CHAPTER - 6
ADDITIONAL STUDIES

6.1 PUBLIC HEARING / PUBLIC CONSULTATION:

Public Hearing is applicable as per obtained TOR (Terms of Reference). Public Hearing was carried-out for the proposed expansion project of synthetic organic chemicals (emulsifier & de-emulsifier) of Shree Vallabh Chemical at Survey No.: 163, 174/2 & 175/4, Village: Ahmedpura-Sampa, Taluka: Dehgam, District: Gandhinagar under category – A of the scheduled at 5(f) on 20/12/2014 at 16:00 hrs at Yogi Satsang Hall, Nr. Nilkanth Mahadev Temple, Dehgam-Modasa Road, Village: Palaiya, Taluka: Dehgam, District: Gandhinagar. An advertisement in English was published in "The Indian Express" dated 19-11-2014 & 19-12-2014 and in Gujarati in "Gujarat Samachar" dated 19/11/2014 & 19-12-2014. Dr. M. D. Modiya (GAS), Resident Additional Collector and Additional District Magistrate, Gandhinagar as representative of District Magistrate and District Collector Gandhinagar supervised and presided over the entire public hearing proceedings with Mr. B. R. Gajjar, Regional Officer, GPCB, Gandhinagar.

The public hearing presentation and question answer session ended with positive responses from the local people about the project. They were satisfied with mitigation measures and environmental management plan of the proposed expansion project. Raised queries during the public hearing were also adequately addressed. The minutes of meeting of the public hearing proceeding is enclosed as Annexure – 5. In view of the above, it was concluded that no change is required in EMP of the proposed expansion project. Industry will provide 5% (Rs.4 lac) of the expansion cost (Rs.80 lac) towards CSR:

Sr. No.	CSR Activity	Budgetary Amount
1.	Computers for school	Rs.2,50,000/-
2.	Public health programme / seminar	Rs.1,50,000/-
	TOTAL	Rs.4,00,000/-

6.2 RISK ASSESSMENT:

A. Raw Material Handling and Storage :

Table 6.1 gives a list of the monthly requirement of each raw material that will be consumed to manufacture the maximum quantity. All the raw materials shall be first received by the stores department and samples of raw materials shall be sent to quality control laboratory wherein the quality of raw material shall be tested. Only after confirmation of quality by the QC lab, the raw material shall be transferred / unloaded at the respective storage area in the factory with proper labeling. The raw material in general will be received in bags, carboys, drums as well as through tankers.

Table : 6.1 : LIST OF RAW MATERIALS WITH CONSUMPTION

Sr. No.	Raw Materials	Consumption	
		MT / MT of product	MT / Month
1.0	**Nonyl Phenol Ethoxylate : 160 MT / Month**		
1.1	Nonyl Phenol	**0.332**	53.220
1.2	Ethylene Oxide	**0.666**	106.46
1.3	NaOH / KOH	**0.002**	0.320
1.4	Water	**0.008**	1.280
2.0	**Octyl Phenol Ethoxylate : 30 MT / Month**		
2.1	Octyl Phenol	**0.318**	9.556
2.2	Ethylene Oxide	**0.680**	20.384
2.3	NaOH / KOH	**0.002**	0.060
2.4	Water	**0.008**	0.240
3.0	**Dodesyl Phenol Ethoxylate : 10 MT / Month**		
3.1	Dodesyl Phenol	**0.229**	2.290
3.2	Ethylene Oxide	**0.769**	7.690
3.3	NaOH / KOH	**0.002**	0.020
3.4	Water	**0.008**	0.080
4.0	**Castor Oil Ethoxylate : 100 MT/ Month**		
4.1	Castor Oil	**0.508**	50.765
4.2	Ethylene Oxide	**0.490**	49.035
4.3	NaOH / KOH	**0.002**	0.200
4.4	Water	**0.008**	0.800
5.0	**Poly Ethylene Ethoxylate : 80 MT / Month**		
5.1	Poly Ethylene (Di – Ethylene) Glycol	**0.194**	15.501

5.2	Ethylene Oxide	**0.804**	64.339
5.3	NaOH / KOH	**0.002**	0.160
5.4	Water	**0.008**	0.640
6.0	**Fatty Alcohol Ethoxylate : 120 MT / Month**		
6.1	Fatty Alcohol	**0.296**	35.584
6.2	Ethylene Oxide	**0.702**	84.176
6.3	NaOH / KOH	**0.002**	0.240
6.4	Water	**0.008**	0.960
7.0	**Hydrogenated Castor Oil (HCO) : 20 MT / Month**		
7.1	Hydrogenated Castor Oil (HCO)	**0.319**	13.587
7.2	Ethylene Oxide	**0.681**	6.373
7.3	NaOH / KOH	**0.002**	0.040
7.4	Water	**0.008**	0.160
8.0	**Poly Ol Ethoxylate (De – Emulsifier) : 40 MT / Month**		
8.1	Poly Ol	**0.693**	27.198
8.2	Ethylene Oxide	**0.305**	12.198
8.3	NaOH / KOH	**0.002**	0.008
8.4	Water	**0.008**	0.320

Storage and Transportation of Liquid Raw Materials

All liquid raw materials will be stored in storage tanks and in Drums/Carbouys at separate storage area. The storage area for hazardous chemicals will be located within the boundary wall with a constant watch by security round the clock. Proper enclosures shall be provided for all storage tanks. All necessary firefighting system and safety arrangements shall be provided near the storage area to combat any emergency accident. The liquid chemicals shall be transported through pipes via rack to production area from storage tanks. The same system is provided for exiting activities.

Storage and Transportation of other Raw Materials

The raw materials which are procured in drums/carboys/bags shall be stored in separate storage area in stores department and transported from the storage area to the production plant by hydraulic lift/trolley/forklift as applicable. The same system is provided for exiting activities.

Table 6.2 & Table 6.3 shows the details on Transportation, Storage and Handling of products and raw materials, respectively.

Table : 6.2 : TRANSPORTATION DETAILS ON FINISHED PRODUCTS

Sr. No.	Product	Physical State	Dispatch	Means of Transportation
1.	Nonyl Phenol Ethoxylate	Liquid	Local / Export	Truck / Container
2.	Octyl Phenol Ethoxylate	Liquid	Local / Export	Truck / Container
3.	Dodesyl Phenol Ethoxylate	Liquid	Local / Export	Truck / Container
4.	Castor Oil Ethoxylate	Liquid	Local / Export	Truck / Container
5.	Poly Ethylene Ethoxylate	Liquid	Local / Export	Truck / Container
6.	Fatty Alcohol Ethoxylate	Liquid	Local / Export	Truck / Container
7.	Hydrogenated Castor Oil (HCO) Ethoxylate	Liquid	Local / Export	Truck / Container
8.	Poly Ol Ethoxylate (De – Emulsifier)	Liquid	Local / Export	Truck / Container

Table – 6.3 : DETAILS ON RAW MATERIALS – TRANSPORTATION

Sr. No.	Raw Material	Physical State	Source of Supply	Means of Transportation (by road)	Distance of Supplier from Project Site (km)
1.	Nonyl Phenol	Liquid	**Local**	**200 kg drum**	**50 - 500**
2.	KOH	Flakes	**Local**	**25/50 kg bags**	**50 - 500**
3.	NaOH	Liquid/ Flakes	**Local**	**25/50 kg bags**	**50 - 500**
4.	Octyl Phenol	Flakes	**Local**	**25/50 kg bags**	**50 - 500**
5.	Dodesyl Phenol	Liquid	**Local**	**200 kg drum**	**50 - 500**
6.	Castor Oil	Liquid	Local	**200 kg drum**	**50 - 500**
7.	Di – Ethylene Glycol	Liquid	**Local**	**200 kg drum**	**50 - 500**
8.	Fatty Alcohol	Liquid	**Local**	**200 kg drum**	**50 - 500**
9.	Hydrogenated Castor Oil	Flakes	**Local**	**25/50 kg bags**	**50 - 500**
10.	Poly Ol	Liquid	**Local**	**200 kg drum**	**50 - 100**
11.	Ethylene Oxide	Liquid	**Local**	**7 T Tanker load**	**50 - 100**

Safety Procedures for Transfer of Raw Materials

- ⇨ All the lines shall be metallic and provided with jumpers for the conductivity of each flames zones
- ⇨ All the day tanks shall be provided with level indicators and an overflow line which will come back to the tank

Action plan for the transportation of raw material and products

1. The following major raw materials and products being transported to the facility and from the facility
   - 1.1 Ethylene Oxide
   - 1.2 Hydrogen Peroxide
   - 1.3 Fatty Alcohols
   - 1.4 Nonyl Phenol, Octyl Phenol & Dodecyl Phenol
   - 1.5 Castor oil & Hydrogenated Castor oil
   - 1.6 Polyethylene Glycol (PEG)
   - 1.7 Potassium Hydroxide (or Sodium Hydroxide) Flakes as a catalyst
   - 1.8 The ethylene oxide condensates (Ethoxylated Products) of all the above
   - 1.9 Diesel
   - 1.10 Coal – Anthracite coal

2. Transportation and handling of Ethylene oxide

Of all the above products ethylene oxide transportation is most hazardous as it is both flammable and toxic. It is transported in a pressured tanker at a pressure of 4 to 5 Kg/cm^2. The transportation of this material is done in a liquefied stage at higher pressure and low temperature of about 4 to 6°C, in an insulated tanker. Following precautions are taken for transportation of this material.

2.1 The responsibility of the transportation lies with the supplier only.

2.2 The road tanker is filled at a temperature of 2 to 4°C and at a pressure of 4 to 5 kg/cm^2

2.3 The tanker is fully insulated to minimize the heat gain during transportation. The material of insulation should be compatible with EO.

2.4 The tanker is fully equipped with safety equipment and accessories like safety valve, pressure gauge, temperature gauge and fire extinguisher.

