MERIDIAN POLYMERS

SY.NO. 169/PART-2, MANHALLI VILLAGE,
BIDAR TALUK AND DISTRICT, KARNATAKA

RISK ASSESSMENT REPORT

Project No. 0319-21-01
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STUDIES AND DOCUMENTATION BY

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7.0 Introduction

This chapter presents the risk assessment study results for the plant operations, transport and storage of raw materials, and identifies maximum credible accident scenarios to draw the emergency management plan addressing various credible scenarios identified.

7.1. Objectives and Scope

The production of Carboxyl methyl cellulose (CMC) involves usage of chemicals which are hazardous in nature. In order to ensure the health and safety of persons at or near the facilities, Govt. has approved some regulations. The regulation requires Employers to consult with employees in relation to:

- Identification of major hazards and potential major accidents
- Risk assessment
- Adoption of control measures
- Establishment and implementation of a safety management system
- Development of the safety report

The involvement of the employees in identification of hazards and control measures enhances their awareness of these issues and is critical to the achievement of safe operation in practice. In order to comply with regulatory authorities, M/s Meridian Polymers have entrusted Team Labs and Consultants, Hyderabad to review and prepare Hazard analysis and Risk assessment for their facility along with an approach to on-site emergency preparedness plan as required under the acts and rules. (Manual on emergency preparedness for chemical hazards, MOEF, New Delhi).In this endeavor, the methodology adopted is based on;

- visualizing various probable undesirable events which lead to major accidents
- detailed and systematic assessment of the risk associated with each of those hazards, including the likelihood and consequences of each potential major accident event; and

- identifying the technical and other control measures that are necessary to reduce that risk to a level that is as low as reasonably practicable

The strategy to tackle such emergencies, in-depth planning and person(s) or positional responsibilities of employees for implementation and coordination of timely and effective response measures are described in onsite detail in Emergency Plan.

7.2 Project Details

The project site of 3.0 acres is located at Sy. No 169/Part-2, Manhalli Village, Bidar Taluk and District, Karnataka. The site is situated at the intersection of 17^0 45′ 10″ (N) latitude and 77^0 28′57″ (E) longitude. The site elevation above mean sea level (MSL) is 653 m. The site is surrounded by open lands in north, south directions, road connecting to SH122 in east direction and Cellulose Solutions Private Limited in west direction. The nearest human settlement is Manhalli village at a distance of 2.5 km in northeast direction. The main approach road is SH122 passing at a distance of 0.2 km in south direction. NH 9 s at a distance of 6.3 km in south direction. The nearest railway station of Metalkunta is at a distance of 8.5 km in east direction and the nearest airport is Bidar Air Force Station, a defense facility is located at a distance of 15.6 km at in north direction. Rajiv Gandhi International airport is located at a distance of 112 km in southeast direction Madhura Canal is passing at a distance of 4.4 km in northeast direction. Karanja Vagu is passing at a distance of 4.5 km in South direction. Telangana – Karnataka Inter state Boundary is at a distance of 3.9 km in northeast direction. There are seven reserve forest in the impact area of 10 km. Tadaplli RF located at 0.2 km in southwest direction, Honnadi RF located at 4.6 km in West direction, Kalbemal RF located at 6.9 km in North direction, Bagdal RF located at 7.1 km in West direction, Godepalli RF located at 7.1 km in North direction, Chitta RF located at 7.5 km in North direction and Rajola RF located at 9.4 km in North direction. There is no national park, wildlife sanctuary, ecologically sensitive area, biosphere reserve, tiger reserve, elephant reserve and critically polluted areas within 10 km radius of the site. Chemical inventory is presented in **Table 7.1**

Table 7.1 List of Raw Materials and Inventory *(Terms of Reference No. 3(iv) & (3(v))*

S.No	Name of the Raw Material	Maximum storage	Physical Form	Type of Hazard	Mode of Storage	Mode of Transport
1	Ethyl Alcohol	2 x 30 Kl	Liquid	Flammable	Storage Tank	By Road
2	Monochloro Acetic acid	8000 kgs	Crystals	Toxic	HDPE line Bags	By Road
3	Caustic lye (48%)	1 x 15 Kl	Liquid	Corrosive	Storage Tank	By Road
4	Cotton Cellulose	40 Tons	Solid	Non-Hazard	Bales	By Road
5	Wood Cellulose	40 Tons	Solid	Non-Hazard	Bales	By Road

7.3 Process Description

Carboxymethyl cellulose (CMC) is an Ether derivative of Cellulose and is manufactured by Alkalization and Etherification of Cellulose followed by Purification.

The origin of the basic Cellulose can be either Cotton linter pulp /wood pulp or Hosiery cuttings. Cellulose is charged to the first reactor; the reactor is kept in rotation and chilled mixer of Caustic soda lye and Ethyl Alcohol is sprayed on the fibers to achieve uniform wetting of the cellulose fibers. During this operation the brine from the chilling plant is circulated in the jacket of the reactor to maintain low temperature in the reactor. The alkalization of cellulose is complete in about 2 hrs., then mixture of alcohol and mono choro acetic acid is added transferred to the second reactor. After the first reactor is emptied another charge of cellulose is added and alkalization continues in the first reactor.

In the second reactor, steams circulated in the jacket for etherification of cellulose to yield technical. Ethanol added in the first reactor is distilled for recovery of ethanol. The recovery system consists of two stage condensing system with chilled brine circulation in both condensers. The recovered Alcohol is sent back to the storage tank to be used for the next alkalization reaction. The Technical CMC thus produced is taken for further purification. For producing purified grades of CMC, the technical CMC is charged into a reactor along with Alcohol-water mixture. At the end of the purification cycle, the slurry is sent to centrifuge, for solid liquid separation. The solids contain purified CMC is sent to drier for drying. The Vacuum drier is connected to alcohol recovery system. The liquid contains a mixture of Water, ethanol and slats. This is sent to a Solvent recovery system. (Distillation)

The dried Purified grade of CMC is pulverized in the pulverize to the required particle size and sent for screening. The oversize from the screening machine is sent back to pulverize and under size is packed in bags of 25 kgs each. The process flow diagram for CMC is presented in **Fig 7.1**

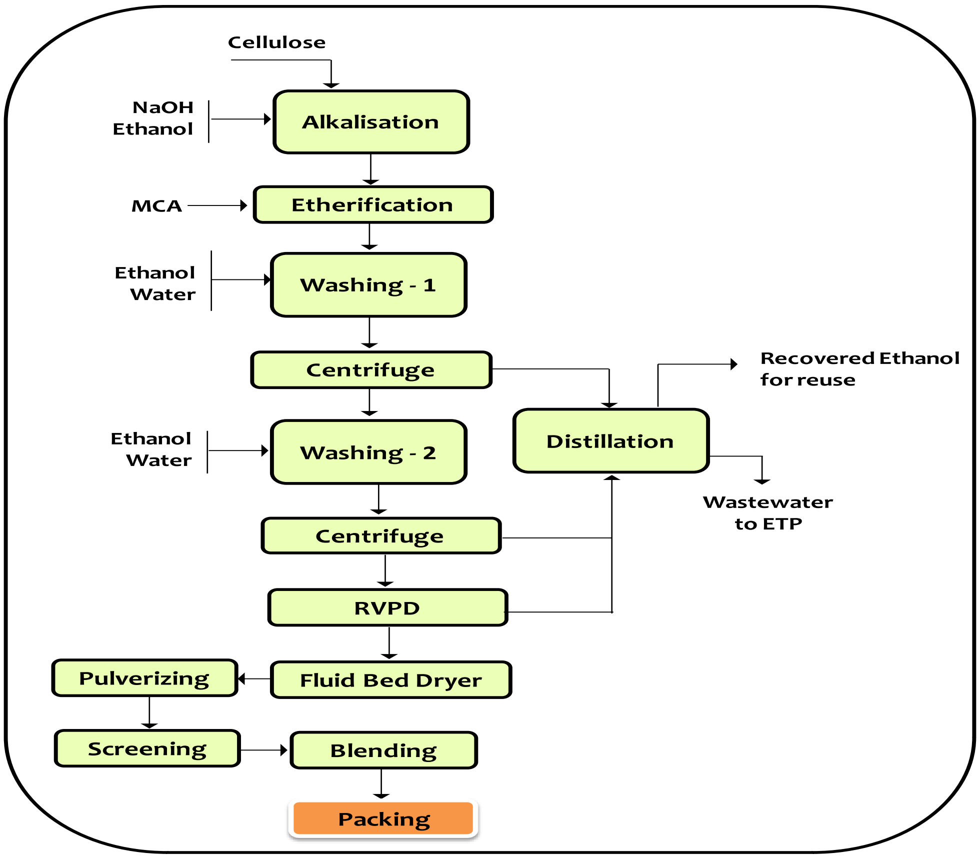

Fig 7.1 Process Flow Diagram of Purified Carboxy Methyl Cellulose.

7.4 Plant Facilities

The manufacturing facility shall be provided with

1) Production block
2) Utilities
3) Quality Control, R&D lab
4) Effluent Treatment plant
5) Warehouses
6) Tank farm area
7) Administrative Office
8) Solvent recovery area
9) Coal and Ash Storage Area

The production facilities shall be designed for proper handling of materials and machines. Safety of operators, batch repeatability and process parameter monitoring shall be the major points of focus in the design of facility. The current Good Manufacturing Practices (GMP) guidelines shall be incorporated as applicable to synthetic organic chemicals manufacturing facilities. Isolation of the various process areas from the utilities and non-process areas is considered in view of both containment and cGMP. A tentative plant layout is shown in **Fig 7.2.**

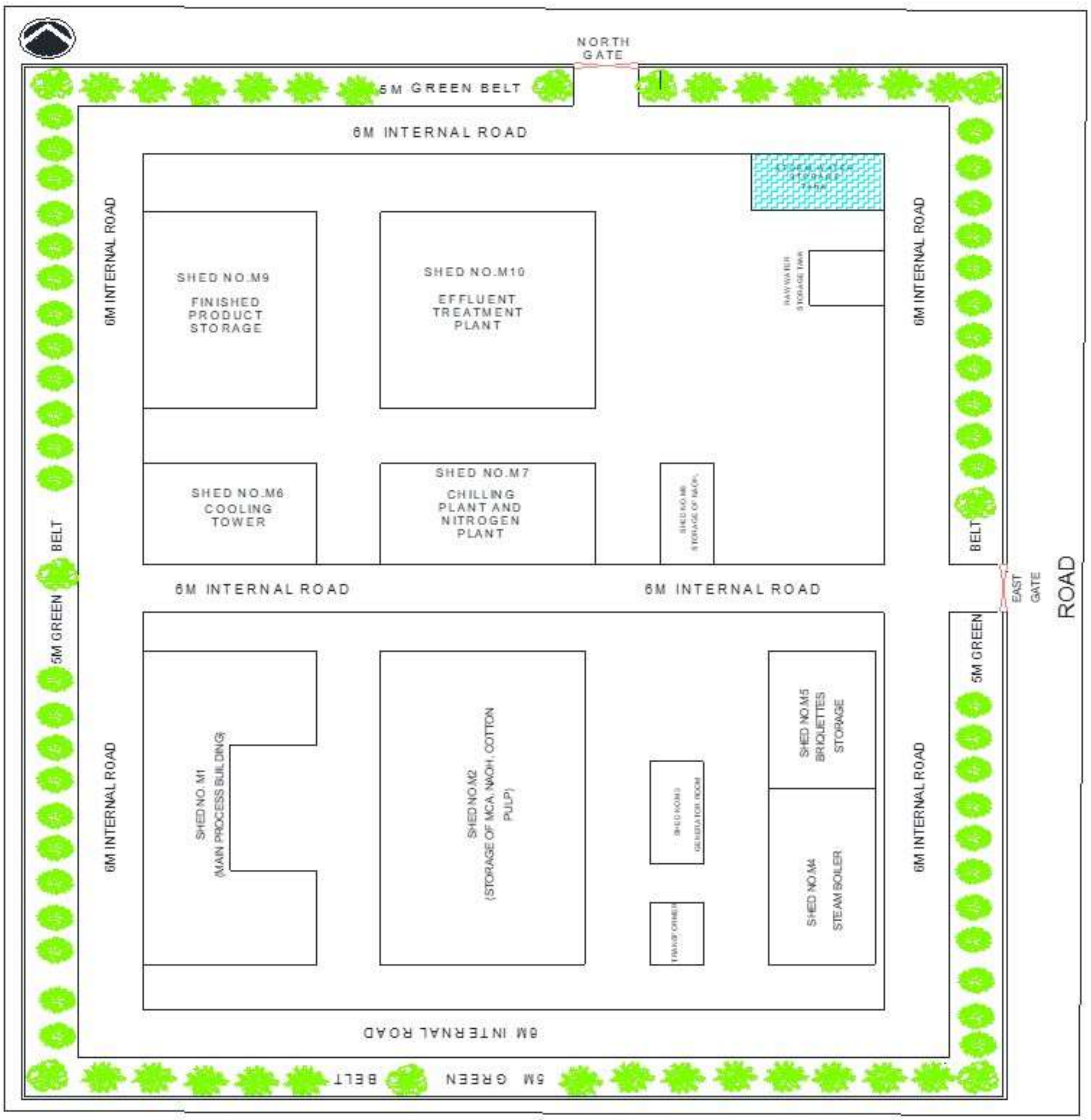

Fig 7.2 Plant Layout of Meridian Polymers

7.5Hazard Analysis and Risk Assessment

7.5.1 Introduction.

Hazard analysis involves the identification and quantification of the various hazards (unsafe conditions) that exist in the plant. On the other hand, risk analysis deals with the identification and quantification of risks, the plant equipment and personnel are exposed to, due to accidents resulting from the hazards present in the plant.

Hazard and risk analysis involve very extensive studies, and requires a very detailed design and engineering information. The various hazard analysis techniques that may be applied are hazard and operability studies, fault-tree analysis, event-tree analysis and failure and effects mode analysis.

Risk analysis follows an extensive hazard analysis. It involves the identification and assessment of risks; the neighboring populations are exposed to as a result of hazards present. This requires a thorough knowledge of failure probability, credible accident scenario, vulnerability of population's etc. Much of this information is difficult to get or generate. Consequently, the risk analysis is often confined to maximum credible accident studies.

7.5.2 Hazard Identification *(Terms of Reference No. 3(ix))*

The Hazard identification process must identify hazards that could cause a potential major accident for the full range of operational modes, including normal operations, start-up, and shutdown, and also potential upset, emergency or abnormal conditions. Employers should also reassess their Hazard identification process whenever a significant change in operations has occurred or a new substance has been introduced. They should also consider incidents, which have occurred elsewhere at similar facilities including within the same industry and in other industries.

After identifying hazards through a qualitative process, quantification of potential consequences of identified hazards using simulation modellings undertaken. Estimation of probability of an unexpected event and its consequences form the basis of quantification of risk in terms of damage to property, environment or personnel. Therefore, the type, quantity, location and conditions of release of a toxic or flammable substance have to be identified in order to estimate its damaging effects, the area involved, and the possible precautionary measures required to be taken.

Considering operating modes of the facility, and based on available resources the following hazard identification process chosen are:

a) