, shift-in-charge should take the roll call & ensure that no person is left trapped.

The Rescue Coordinator or Guard (who is inside the plant for duty) shall ensure that none is trapped inside the plant. Security guards shall ensure total evacuation.

Main gate will be used for movement of personnel, movement of rescue, medical aid.

1.3.13.3 Traffic Control

The Security In-charge or Guard shall contact Service Coordinator and shall make himself available at main gate for traffic control till local authorities help is available.

Unwanted traffic and public gathering shall be controlled & avoided by security personnel till local help from police is available.

1.3.13.4 Public Relations

Inevitably a major incident will attract the attention of the press, television and radio services and anxious inquiries from friends and relatives will be flooding the factory. It is essential to make arrangements for authoritative release of information to them. SMC/IC who is familiar with procedures of dealing with such situations, shall take charge of public Relations, information etc. He will be the sole authoritative source of information to the news media and others.

Declaration of cessation of emergency

The Service coordinator (Emergency Fire, Rescue & Security Co-coordinators etc.) will not signal the end of the emergency until he is satisfied that all the spillage are arrested or fires are extinguished and there is no risk of re-ignition (in case of fire). In the case of gas, the all clear will be declared only when the source of emission has been effectively isolated and gas clouds dispersed well below safe level. Even when the all clear Signal has been given, great care is needed while entering affected areas and no work in connection with salvage, collection of evidence should be commenced until a thorough examination of the area has been carried out. The siren code will follow for declaring the cessation of an emergency. Sources of leakage, fire, and explosion and so on, until it has been established that no materials remain where they could be ignited. All clear signed shall be given by SMC / Incident Controller.

Plan appraisal and updating

The matters relating to review effectiveness of emergency planning should cover:

Time limit, which is essential for rescuing and evacuating personnel from the scene or confined space for carrying out any emergency measures. It is essential to check whether pre-determined time limit has been met and if not the impediments for it should be identified. For example, if 15 minutes is fixed for evacuating the people from confined space, it may be reduced to 10 minutes, if considered necessary for the safe evacuation.
To check the quantum of emergency, equipments like firefighting equipment, personnel protective equipment etc. are required to be provided in the critical areas whether it is adequate or not. Any changes made in the plant should also be made known to all.

1.3.14 Safety and mitigating measures

Safety Considerations in the design of M/s. Creative Carbon Pvt. Ltd., important mitigating measures will be provided to contain and control the emergency are outlined below:-

Fire Protection and Fire Fighting System

The plant will be equipped with a comprehensive fire protection system. Following facilities will be provided for the fire protection:-

- Fire Water Supply
- Fire Hydrant system, Fire sprinkler system with smoke/fire detectors
- Water Pump (Hydrant Pump)
- Portable Fire Extinguishers(DCP, mechanical foam and CO_2 types with sand buckets)

Equipments and Process safety

- Control of noise emissions may include the use of silencers for fans, room enclosures for mill operators, noise barriers, and, if noise cannot be reduced to acceptable levels, adopt personal hearing protection.

- An enclosure covered from all sides and should have a venting arrangement along with a bag filter.
- Storage tanks containing hazardous materials will be located away from the plant.
- Provision for delay start warning (Audio/visual) to be followed
- Provision for Machine guard system as per requirement either fixed or interlocked.
- The fire-fighting system and equipment will be tested and maintained as per relevant standards.
- Safety measures in the form of Do's and Don'ts will be displayed at strategic locations especially in local language.
- Post emergency planning
- Assess the situation from safety & production angle.
- Re-start the plant in the standard sequence.
- All evidences should be collected & accident should be investigated.

1.3.15 Health, Safety and Environmental Protection

Company committed to achieving environmental, health & safety (EHS) excellence. This is a responsibility of management & employer in all function. Company will strive to provide a safe and healthy working environment & the community in which we do business. Our programs must combine clear leadership by management, the participation of all employees and functions, and the use of appropriate technology in developing and distributing company products & services.

Requirements

- Comply with applicable environmental, health, & safety laws and regulations.
- Take appropriate measures to prevent workplace injuries & illness, and to provide employees with a safe & healthy working environment. Consider evolving industry practices, regulatory requirements and social standards of care.
- Eliminate unreasonable, risk form facilities, products, services and activities.
- To the extent practicable, reduce the use
- Research and where appropriate, implement advanced technology, design and production facilities, products, services & activities.
- Research and where appropriate, implement advanced technology in the design, production and services and to prevent pollution and conserve, recover and recycle raw material.

1. **Monitoring of the occupational injury & impact on workers/employees:**

   1.1 Provision of Industrial Hygienist: Project Proponent will tie-up with nearest Occupational health centre/doctor who's expert in handling chemical emergencies. The Govt. of Gujarat approved Industrial Hygienst visits periodically for health check up of workers and officers and the record is maintained in form 32 as per factories rules.

   1.2 Monitoring of minor and major injuries and occupational health – The Enterprise have to maintain the record of minor and major injuries of the workers as per our Environmental management plan. They are also planning to keep the record of near miss injuries and accidents as a proactive measure. The periodic monitoring of occupational health will be done as per Gujarat factories rules in the form No. 32. The monitoring will be as per our Prescribed EMP Plan.

2. **Periodical Medical health check up of workers/employees**:

The preplacement health check up of employees done before recruitment to decided if they are physically fit to do the work in chemical factory and if they have any history of family disease and allergy as per the format in Gujarat factories rules form No 27A and form No 33. The health check up of the employees will be done by the Govt. approved medical practitioner of the company and records will be maintained as per Gujarat factories rules Form No 32.

3. **Ambient air Monitoring and work place monitoring -** The ambient air monitoring will be done as per GPCB consent once in three months or more frequently as per directives of state pollution control Board. The workplace monitoring will be done as per Gujarat factories rules once in three months and will be recorded in the prescribed format.

1.4 Corporate Environment Policy

An Environment Management Policy is a set of laws, restrictions, or standards designed to protect and conserve environmental resources. An effective Environment Management Policy clearly outlines rules and expectations for people to follow and includes the reasons why conservation is important. The project proponent is well aware of environmental requirements for planning and implementation of the project and shall set up a department with trained personnel to take up responsibility for Environment, Safety and Health. It recognizes that day-to-day operations can impact the environment both directly and indirectly. It is therefore aimed by the project proponent to protect and improve the environment through proper management and by adopting best practice wherever possible.

The main aims under the said Policy are to:

- Effectively manage, monitor, improve and communicate the environmental performance.
- Take all reasonable steps to prevent pollution.
- Set realistic and measurable objectives and targets for continual improvement of the environmental performance.
- Comply fully with all relevant legal requirements, codes of practice and regulations.
- Reduce, recycle and reuse natural resources.
- Minimise waste and increase recycling within the framework of waste management procedures
- Identify and manage environmental risks and hazards

The project proponent shall regularly review this policy and ensure that corrective and preventative actions are taken in order to ensure continual improvement.

The company will provide basic infrastructure for sanitation system, fuel storage and handling system, rest room for labours and drivers during construction and operation phase to maintain surrounding environment.

1.4.1 Employee responsibility

- Follow the policy and applicable laws and regulation to protect your own health and safety as well as that of other workers, the public and the environment.
- Present ideas that support the goals of policy.
- Promptly report concerns about possible violation of this policy to the persons listed or to your manager.

Additional responsibility of leaders:

It will make sure this policy is part of an overall policy compliance program as described. The person will:

- Consult with adequacy of their health, safety and environmental programs.
- Implement monitoring and auditing system at the plant and business levels designed to detect violations & assure compliance with law and this policy.
- Regularly evaluate the effectiveness of managers & other senior employees on their implementation of this policy and environmental, health & safety programs.

Managers responsible for a facility, activity, product or service will:

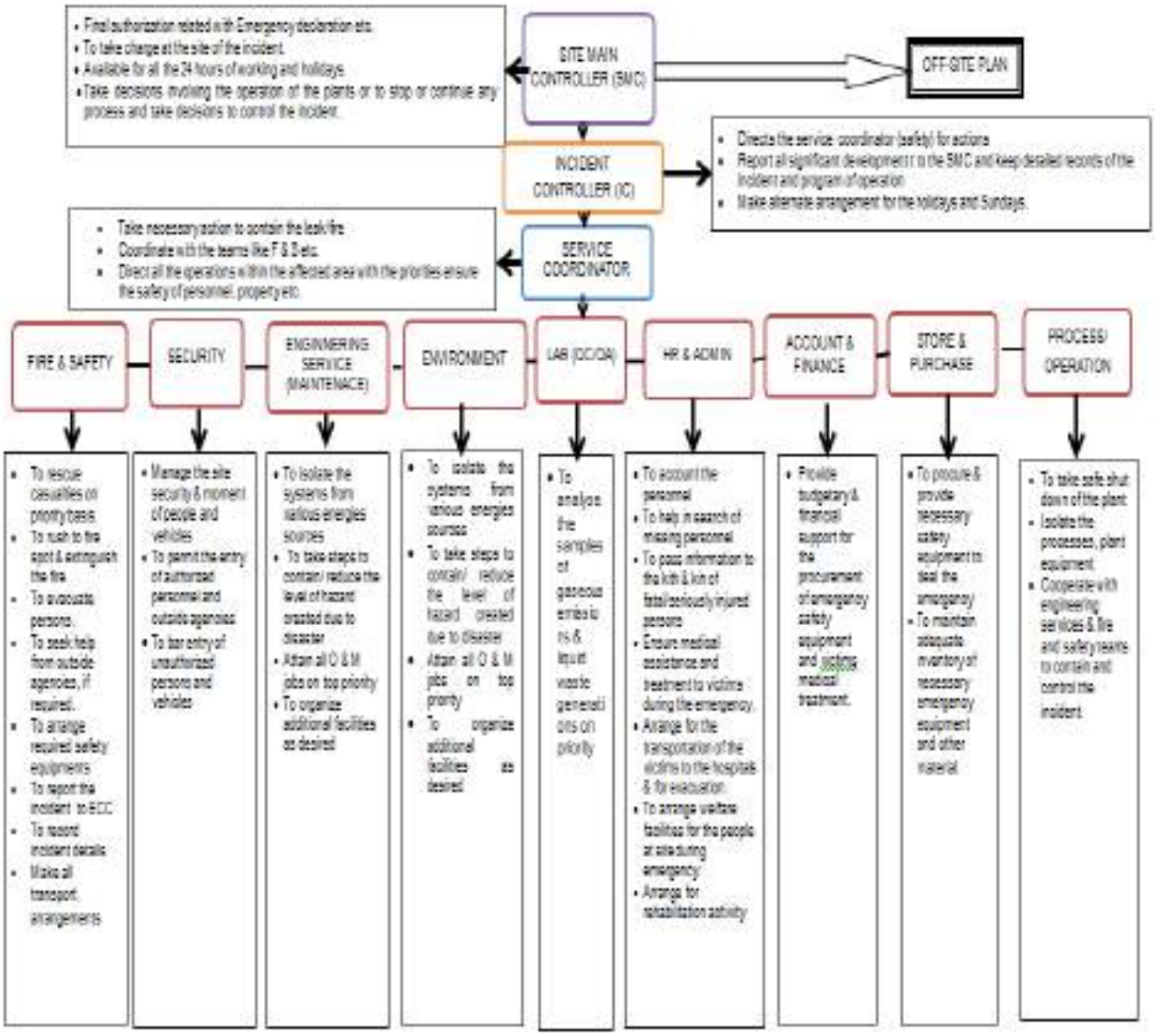
- Communicate responsibility with employees, communities, customers and government agencies regarding environmental health and safety issue.
- Cooperate with the public, government and other interested parties to develop appropriate regulatory and public policies that protect employee and public health and the environment.
- Implement effective programs, training and best practices for health, safety and environment protection and for the elimination or reasonable reduction of materials.
- Regularly assess plant operations & management. Establish measurements to ensure compliance with this policy and applicable laws & regulations, when appropriate; review assessment results with environmental programs.
- Ensure that an employee with EHS responsibilities is appropriately screened before appointment and that continued appropriateness for their position is periodically reviewed.
- Develop appropriate program for safety reviews of new and redesigned products prior to sale and distribution to customers. Monitor after-sale safety performance to identify and address significant product safety issues.
- Work cooperatively with, contractors, business partners & suppliers to ensure that our relationships with them are supportive of this policy.
- Promptly report to medical Services, Environmental Program & your assigned legal counsel any,
- Emergency evacuation, communicable disease or other serious health indent.
- Work related employee facilities & other serious safety incidents requiring a report to a governmental agency.
- Information regarding a report to a governmental agency or any governmental allegations of substantial violations of environmental laws or regulations.
- Legal proceedings alleging significant property damage or personal injury from environmental contamination or exposure to dust & other information requested by medical services or Environmental programs.

1.4.2 Training and rehearsing

All employees should know the details of Disaster Management plan and they must receive initial training in emergency procedures. Then, at suitable intervals this knowledge must be exercised and the basic plan reviewed and brought up-to-date. It is essential to establish the necessary confident volunteers and better expertise, so the individuals can carry out their allocated duties. Rehearsal of evacuation should be regularly carried out efficiently and should cause minimum disruption to the normal activities. As per industrial best practice Mock Drill should be conducted six monthly.

An after-mock drill report may be prepared detailing the lacunas & strong points so as to make improvements in the emergency action plan.

EMERGENCY MANAGEMENTCHART



Important Telephone Numbers

SN	Service	Telephone no.
1	District Collector (DC)	0268 2553334
2	Police Commissioner	0268-2550150
3	Superintendent of Police (SP)	0268-2550250
4	Fire station, Kothariya Main Road	098245 95628
5	kheda civil hospital, Kheda	02684 224932
6	Indian Red Cross Society Blood Center, Nadiad, Kheda	0268 2566944