2.5 The driver and cleaner are fully trained in handling the Ethylene Oxide related emergencies which are likely on the road.

2.6 The route of the vehicle is planned in such a way that busy and populated areas are avoided.

2.7 The ethylene oxide is purchased and transported from the nearest location (From Vadodara facility of RIL) as far as possible.

2.8 The estimated transportation time is 6 to 8 hours (The distance from Vadodara manufacturing facility of RIL is about 125 km).

2.9 In case there is any mishap on the road or the tanker develops the leak, then it is handled by supplier i.e. (RIL) for which they have a 24 hr emergency and rescue teams are available at their Vadodara plant.

2.10 **The material of construction:** of the tanker is stainless steel only as any contamination of tanker can result in initiating polymerization reaction which is exothermic and can cause bursting of the container/tanker.

2.11 Tank fittings and attachments in contact with Ethylene Oxide shall also be of the above-mentioned materials, and may not contain copper or alloys of copper and/or magnesium.

2.12 The tanker is never filled upto the bream. Some empty space is left to allow for the expansion of the liquid.

2.13 The road tanker is not allowed to keep waiting in the open sun either on the road or in the factory premises to minimize the heat gain.

2.14 The tanker is emptied in the Ethylene Oxide storage tank only when the tank is empty.

2.15 The unloading is done by nitrogen pressure. The pumping of Ethylene Oxide is avoided in order to control fugitive emissions of EO.

2.16 **Use of dedicated tankers**: The EO tankers are dedicated for the transportation of EO only. This is to avoid contamination and polymerization of EO. If it gets polymerized it will choke the inlet outlet lines and safety valve.

2.17 **Parking the vehicle** - Drivers must ensure that the vehicle is either supervised or is parked in a secure place. No potential source of heat or fire must exist in the vicinity, and the vehicle must be capable of being easily removed in an emergency.

2.18 The parking of the vehicle is to be avoided as far as possible. Drivers must inform the hauler of their overnight parking location.

2.19 **Delays or accidents**: - All delays during transport, whether due to severe weather conditions, breakdown or other reasons must be reported to the consignor as soon as possible. Transport accidents must also be reported to the consignor as soon as possible

2.20 **Pressure and temperature checks** :- For road transport the pressure and/or temperature of the tank contents should be checked regularly and recorded on a checklist or in a logbook

2.21 **Emergency procedure**: - Drivers should be given precise instructions as to the acceptable pressure and temperature rise during the journey, and the emergency action to be taken in the event that readings in excess of acceptable levels are observed.

2.22 **The design of the road tankers** / tank containers must guarantee a complete unloading of the road tankers/tank containers. Criterion: less than 5 litres remaining product.

2.23 The ethylene oxide tanker is padded with nitrogen to avoid self-polymerization of EO vapour.

2.24 The loading and unloading operation of the tanker should be situated at the safe distance from the storage tanks.

2.25 After loading the tanker is pressured with nitrogen to ensure the gas phase remains inert even up to 50 °C.

2.26 The drivers of the tanker to check that the pressure of the tanker does not rize above 10 Kg/cm^2 or temp do not rise above 50 °C.

2.27 The valves of the tanker may get choked due to polymerization of EO, hence they should be cleaned periodically.

2.28 The tanker should not be kept empty containing vapour of EO for long times to avoid polymerization of EO. It should be purged and maintained under nitrogen pressure.

2.29 Precautions while unloading the tanker

2.29.1. During loading or unloading the vehicle must be earthed. Ensure double earthing to avoid any static charge accumulation

2.29.2. The oxygen content of the tanker should be less than 0.3% by vol. before loading of EO

2.29.3 The operator should wear breathing apparatus before loading or unloading ethylene.

2.29.4 After connection the hose must be purged with nitrogen to make it free from Oxygen

2.29.5 The flange joints and other connections to be checked with soap solution for leakage. It should be kept in mind that the thresh hold limit for EO in air is 1 ppm only.

2.29.6 The key of the vehicle should be removed

2.29.7 The vehicle hand brake is to be put on.

2.29.8 The wheel chocks should be applied during loading unloading to stop accidental movement of vehicle.

2.29.9 Hand brake should be applied when the tanker is getting loaded or unloaded.

2.29.10 The driver should be near the vehicle during loading unloading operation.

2.29.11 The vehicle should be parked in the shed when it is loaded or unloaded.

Company has obtained renewal license for Ehylene Oxide Storage license from Petroleum and Explosives Safety Organisation (PESO), West Circle, Ministry of Commerce & Industry, Govt. of India, vide License No.: S/HO/GJ/03/210(S1368) Date of Issue: 13-04-2011, Validity upto: 31-03-2014 and Renewal License vide License No.: S/HO/GJ/03/210(S1368) Date of Issue: 17-02-2014, Validity up to 31-03-2017 (Please Refer Annexure – 1) vide compliance of their requirements.

3. Storage and handling of Hydrogen Peroxide

3.1 The hydrogen peroxide is used in the process as a bleaching agent. Whenever the product has a yellowish tinge about 1litre of hydrogen peroxide is added to the reactor to make a colourless liquid.

3.2 The hydrogen peroxide is brought in a 50 litre carboys

3.3 It is stored in a shed away from the other material as it is a strong oxidizing agent.

4. **Storage and handling of alkyl phenols**
   4.1 The alkyl phenols are the main raw materials for the facility. The alkyl phenols mainly used are Nonyl Phenol, Dodesyl Phenol and Octyl Phenol.
   4.2 These are mostly available in liquid form
   4.3 They are purchased in the 200 litres HDPE drums or MS Drums and brought to the factory in the transport truck.
   4.4 They are stored in the factory main storage area.
   4.5 The liquid from the drums is transferred to the reactor by a portable pump, the pump is mounted on the top of the drum and the suction pipe is dipped in the drum upto the bottom.
   4.6 The remaining liquid is manually poured in a small container of about 10 to 20 litres in size and is pumped to the reactor.
   4.7 Secondary containment in the form of a tray is used to control the spillage of the material
   4.8 All the used drums are sold to the authorized and GPCB approved recyclers
5. **Storage and handling of castor oil, hydrogenated castor oil and fatty alcohol**
   The castor oil and fatty alcohol are liquids with a similar properties like alkyl phenols and they are brought in 200 litres MS or HDPE drums by road trucks.
   They are handled in the similar way like an alkyl phenols.
6. **Storage and Handling of PEG (polyethylene glycol)**
   6.1 PEG is the main raw material for the production of Poly-Sol a de-emulsifier used in crude oil processing to separate oil from the water.
   6.2 PEG is the higher boiling glycol. It is in liquid form. It is procured in 200 liters MS or HDPE drums.
   6.3 The drums are transported in the road truck and stored in a separate area in the raw material storage shed.
   6.4 Occasionally the material is supplied in the road tanker. The road tanker material is emptied in the 200 litres HDPE drums. They are stored in the shed away from the direct sunlight.

6.5 The PEG is transferred to the reactor from the drum by the portable pump which can be mounted on the drum top.

6.6 The used drums are sold to the authorized recyclers.

7. Storage and handling of potash flakes or caustic flakes

7.1 The caustic or potassium hydroxide is used as a catalyst for the initiation of ethoxylation reaction

7.2 The material is purchased and is available in 25 kg or 50 kg HDPE lined woven sacks.

7.3 This is transported by the road truck.

7.4 Since the material is highly hygroscopic, the bags are tightly closed after taking out the material.

7.5 A 30 % or 50 % caustic or potash solution is made in water for use as a catalyst.

7.6 Adequate PPE is used while handling the flakes, especially the use of hand gloves and goggles is must while handling.

7.7 Since the material is harmful to skin and eyes adequate training in handling this material is given to workers.

7.8 The empty bags are fully washed and decontaminated before selling or recycling them for storage of other product.

8. Diesel

8.1 Diesel will be used as fuel for running the DG set in case of power failure.

8.2 The quantity of diesel required is depends on the running of DG set. But it is about 100 liters per month.

8.3 . Diesel is available on the nearby petrol pump

8.4 It is brought in a 35 or 50 liters carboys and is transferred to the tank in the DG set.

8.5 The carboys are dedicated for diesel

8.6 All necessary safety precautions are taken as diesel is a flammable liquid.

9. Coal

9.1 The facility will be set up a coal fired boiler for production of steam

9.2 The coal requirement is about 2 MT per day.

9.3 Imported coal or Anthracite coal is procured through the dealers is delivered to the site by Road Lorries.

9.4 The coal is stored in shed near the boiler and is manually fed to the boiler to maintain boiler pressure.

9.5 Big lumps of coal are broken into small pieces manually for feeding to the boiler.

9.6 Since coal can catch fire on its own in the open storage, regular water spraying is done the coal.

9.7 Big heaps of coal is avoided to reduce chances of fire.

10. Storage and handling of ethoxylate products: All ethoxylate products are in liquid form and near to similar properties and sell in 200 liters capacity HDPE drums by road. Handling of product like similar way of raw material.

DETAILS OF OCCUPATIONAL HEALTH PROGRAMME

1. **To which chemicals, workers are exposed directly or indirectly**

The following chemicals are being used as raw materials in the plant

- I) Ethylene Oxide
- II) Hydrogen Peroxide
- III) Fatty alcohols
- IV) Nonyl Phenol, Octyl Phenol & Dodecyl Phenol
- V) Castor oil & Hydrogenated Castor oil.
- VI) Polyethylene Glycol (PEG)
- VII) Potassium Hydroxide (or Sodium Hydroxide) Flakes as a catalyst.
- VIII) The Ethylene Oxide condensates(Ethoxylated Products of all the above)

2. **Whether these chemicals are within Threshold Limit Values (TLV) / Permissible Exposure Levels as per ACGIH recommendation?**

In the expanded facility of Shree Vallabh Chemical. The most hazardous chemical handled is Ethylene oxide. The TLV and PEL values of the Ethylene Oxide are

I. A. TLV – 8 Hour weighted average (TWA) Value – 1.8 mg/M^3 or 1 ppm
B. TLV – Immediate Danger to life or health (IDLV) value – 800 ppm
The above values are as per the US notification of Jan 2009. (ACGIH)

II. The PEL exposure value as per OHSA, United states Nov 2006 is
A STEL– Short term Exposure limit is 5 ppm for 15 minutes & 1 ppm for 8 Hrs (TWA)

The other materials are mostly in liquid form and mostly with high boiling points hence their concentration in the working atmosphere is very low and do not pose any health danger to the persons working.

3. **What measures company has taken to keep these chemicals within PEL/TLV.?**

The following measures and precautions will be taken to keep the concentrations of EO in the working atmosphere below the PEL / TLV

3.1 The main storage tank (pressurized vessel) is installed in the open outside the building and is under the shed.

3.2 The transfer of Ethylene Oxide material to the reactor and to the measuring tank is by pipe line and is under nitrogen pressure.

3.3 Manual handling of the hazardous material like Ethylene Oxide is not there.

3.4 Minimum flange joints are used in the pipeline to minimize the chances of Ethylene Oxide leakage.

3.5 The joints are regularly checked with soap solution for leakages.

3.6 The area where ethylene oxide is handled is well ventilated. The use of Eco ventilators is being done.

3.7 Exhaust fans and windows are fitted on the wall at lower level to keep the area free from pollutants. (EO vapour are heavier than air try to stick to the lower levels.)

3.8 Regular monitoring of the workplace is done by using drägar tubes and monitors.

3.9 The workers have been provided adequate PPE's like breather mask, face mask to carry out critical operations like shut down, or maintenance of equipments where there is chance of exposure.

3.10 Permit system is strictly enforced for carrying out maintenance and non-routine jobs.

3.11 Staff and workers are well trained in the operations and to avoid exposure to dangerous chemicals.

3.12 The vent of the condensation reactor is dipped in the water bath. The water in the water bath is changed daily. Ethylene Oxide vapour if any in the vent gases are absorbed in the water. The water in the water bath is sent to the waste water treatment facility.

3.13 There is a double mechanical seal on the agitator of the reactors. This ensure that there is no fugitive emission of Ethylene Oxide

3.14 There is a safety valve on the reactor which is set at 7 Kg pressure (g)

3.15 The reactor and other vessels containing EO are purged thoroughly to make them free from EO before opening

3.16 LDAR program is enforced for Ethylene Oxide and steam lines (Leak Detection and Repair) program.

3.17 Fugitive emission control – Since the Ethylene Oxide storage is under pressure and no direct vent is provided the fugitive emission of ethylene oxide is zero.

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4. **How the workers are evaluated concerning their exposure to chemicals during pre-placement and periodical medical monitoring?**

As per policy and norms all of the workmen are put to medical examination and testing periodically and at set interval and based on the medical report actions are taken, if at all anything is necessary and required. Even based on the medical examination report/

feedback, workmen are counselled and put in different area / job rotation kind of activities. Medical record should be maintained in office.

The pre-placement and periodical medical examination records are to be maintained in the prescribed format as per the Factories Act 1948 and Gujarat Factories Rules 1963.

5. What are onsite and offsite emergency plan during chemical disaster

5.1 Onsite Emergency Response

The following types of emergencies are possible in the facility which handling flammable and dangerous material like Ethylene Oxide

a. Fire
b. Gas leak / toxic release.
c. Spillage of liquid chemical from 200 liters drums.
d. Accident involving human injury

In case of the above emergencies the company has well defined and documented emergency management procedure, this procedure is described in short in the following paragraphs

5.1.1 **Shut down and Isolation**: Raising the alarm, followed by immediate safe shut down of the processes, reactors, power supply, and isolation of affected areas

5.1.2 **Escape, Evacuation and Rescue**: Safeguarding human lives at site by commencement of the Emergency Evacuation and Rescue Plan. Ensuring that all personnel are accounted for and carrying out a head count of persons evacuated. Notification and commencement of offsite emergency plan in case offsite impacts are possible The persons should be asked to gather at the designated place.(Emergency assembly Points)

5.1.3 **Stopping the development of the emergency**: Control or response to the emergency depending upon its nature (fire, toxic release or explosion). Fire can be somewhat better controlled through fire fighting, while toxic release impacts can be partially controlled through proper communication with affected population. Impacts of explosions impacts cannot be controlled once they occur, hence efforts will require focusing on provision of relief or control of secondary impacts (such as property damage or fires) resulting from explosions.

5.1.4 **Treatment of injured**: First aid and hospitalization of injured persons

5.1.5 **Protection of environment and property**: During mitigation, efforts should be made to prevent impacts on environment and property to the extent possible.

5.1.6 **Welfare of the personnel managing the emergency**: Change over, first aid and refreshments for the persons managing the emergency

5.1.7 Informing and assisting relatives of the victims

5.1.8 Informing the news and electronic media

5.1.9 **Preserving all evidences and records**: This should be done to enable a thorough investigation of the true causes of the emergency

5.1.10 **Investigation and follow up**: This requires to be carried out to establish preventive measures for the future and a review of the DMP and its annexure to fill up the deficiencies in the emergency planning procedures

5.1.11 **Ensuring safety of personnel prior to restarting of operations**: Efforts require to be made to ensure that work environment is safe prior to restarting the work.

5.1.12 **In case of fire**: If there is a fire and there is little personal risk, use appropriate extinguisher if you have been trained in its proper use. If the fire is very small, it may be extinguished by smothering it with a non flammable material such as a sand, watch glasses or metal sheet. Turn off electrical circuit and gas lines.

5.2 Off-site Emergency Response Plan

5.2.1 An emergency may affect areas offsite of the works as for example, an explosion can scatter debris over wide areas and the effects of blast can cover considerable distances, wind can spread burning brands of gases.

5.2.2 In some cases e.g. as the result of an explosion, outside damage will be immediate and part of the available resources of the emergency services may need to be deployed in the affected areas. In any case, the possibility of further damage may remain, e.g. as the result of further explosion or by the effect of wind spreading burning brands of hazardous material.

5.2.3 It will be necessary to prepare in advance simple charts or tables relating the likely spread of the vapours cloud taking into account its expected buoyancy, the local topography and all possible weather conditions during the time of release.

5.2.4 It may also be desirable to install instruments indicating wind speed and direction, which could be done jointly with surrounding industries.

5.3 First aid treatment plan should be taken if any employee get injured in any emergency situation as follows:

5.3.1. In all actual or suspected cases of exposure to EO, medical attention should be obtained at once and the patient should always be removed from the contaminated area.

5.3.2. All contaminated clothing should be removed immediately.

5.3.3. Remove from exposure. If unconscious secure airway and place in semi prone recovery position. If not breathing give artificial respiration.

5.3.4. If heart beat absent give external cardiac compression.
5.3.5. If there is cyanosis (blueness of the lips) administer oxygen by face mask. If there is breathing difficulty or cough keep patient at rest seated in position of maximum comfort. Refer to hospital or doctor risk of delayed symptoms.
5.3.6. Remove all contaminated clothing to a safe ventilated place or a sealed container.
5.3.7. In case of skin contamination wash immediately with plenty of clean, gently flow water.
5.3.8. In case of eye contamination wash the eye immediately with plenty of clean, gently flow water for 10 minutes. Then send promptly to a doctor or hospital.
5.3.9. Cover skin burns with a sterile dressing.
5.3.10. If patient appears confused, excited or uncoordinated use only minimal restraint necessary for safety and treatment.
5.3.11. If patient is conscious permit water to drink.

6. Liver function tests (LFT) during pre-placement and periodical examination

Ethylene Oxide may also damage the liver and kidneys in case of chronic exposure. Hence Lever function and kidney tests will be done during pre –placement and during periodical medical checkup once in a years for those workers who are likely to get exposed to Ethylene Oxide. More detailed information on various tests to be performed for those working in EO handling areas is given in next para on occupational health surveillance program.

7. Details of occupational health surveillance program

7.1 Medical surveillance program

The EO has been linked to an increased risk of cancer and reproductive effects including decreased male fertility, fetotoxicity, and spontaneous abortion. At the present, limited studies of chronic effects in humans resulting from exposure to EO suggest a causal association with leukemia. Adequate screening tests to determine an employee's potential for developing serious chronic diseases, such as cancer, from exposure to EO do not presently exist. Laboratory tests may give evidence to suggest that an employee is potentially overexposed to EO. The physician must become familiar with the signs and symptoms that indicate a worker is receiving otherwise unrecognized and unacceptable exposure to EO. The employer is required to institute a medical surveillance program for all employees who are or will be exposed to EO at or above the action level (0.5 ppm) for at least 30 days per year, without regard to respirator use.

Although broad latitude in prescribing specific tests to be included in the medical surveillance program is extended to the examining physician, OSHA requires inclusion of the following elements in the routine examination:

(i) Medical and work histories with special emphasis directed to symptoms related to the pulmonary, hematologic, neurologic, and reproductive systems and to the eyes and skin.

(ii) Physical examination with particular emphasis given to the pulmonary, hematologic, neurologic, and reproductive systems and to the eyes and skin.

(iii) Complete blood count to include at least a white cell count (including differential cell count), red cell count, hematocrit, and hemoglobin.

(iv) Any laboratory or other test which the examining physician deems necessary by sound medical practice.

The employer is required to make the prescribed tests available at least annually to employees who are or will be exposed at or above the action level, for 30 or more days per year; more often than specified if recommended by the examining physician; and upon the employee's termination of employment or reassignment to another work area. While little is known about the long term consequences of high short-term exposures, it appears prudent to monitor such affected employees closely in light of existing health data. The employer shall provide physician recommended examinations to any employee exposed to EO in emergency conditions. Likewise, the employer shall make available medical consultations including physician recommended exams to employees who believe they are suffering signs or symptoms of exposure to EO.

The employer is required to provide the physician with the following information: a description of the affected employee's duties as they relate to the employee exposure level; and information from the employee's previous medical examinations which is not readily available to the examining physician. Making this information available to the physician will aid in the evaluation of the employee's health in relation to assigned duties and fitness to wear personal protective equipment, when required.

The employer is required to obtain a written opinion from the examining physician containing the results of the medical examinations; the physician's opinion as to whether the employee has any detected medical conditions which would place the employee at increased risk of material impairment of his or her health from exposure to EO; any recommended restrictions upon the employee's exposure to EO, or upon the use of protective clothing or equipment such as respirators; and a statement that the employee has been informed by the physician of the results of the medical examination and of any medical conditions which require further explanation or treatment. This written opinion must not reveal specific findings or diagnoses unrelated to occupational exposure to EO, and a copy of the opinion must be provided to the affected employee.

The annexure below is the formats for medical checkup as per the factories act.

7.2 Details of occupational Health/Safety surveillance Requirements:

Provision for following matters need to be made:

- Checking packaging or container labels and material safety data sheets; on regular basis.
- Regular communication between workers, supervisors and employers about likely hazards; Regular training to all concerned people on the hazardous involved especially of the EO exposure
- Regular inspection of workplaces, plant and equipment; for leakages and spillages. The flange joints and other joints to be examined with soap solution for any leakages of EO.
- The plant and process area is well ventilated by use of eco –ventilators and exhaust fans mounted on the lower side of the wall.
- Regular monitoring of workplace by dragger tube for presence of EO. The EO level should be less than 1 ppm which is a threshold limit. The desired level of EO in the working atmosphere should be less than 0.5 ppm
- Regular review of tasks and procedures; and
- Checking of previous incident and injury records for recurring situations.
- Job risk analysis/ job safety analysis
- Enclosed systems for chemicals, relocation of employees or physical barriers
- Storing hazardous substances in a lockable, enclosed area with adequate ventilation
- Limiting access to chemical storage areas to authorized people only
- Ensuring all labels remain intact on containers and packaging
- Where possible, pump chemicals into reactors or tanks rather than pouring manually from containers.
- Minimizing risk of items accidentally dropping into tanks, splashing.

PRE-PLACEMENT FORM **ANNEXURE-1**

FORM NO: 27-A

(Prescribed under Rule 102)

CERTIFICATE OF FITNESS

1. Serial number:

I certify that I have personally examined____ son of

(Father's name) ____ residing

at (address)____ who is

desirous of being employed as (designation) __________________________________ in (process,

department and factory) ____ and that his

age, as nearly as can be ascertained from my examination, is _______________ years, and that

he is in my opinion, fit/unfit for employment in the above mentioned factory as mentioned

above.

2. He may be produced for further examination after a period of

____months

3. The serial number of the previous certificate is ____________________________

Signature or left hand
thumb impression of
person examined:

Signature of Certifying

Surgeon :Name ___________

Date: ______________

I certify that I examined the person mentioned above on	I extended this certificate until (If certificate is not extended, the period for which the worker is considered unfit for work is to be mentioned)	Signs and symptoms observed during examination	Signature of the Certifying Surgeon
Date –			

PRE-PLACEMENT FORM **ANNEXURE-2**

FORM NO: 33

(Prescribed under Rule 68-T and 102)

Certificate of fitness of employment in hazardous process and operations.

(TO BE ISSUED BY FACTORY MEDICAL OFFICER)

1. Serial number in the register Of adult workers :
2. Name of the person examined :
3. Father's Name :
4. Sex :
5. Residence :
6. Date of Birth :
7. Name & address of the factory :
8. The worker is employed/proposed :
    a. Hazardous process :
    b. Dangerous operation :

I certify that I have personally examined the above named person whose identification marks are _________ and who is desirous of being employed in above mentioned process/operation and that his/her, age, as nearly as can be ascertained from my examination, is ________ years.

In my opinion he/she is fit for employment in the said manufacturing process/operation.

In my opinion he/she is unfit for employment in the said manufacturing process/operation for the reason ______________. He/she is referred for further examination to the certifying Surgeon.

The serial number of previous certificate is ______________.

Signature or left hand thumb
impression of the person examined:

Signature of the Factory Medical Officer:
Stamp of factory: _______________
Medical officer with Name of the Factory: ___________

QUANTITATIVE RISK ASSESSMENT

1.0 INTRODUCTION

QRA study for, M/s. Shree Vallabh Chemical has been carried out based on data provided by them. The study has been carried out in accordance with the International codes of practices using PHAST (Process Hazard Analysis Software Tool) – 6.53 software. The latest version of the renowned PHAST Risk 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, affected distances and the damage of property and population from the identified scenarios considering the Maximum Credible Loss Scenario (MCLS) & Worst case scenario of the phenomenon occur. 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.

We have assumed Maximum credible loss scenario (MCLS) i.e. Nozzle failure and Worst case Scenario i.e. catastrophic rupture as per the guidelines suggested by DNV – UK. Similarly, maximum inventory at the time of failure is assumed.

1.1 OBJECTIVE OF THE STUDY

The main objective QRA (Quantitative Risk Analysis) is to determine the potential risks of major disasters having damage potential to life and property and provide a scientific basis for decision makers to be satisfied about the safety levels of the facilities to be set up. This is achieved by the following:

- Identification of hazards that could be realized from process plant.
- 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.
- Analyze 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.

1.2 SCOPE OF THE STUDY

Following flammable chemicals or solvents stored, used and handled in the premises.

S. No	Flammable solvents/Material	Hazards	Flash Point (°C)	Approx Quantity (MT)
1	Ethylene Oxide	Highly Flammable (Pool fire, Jet fire, flash fire)	-20	9
2	Ethylene Oxide	Highly Flammable (Pool fire, Jet fire, flash fire)	-20	4.4
3	Ethylene Oxide	Highly Flammable (Pool fire, Jet fire, flash fire)	-20	3

1.3 USE OF QRA RESULTS

The techniques used for risk prediction within the QRA have inherent uncertainties associated with them due to the necessary simplifications required. In addition, QRA incorporates a certain amount of subjective engineering judgment and the results are subject to levels of uncertainty. For this reason, the results should not be used as the sole basis for decision making and should not drive deviations from sound engineering practice. The results should be used as a tool to aid engineering judgment and, if used in this way, can provide valuable information during the decision making process.

The QRA results are dependent on the assumptions made in the calculations, which are clearly documented throughout the following sections of this report. Conservative assumptions have been used, which helps to remove the requirement for detailed analysis of the uncertainty. The results show the significant contributions to the overall risk and indicate where worthwhile gains may be achieved if further enhancement of safety is deemed necessary.

1.4 SOFTWARE USED

PHAST 6.53 (latest version) has been used for consequence analysis include discharge and dispersion calculations.

1.5 METEOROLOGICAL CONDITIONS

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 are those that affect the atmospheric dispersion of the escaping material. The crucial variables are 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 behavior of any release would largely depend on prevailing weather condition at the time of release.

1.6 ATMOSPHERIC PARAMETERS

The Climatological data which have been used for the study is summarized below:

Table 1.1: Climatological data

S. No.	Parameter	Max	Min.	Annual Average
1.	Ambient Temperature (°C)	35	25	33.6
2.	Relative Humidity (%)	60	27	38.5

The average value of the atmospheric parameters is assumed for the study.

1.6.1 Wind Speed and Wind Direction

The wind speed and wind direction data which have been used for the study is summarized below:
Wind Speed : 1.5 m/s & 5 m/s
Atmospheric Stability: F and D
Wind Direction : SW.

1.6.2 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 existing 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.

Pas-quill stability parameter, based on Pas-quill – Gifford categorization, is such a meteorological parameter, which describes the stability of atmosphere, i.e., the degree of convective turbulence. Pas-quill 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.

1.7 METHODOLOGY ADOPTED FOR CONSEQUENCE ANALYSIS

Consequences of loss of containment 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.

Consequence analysis and calculations are effectively performed by computer software using models validated over a number of applications. Consequence modeling 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 modeled failure case:

- Run discharge calculations based on physical conditions and leak size.
- Model first stage of release (for each weather category).
- Determine vapor release rate by flashing of liquid and pool evaporation rate.
- Dispersion modeling 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. Flow chart for consequence analysis is shown in the form of event tree for release of flammable liquid.

1.8 HAZARDS OF MATERIALS

Definitions

The release of flammable gas or liquid can lead to different types of fire or explosion scenarios. These 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.

a. Pool fire

The released flammable material which is 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. dyked area) and the depth of the resulting pool is greater than that for an unconfined spill.

b. 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 modeling. Even where the concentration may be above the UFL, turbulent induced combustion mixes the material with air and results in flash fire.

c. 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.

d. 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, the result is 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.

1.8.1 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. The considerations for specifying the end-points for the hazardous material involved in the failure scenario are described in the following paragraphs. American Industrial Hygiene Association (AIHA) has issued Emergency Response Planning Guidelines (ERPG) for many chemicals.

- 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 Immediately Dangerous to Life or Health (IDLH) concentrations are issued by US National Institute for Occupational Safety and Health (NIOSH). An IDLH level represents the maximum airborne concentration of a substance to which a healthy male worker can be exposed as long as 30 minutes and still be able to escape without loss of life or irreversible organ system damage. IDLH values also take into consideration acute toxic reactions such as severe eye irritation, which could prevent escape. IDLH values are used in selection of breathing apparatus.

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.

It is permitted Short Time Exposure Limit usually for a 15-minute exposure.

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.

LCLo: Lethal Concentration Low (LCLo) value is the lowest concentration of a material in air reported to have caused the death of animals or humans. The exposure may be acute or chronic. This is also called the lowest concentration causing death, lowest detected lethal concentration, and lethal concentration low.

LDLo: LDLo is closely related to the LC50 value which is the concentration which kills half of the test animals under controlled conditions. This value applies to vapors, dusts, mists and gases. Solids and liquids use the closely related LDLo value for routes other than inhalation

TCLo: Toxic Concentration Low quantity at which a water-soluble, liquid, or gaseous substance produces harmful effects in specified test specie over a certain exposure period.

1.8.2 Damage Criteria

Damage estimates due to thermal radiations and overpressure have been arrived at by taking in to consideration the published literature on the subject. The consequences can then be 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 neighboring environment, which might be adversely affected, should one or more hazards materialize in real life.

1.8.3 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.

1.8.3.1 Damage Due to Radiation Intensity

Table 1.2: Damage Due to Radiation Intensity

RADIATION KW/m²	DAMAGE TO EQUIPMENT	DAMAGE TO PEOPLE
1.2		Solar heat at noon.
1.6	***	Minimum level of pain threshold.
2.0	PVC insulated cables damaged	Minimum level of pain threshold.
4.0	***	Causes pain if duration is longer than 20 sec. But blistering is unlikely.
6.4	***	Pain threshold reached after 8 sec. Second degree burns after 20 sec.
12.5	Minimum energy to ignite wood with a flame; Melts plastic tubing.	1% lethality in one minute. First degree burns in 10 sec.
16.0	***	Severe burns after 5 sec.
25.0	Minimum energy to ignite wood at identifying long exposure without a flame.	100% lethality in 1 minute. Significant injury in 10 sec.
37.5	Severe damage to plant	100% lethality in 1 minute. 50% lethality in 20 sec. 1% lethality in 10 sec.

1.8.3.2 Fatal radiation exposure levels

Table 1.3: Fetal radiation Exposure Level

RADIATION LEVEL kW/m²	FATALITY		
	1%	50%	99%
	EXPOSURE IN SECONDS		
4.0	150	370	930
12.5	30	80	200
37.5	8	20	50

1.8.4 Overpressure Damage:

Table 1.4: 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	***

1.8.4.1 Over pressure damage: (In Details)

Table 1.5: Over pressure Damage

OVER PRESSURE		MECHANICAL DAMAGE TO EQUIPMENTS
Bar	KPa	
0.0014	0.14	Annoying noise (137 dB if of low frequency 10–15 Hz).
0.0021	0.21	Occasional breaking of large glass windows already under strain.
0.0028	0.28	Loud noise (143 dB), sonic boom, glass failure.
0.0069	0.69	Breakage of small windows under strain.
0.0103	1.03	Typical pressure for glass breakage.
0.0207	2.07	Safe distance" (probability 0.95 of no serious damage below this value); projectile limit; some damage to house ceilings; 10% window glass broken.
0.0276	2.76	Limited minor structural damage.
0.03-0.069	3.4-6.9	Large and small windows usually shattered; occasional .damage to window frames.
0.048	4.8	Minor damage to house structures.
0.069	6.9	Partial demolition of houses, made uninhabitable.
0.069-0.138	6.9-13.8	Corrugated asbestos shattered; corrugated steel or aluminum panels, fastenings fail, followed by buckling; wood panels (standard housing)fastenings fail, panels blown in.
0.09	9.0	Steel frame of clad building slightly distorted.

0.138	13.8	Partial collapse of walls and roofs of houses.
0.138-0.207	13.8-20.7	Concrete or cinder block walls, not reinforced, shattered.
0.158	15.8	Lower limit of serious structural damage.
0.172	17.2	50% destruction of brickwork of houses.
0.207	20.7	Heavy machines (3000 lb) in industrial building suffered little damage; steel frame building distorted and pulled away from foundations.
0.207-0.276	20.7-27.6	Frameless, self-framing steel panel building demolished; rupture of oil storage tanks.
0.276	27.6	Cladding of light industrial buildings ruptured.
0.345	34.5	Wooden utility poles snapped; tall hydraulic press (40,000 lb) in building slightly damaged.
0.345-0.482	34.5-48.2	Nearly complete destruction of houses.
0.482	48.2	Loaded, lighter weight (British) train wagons overturned.
0.482-0.551	48.2-55.1	Brick panels, 8–12 in. thick, not reinforced, fail by shearing or flexure.
0.62	62.0	Loaded train boxcars completely demolished.
0.689	68.9	Probable total destruction of buildings; heavy machine tools (7,000 lb) moved and badly damaged, very heavy machine tools (12,000 lb) survive.
0.689	68.9	Probable total destruction of buildings; heavy machine tools (7,000 lb) moved and badly damaged, very heavy machine tools (12,000 lb) survive.
20.68	2068	Limit of crater lip.

1.9 CONSEQUENCE ANALYSIS

1.9.1 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 qualitative 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.

1.9.2 Event Outcomes

Upon release of flammable / toxic gas & liquids, the hazards could lead to various events which are governed by the type of release, release phase, ignition etc. PHAST has an in-built event tree for determining the outcomes which are based on two types of releases namely continuous and instantaneous. Leaks are considered to be continuous releases whereas, ruptures are considered to be instantaneous releases. These types of releases are further classified into those which have a potential for rain-out and those which do not. Whether the release would leak to a rain-out or not depends upon droplet modeling which is the main cause of formation of pools. Fig 6.1, 6.2, 6.3 and 6.4 presents the event trees utilized by PHAST to generate the event outcomes.

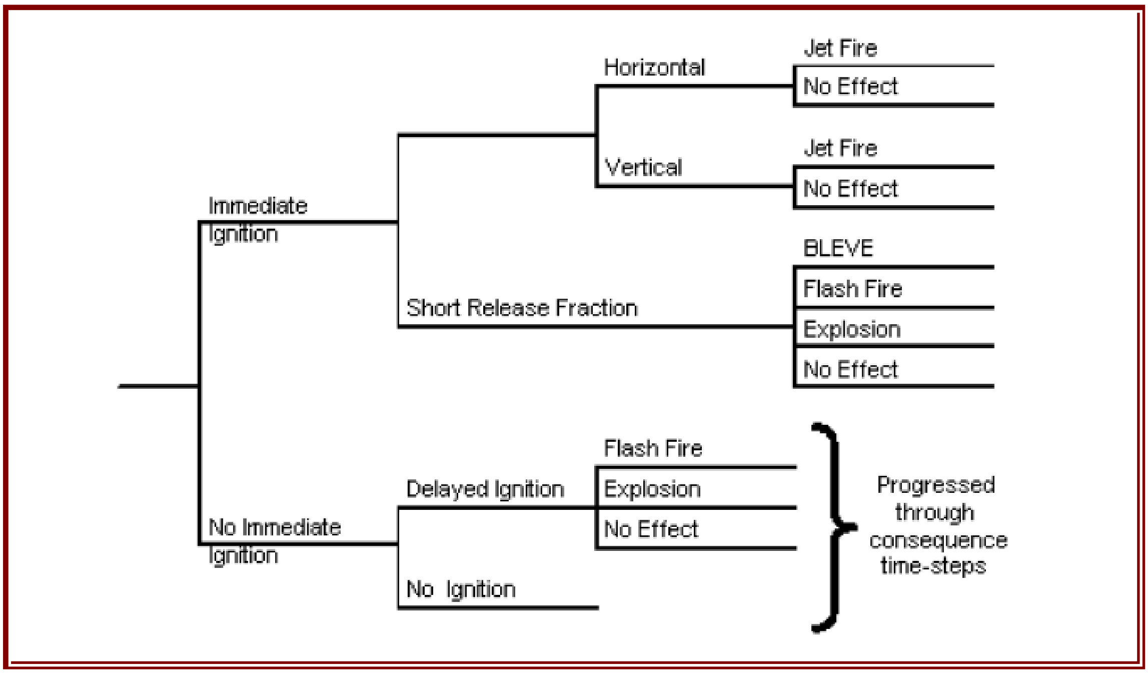

Figure 1.1: Event Tree for continuous release without rain-out (from PHAST)

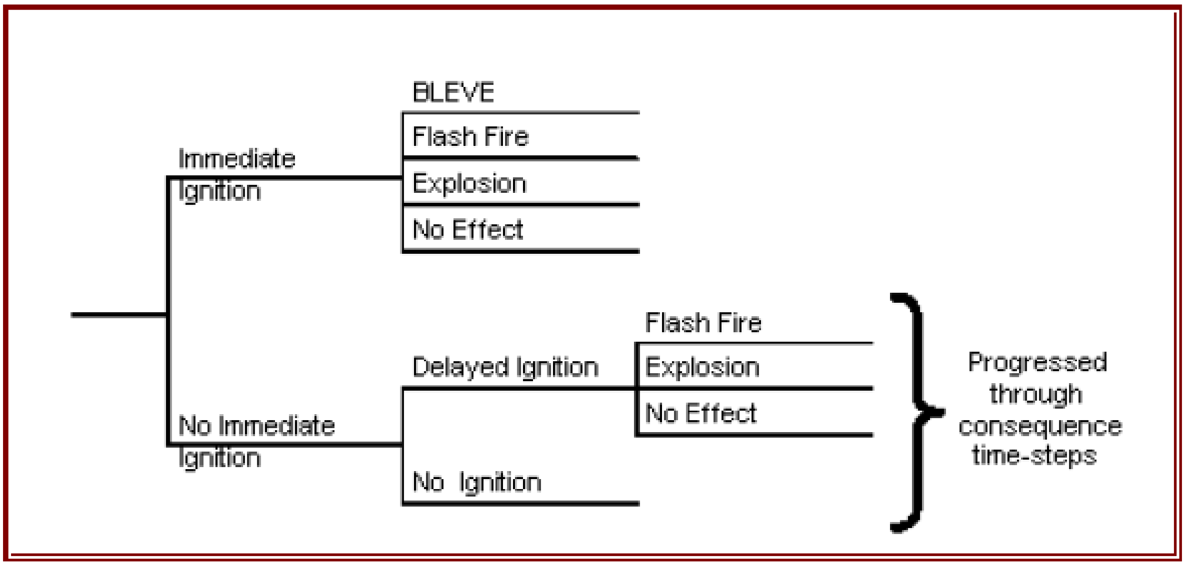

Figure 1.2: Event Tree for Instantaneous release without rain-out (from PHAST)

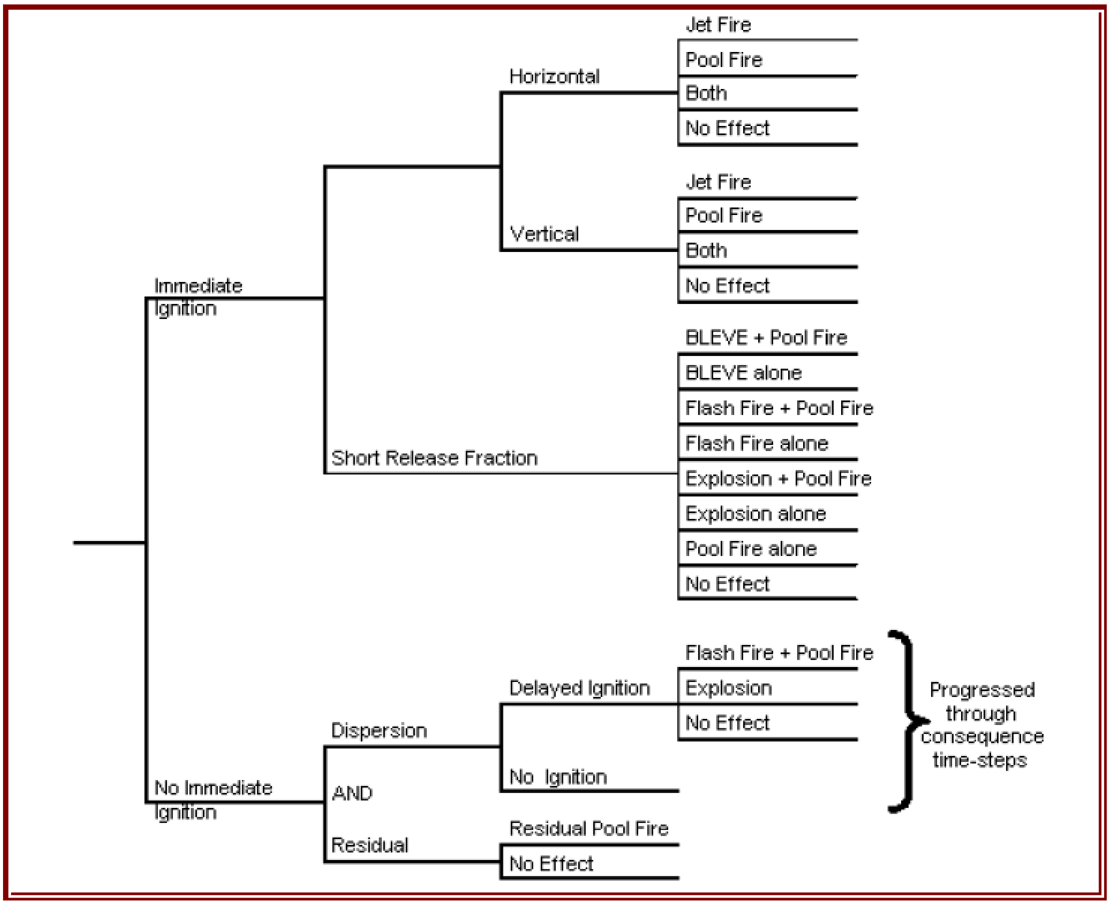

Figure 1.3: Event Tree for continuous release with rain-out (from PHAST)

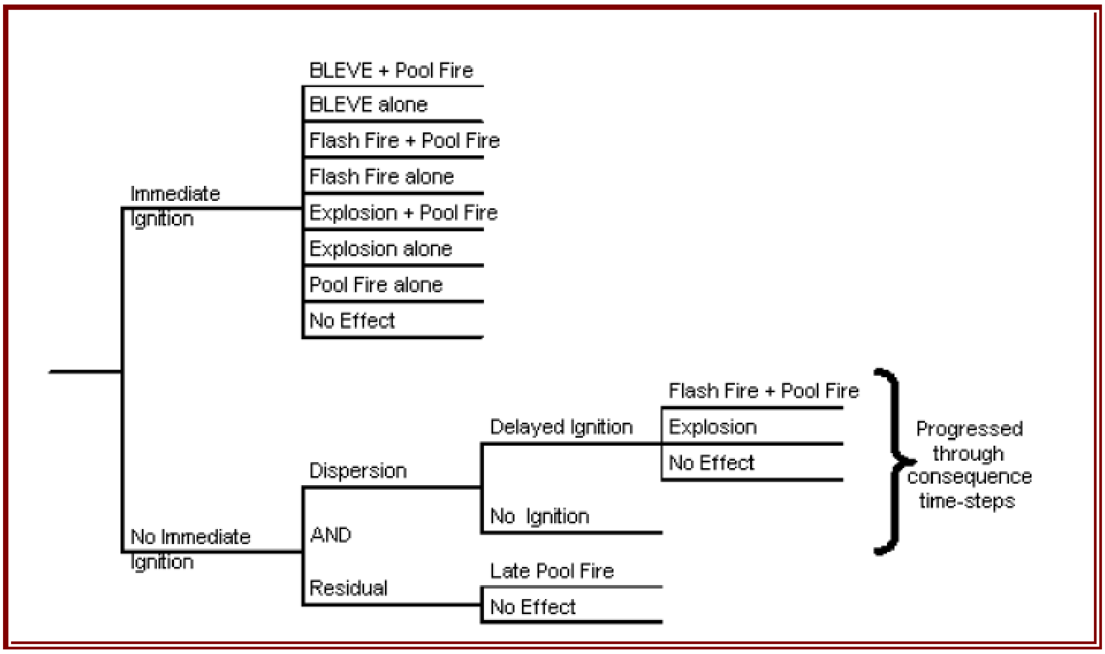

Figure 1.4: Event Tree for Instantaneous release with rain-out (from PHAST)

1.9.3 Modes of Failure

There are various potential causes and sources of leakage. This may be by way of failures of equipment or piping, due to pump seal failure, instrument tubing giving way, failure of the pipes, failure of process vessels etc. Following Table represents general mechanism for loss of containment for Piping and fitting, instruments, and human error.

(A). Piping and Fitting

Table 1.6: Piping and Fitting

Ref. No.	LOSS OF CONTAINMENT	EXAMPLES OF POSSIBLE BASIC CAUSE	REMARKS
A.1	Flange/Gasket Leaks	- Incorrect gasket installed, e.g. incorrect material, incorrect size (thickness and diameter). - Incorrect installation, e.g. flange faces not cleaned, flanged face damaged, incorrectly tightened bolts, incorrect bolts used. - Flange replacement without gasket.	Possible flame impingement and localized heating of adjacent equipment.

Ref. No.	LOSS OF CONTAINMENT	EXAMPLES OF POSSIBLE BASIC CAUSE	REMARKS
A.2	Pipe Overstress Causing Fracture	- Inappropriate use of design codes. - Error in stress analysis calculations. - Lack of inspection during pipe erection, e.g. excessive cold pull. - Pipe testing incorrectly carried out. - Incorrect setting of spring hangers and pipe supports and sliding shoes not free to move. - Pipe not hydro tested because of bore size (or considered not critical) and no secondary test procedures carried out. - Omission to test because systems not clearly identified, or error in documentation. - Extreme temperature differential in pipe work not catered for in design, i.e. cold and hot streams	Pipe stresses would most likely cause a flange leak, unless there existed a combination of errors, e.g. installation of rogue materials and unsuitable pipe support, or error in stress calculation plus failure to pressure test.
A.3	Over pressurization of Pipe work Causing Fracture	a) Inadequate Pressure Relief - Relief valve 'simmering' and hydrating, icing. - Incorrect setting of RV pressure. - Incorrectly sized RV. - Wrongly installed RV, e.g. due to transferred tag No. : or installation of incorrect spring material. - Abuse of locking system and all RVs isolated from system - Excessive back pressure caused by blockage of relief sub-headers with sludge, ice/hydrate, etc.	Careful attention required for handling hydrocarbons with "free" water. Rigorous adherence to procedures is essential.

Ref. No.	LOSS OF CONTAINMENT	EXAMPLES OF POSSIBLE BASIC CAUSE	REMARKS
		- High pressure breakthrough into low pressure systems, which have inadequate relief capacity. - Blockage of RVs with debris/fines, e.g. mol sieve dust, or breakage of screens/package/demister. b) <u>Excessive Surge Pressure / Hammer</u> - Too rapid isolation or blockage of liquid full lines, i.e., operator closing isolation valve. - Rapid blockage of liquid lines, e.g. NRV failure. - Lines not or inadequately designed for two phase/slug flow. - Too rapid opening of valves and letdown of liquid under high differential pressure. - Rapid vaporization of cold liquid in contact with hot fluid. (Rapid phase transition). c) <u>Rupture Under Fire Conditions</u> - Direct fire impingement without any cooling (internal or external) or failure to effectively depressure equipment.	Relief capacity should always be adequate or high integrity trip system installed. Potential problem around mol sieve vessels, absorbers, columns and RVs. Consider needs to handle liquid slugs from feed line when pigging recommended. Particular care required at pig traps and at inlet PCVs/bypass. No remote depressurizing system available; requires review. Potential for catastrophic rupture of equipment, fragmentation and fireball effects.
A-4	Failure of piping due to fatigue or vibration.	- Failure due to acoustic fatigue arising from:- E.g. failure to recognize problem exists in particular areas, failure to take adequate precautions (selection	Vulnerable areas are piping downstream of PCVs and RVs operating at very high pressures. Particularly susceptible

Ref. No.	LOSS OF CONTAINMENT	EXAMPLES OF POSSIBLE BASIC CAUSE	REMARKS
		of incorrect valve at design stage or during maintenance, inadequate line support). Improper testing/inspection when in service, failure to report abnormally high noise levels (during normal and upset conditions). - Failure due to mechanical vibration arising from: e.g. failure to recognize problem, inadequate support, failure to report and minor excessive vibrations (under all plant conditions), maintenance error, (failure to correctly align rotating equipment and test for vibration prior to reinstatement? - Failure due to pressure or thermal cycling.	is small bore pipe work associated with pressure letdown and two phase flow systems and compressors/ pumps. Regeneration gas pipe work and connections to mol sieve vessels merit particular attention.
A.5	Failure of Pipe due to Stress Corrosion of Embrittlement	- Hydrogen embrittlement/blistering. (Hydrogen induced cracking).	Only stainless steel equipment.
A.8	Failure of piping Due to installation of Wrong Materials	- Incorrect materials selection, e.g. at design stage, from supplier or site stores. - Incorrect material installed, e.g. improper supervision and identification of materials after withdrawal from stores.	Strict system for supervision, inspection and verification of materials required during all modifications.
A.9	Failure of Piping Due to low Temperature Brittle fracture	- Rogue material used in construction, wrong material specified, or uncertainties in material specification. - Error in calculating minimum	A number of systems have been identified as bring vulnerable, particularly where condensate at high

Ref. No.	LOSS OF CONTAINMENT	EXAMPLES OF POSSIBLE BASIC CAUSE	REMARKS
		lower design temperatures. - Systems not designed for low temperature, (e.g. on emergency depressuring) and immediate repressurising.	pressure may be depressurized.
A.10	Failure of Piping (or nozzles) Due to External Forces or Impact.	- Impact from equipment being moved during maintenance. - Impact of heavy lifting gear, e.g. cranes. - Impact from site transport, e.g. construction traffic, fire tender. - Impact on reinforced nozzle causing fractures elsewhere, e.g. valve, pump casing vessel.	Historically, failure of HP process piping due to mechanical impact is confined mainly to small bore piping. Strict control over site construction will of course be necessary. Any incident of impact on pipe work during construction must be reported and damage investigated.

(B) Human Error

Table 1.7: Human Error

Ref. No.	LOSS OF CONTAINMENT	EXAMPLES OF POSSIBLE BASIC CAUSE	REMARKS
Loss of containment through human error has been assumed implicitly in the storage area however examples or some typical operating and maintenance errors are included below:-			
B.1	Operational Error	- Failure or inability to close instrument or sample valves. - Failure or inability to close drain and vent valves. - Leaving safety trips/systems out of commission after testing or inspecting. - Intentionally defeating trip systems for reasons of production.	
B.2	Error in De-commissioning	- Inadvertent or unauthorized opening of a pressurized system, e.g. filters, vessels. - Improver depressurizing and purging of a system prior to isolation or spading. - Failure to effectively isolate all process (and utility) and electrical connections.	
B.3	Error in Maintenance	- Failure to maintain effective isolation. - Failure to report damage to equipment during repair or modification. - Maintenance activities extended to systems, which are `live'. - Improper supervision of contract maintenance staff, improper maintenance.	
B.4	Error in Re-commissioning	- Failure to close vents/drains, replace plugs.	

Ref. No.	LOSS OF CONTAINMENT	EXAMPLES OF POSSIBLE BASIC CAUSE	REMARKS
		- Improper or lack or purging of equipment e.g. sphere receiver furnaces.	
B.5	Supervision Error	- Design error for modifications. - Lack of supervision and control e.g. Authorization of permits isolation. - Failure to regularly test/inspect e.g. trip/alarm system, safety equipment. Allure to regularly monitor e.g. noise vibration, corrosion, stream composition	

1.9.4 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 is 50mm leakage. The scenarios are considered to be confined to those equipment failures which involve the leakage of flammable or toxic products, of which the frequency of occurrence and the severity of the consequences have been taken into consideration and which may have a low probability of early detection.

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.

Consequence analysis and calculations are effectively performed by computer software using models validated over a number of applications. Consequence modeling 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 modeled failure case:

1.9.4.1 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. Release of hydrocarbons and toxic compounds to atmosphere may usually lead to the following:

(a) 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.

(b) 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.

(c) Lighter hydrocarbon vapor (e.g. Natural Gas) or Hydrogen disperses rapidly in the downwind direction, being lighter than air. But comparatively heavier hydrocarbon vapor cloud like that of LPG, Propylene or Ammonia will travel downwind along the ground. If it encounters an ignition source before it is dispersed below the LFL, explosion of an unconfined vapor cloud will generate blast waves of different intensities.

(d) 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.

(e) Catastrophic failure of tanks/ pressurized vessels, rotary equipment and valves etc. can result in equipment fragments flying and hitting other equipment of the plant.

(f) 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.

(g) 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.

(h) 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 vapors 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. There will be dispersion and movement of vapor cloud formed by evaporation of liquid.

The behavior 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).
(6) Material with boiling point below ambient condition.

Statistical reports of consequence analysis are summarized below in Table 7. Similarly pictorial presentations of consequence results are shown below the tabular report.

➢ **Ethylene Oxide Tank Scenario (Dia 1.5 × 5.6,m Horizontal Tank)**

Scenario description	**1.5 F @ 50 mm Leak & 5 D @ Catastrophic Rupture**		
Weather data		**Distances (m)**	
		1.5 F	**5 D**
Concentration (ppm)	UFL (1e+006)	Not Set	0
	LFL (30000)	10.6493	192.788
	LFL Frac (15000)	23.7713	268.681
Early Pool Fire(kW/m²)	Radiation Level(4)	---	---
	Radiation Level(12.5)	---	---
	Radiation Level(37.5)	---	---
Flash Fire (ppm)	Furthest Extent (15000)	23.7713	268.681
	Furthest Extent (30000)	10.6493	192.788
Jet Fire (kW/m²)	Radiation Level(4)	60.7334	---
	Radiation Level(12.5)	15.5397	---
	Radiation Level(37.5)	Not Reached	---
Late Pool Fire (kW/m²)	Radiation Level(4)	---	122.067
	Radiation Level(12.5)	---	110.732
	Radiation Level(37.5)	---	97.0362
Late Ignition (bar)	Overpressure(0.02068)	116.081	623.654
	Overpressure(0.1379)	44.8778	314.144
	Overpressure(0.2068)	39.2499	297.371
Early Explosion	Overpressure(0.02068)	---	357.079
	Overpressure(0.1379)	---	92.4567
	Overpressure(0.2068)	---	71.5409
Fire Ball Ellipse	Radiation level (4)	---	117.991
	Radiation level (12.5)	---	30.8741
	Radiation level (37.5)	---	Not Reached

➢ **Ethylene Oxide Measuring Tank 1 Scenario (Dia 1.6× 2.7,m Vertical Tank)**

Scenario description	**1.5 F @ 50 mm Leak & 5 D @ Catastrophic Rupture**		
Weather data		**Distances (m)**	
		1.5 F	**5 D**
Concentration (ppm)	UFL (1e+006)	Not set	0
	LFL (30000)	9.73722	145.388
	LFL Frac (15000)	23.0778	206.804
Early Pool Fire(kW/m²)	Radiation Level(4)	---	---
	Radiation Level(12.5)	---	---
	Radiation Level(37.5)	---	---
Flash Fire (ppm)	Furthest Extent (15000)	23.0778	206.804
	Furthest Extent (30000)	9.73722	145.388
Jet Fire (kW/m²)	Radiation Level(4)	58.7377	---
	Radiation Level(12.5)	14.6909	---
	Radiation Level(37.5)	Not Reached	---
Late Pool Fire (kW/m²)	Radiation Level(4)	---	94.4049
	Radiation Level(12.5)	---	85.9069
	Radiation Level(37.5)	---	74.8145
Late Ignition (bar)	Overpressure(0.02068)	112.749	489.517
	Overpressure(0.1379)	44.0151	241.214
	Overpressure(0.2068)	38.5823	227.342
Early Explosion	Overpressure(0.02068)	---	281.299
	Overpressure(0.1379)	---	72.8353
	Overpressure(0.2068)	---	56.3583
Fire Ball Ellipse	Radiation level (4)	---	91.548
	Radiation level (12.5)	---	21.2599
	Radiation level (37.5)	---	Not Reached

➢ **Ethylene Oxide Measuring Tank 2 Scenario**

Scenario description	1.5 F @ 50 mm Leak & 5 D @ Catastrophic Rupture		
Weather data		Distances (m)	
		1.5 F	5 D
Concentration (ppm)	UFL (1e+006)	Not Set	0
	LFL (30000)	10.6114	125.035
	LFL Frac (15000)	23.7701	177.341
Early Pool Fire(kW/m²)	Radiation Level(4)	---	---
	Radiation Level(12.5)	---	---
	Radiation Level(37.5)	---	---
Flash Fire (ppm)	Furthest Extent (15000)	23.7701	177.341
	Furthest Extent (30000)	10.6114	125.035
Jet Fire (kW/m²)	Radiation Level(4)	60.7524	---
	Radiation Level(12.5)	15.5587	---
	Radiation Level(37.5)	Not Reached	---
Late Pool Fire (kW/m²)	Radiation Level(4)	---	80.3497
	Radiation Level(12.5)	---	71.8507
	Radiation Level(37.5)	---	60.7208
Late Ignition (bar)	Overpressure(0.02068)	116.022	427.961
	Overpressure(0.1379)	44.8625	208.149
	Overpressure(0.2068)	39.238	195.072
Early Explosion	Overpressure(0.02068)	---	247.585
	Overpressure(0.1379)	---	64.1059
	Overpressure(0.2068)	---	49.6037
Fire Ball Ellipse	Radiation level (4)	---	79.727
	Radiation level (12.5)	---	16.8565
	Radiation level (37.5)	---	Not Reached

1.10 MITIGATION MEASURES

Measures and recommendations for the proposed Tank Farm area are as follows:-

- Offsite precaution measures are to be prepared.
- Adherence of international engineering standards in the Design, Construction and testing of the storage tanks, equipments and other hardware.
- All tanks to be provided with automatic sprinkler system interlinked with fusible bulbs, the sprinkler system to confirm to TAC design guidelines.
- All storage tanks to have level indicators, flame arrestors, breather valves and foam injection system wherever required.
- The pumps used for transferring the solvents shall be not in the main dyke but in a separate dyke.
- All pumps used to have mechanical seal to prevent leakages and fugitive emission.
- Spillages and leaks from the storage tanks can be collected and transferred out and treated for safe disposal.
- Storage areas shall be free from accumulation of materials.
- All electrical and instrumentation equipment used in the tank farm area to be rated for the solvent present as per ATEX standards.
- There should be good communication system available near tank farm area to the control room, and it should be flameproof.
- The tank farm should be protected with upwind and downwind foam monitors, the spacing of the same is to be as per TAC standards.
- A good layout should provide for adequate fire-fighting access, means of escape in case of fire and also segregation of facilities so that adjacent facilities are not endangered during a fire.
- Routine Inspection of Flame arrestor and breathing valve should be done.
- At every tank farm its license number, storage capacity & name of the chemicals should be displayed at the entrance.
- Flameproof Motors for unloading near flammable storage tank should be provided with double earthing.
- All electric fittings used in the tank farm should be flame proof type.
- Condition of N_2 blanketing should be checked regularly, if provided.
- Fire protection system shall be provided on each tank, a fixed foam pouring arrangement to tackle any duke spillages should also be considered. The foam blanket prevents surface evaporation form liquid pool.

- Develop detailed maintenance/contractor procedures requiring physical identification of tank vents during walk-through and other devices which haven't cover during maintenance activities.
- Emergency cupboards containing self contained breathing apparatus, fires suits and chemicals masks and suits to be kept near the tank farm areas.
- Outside shaded or detached storage areas are preferred for Methanol. A detached storage area is either an outside shaded area or a separate building containing no incompatible materials and located away from all other structures.
- In the case of detached storage the building construction should be fire resistant and provisions made for potential fire-fighting activities. The fire-fighting installation should include provision for an adequate supply of water. Fire extinguishers and hydrants should be distributed around the area. Fire-fighting water run-off should be prevented from polluting water sources.
- A telephone should be provided which is freely available and readily accessible for the reporting of accidents or emergency situations. The emergency telephone numbers should include the fire department, ambulance service, emergency response team, hospital and police.
- Emergency respirator equipment cabinets should be installed not more than 30 meters or ten seconds walking distance from any location in the storage area.
- Non-freeze safety showers and eyewash fountains shall be provided, clearly marked, well lit and with unobstructed access. They should be installed close to the bromine storage area and not more than 30 meters or ten seconds walking distance from any location in the storage area. Provide alternative sources of water supply.
- Lead detector system should be installed.
- **Company has obtained renewal license for Ehylene Oxide Storage license from Petroleum and Explosives Safety Organisation (PESO), West Circle, Ministry of Commerce & Industry, Govt. of India, vide License No.: S/HO/GJ/03/210(S1368) Date of Issue: 13-04-2011, Validity upto: 31-03-2014 and Renewal License vide License No.: S/HO/GJ/03/210(S1368) Date of Issue: 17-02-2014, Validity up to 31-03-2017 (Please Refer Annexure – 1) vide compliance of their requirements. Our suggestion is to maintain Compliance of conditions given by PESO for storage and handling of Ethylene Oxide.**

1.11 REFERENCES

- Quantitative Risk Assessment-M.J Borysiewiez, M.A. Borysiewiez, L.Garanty, A. Kozubal.
- 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.
- World Bank Technical papers relating to “Techniques for assessing Industrial Hazards”.
- Major Hazard Control by ILO.
- Risk Management Program guidelines by EPA (US).
- World Bank Technical Paper no. 55 – Technica ltd. For assessing hazards – A Manual.
- PHAST v 6.53-Software.
- Overall plot plan.

6.3 CREP GUIDELINES:

There are 17 types of industrial sector for which CREP guideline have been given. Since Shree Vallabh Chemical is a Synthetic organic chemical industry of emulsifier and de-emulsifier, the guidelines are not applicable to them. The list of 17 types of industries for which CREP guidelines have been formed is given below.

1. Aluminium
2. Cement
3. Chlor – Alkali
4. Copper
5. Distillery
6. Dyes & dye intermediates
7. Fertilizer
8. Iron & Steel
9. Oil Refineries
10. Pesticides
11. Petrochemicals
12. Pulp & Paper
13. Sugar
14. Tannery
15. Thermal Power Plants
16. Zinc

Even though the CREP guide lines are not yet established for this kind of industry, Shree Vallabh Chemical has initiated number of measures to keep the pollution level to the minimum. Following actions are taken as self-initiated Responsibility for Environmental Protection and Pollution prevention. .

1. The ash from boiler will be sold to cement manufacture or will be sold to brick manufacturer.
2. The height of the boiler chimney will keep 31 meters to disperse flue gases.
3. A Multi-cone type cyclone separator will be provided to removed PM and SPM from boiler flue gases
4. Ethylene Oxide (EO) storage tank vent is dipped in water to control EO pollution.
5. The used drums of raw materials will be sent to the GPCB authorized recyclers.
6. The used oil from engines and pump/agitator seal will be collected and sent to authorized recyclers.
7. Effluent will be treated in effluent treatment plant and will be evaporated.
8. The pumps agitator and flakers use energy efficient motor to conserve energy.
9. Eco ventilators will be used to maintain the EO level below thresh hold limit of 1 ppm.
10. Acoustic enclosure will be installed in DG set to minimize noise pollution.

COMPLIANCE OF CREP GUIDELINES

Sr. No.	Action Point	Compliance
1.	**Segregation of waste stream** • Waste streams should be segregated into high COD waste, toxic waste, low COD waste, inorganic waste etc. for the purpose of providing appropriate treatment	• No high COD streams / toxic streams shall be generated from the unit. • Effluent shall be treated in the Primary Effluent Treatment Plant before sending it to in-house Evaporator for evaporation, thus achieving "Zero Discharge".
2.	**Management of solid waste** • Proper facilities should be provided for handling and storage of hazardous waste. • For final disposal of hazardous waste, recycling and reuse should be given priority, either within the premises or outside with proper manifest system. • In case of incinerable waste, properly designed incinerator should be installed within the premises or outside as a common facility. • The non-incinerable hazardous waste should be disposed of in properly designed secured landfill either within the industry's premises or in a common facility.	• Separate solid & hazardous wastes storage area having impervious bottom, pucca roof and leachate collection system has been provided. Leachate, if any, will be taken to ETP for treatment and disposal. • All hazardous wastes will be separately stored at this site in appropriate container. • ETP sludge will be disposed-off to TSDF. • Used Oil will be given to CPCB registered re-processor of oil. • Discarded containers will be given to registered vendor after decontamination. • Process wastes/ used Softner resin will be disposed-off at CHWIF.
3.	**Minimum scale of production to afford cost of pollution control** • For new industries which are not connected with CETP & TSDF and which do not have the economics to install treatment facilities may not be considered for granting consent to establishment. • Industry association shall submit proposal to SPCB / CPCB	• The Unit will install an in-house ETP cum evaporation system, thus achieving "Zero Discharge". • Unit is in procedure to obtain TSDF membership.

4.	**Long term strategies for reduction in waste** • Consent for establishment and Consent for operation under Water Act will be based on pollution load and concentration of pollutants. • Each industry will submit pollution load, concentration of final discharge alongwith water balance to SPCB/CPCB for formulation of strategy	• Necessary details will be provided to GPCB at appropriate stage of project implementation. • The unit will strive to reduce pollution load through optimum utilization of resources like raw material, energy, etc.
5.	**Control of air pollution** • Industry will take up on priority, the control of hazardous air pollutants (such as Benzene, Carbon Tetrachloride, 1 – 4 Dioxin, Methanol, Toluene, Methyl Chloride etc.) and odorous compounds (Mercaptants & Hydrogen Sulphide)	• There are no process related emissions generated from the unit.
6.	**Self-Regulation by Industry though regular monitoring and environmental auditing** • Industries on their own will carry out monitoring of environmental parameters, audit it in regular intervals and submit the same to SPCB.	• All applicable environmental parameters will be regularly monitored as per the Environmental Monitoring Plan formulated by the unit. • Environmental Statement (in Form-V) will be regularly submitted to GPCB.
7.	**Organisational restructuring and accreditation of Environmental Manager of Industry** • Environment Management Cell will be created for each industry reporting to CEO directly. • There should be a certification system for the environmental managers at individual level and common facility level. BDMA may evolve the programme alongwith SPCB/CPCB	• The unit shall set-up an Environment Management Cell consisting of well-qualified and experienced professionals from the field of safety and environment. • The unit will strive to obtain ISO : 14001 certification.

8.	**Optimising the inventory of hazardous chemicals** • The information shall be submitted to SPCB regularly alongwith rational action plan	• All rules and regulations of Factory Inspectorate will be complied with. • On-site emergency plan will be prepared based on risk assessment study and strictly implemented. • All details will be submitted to all concerned authorities as per MSIHC Rules.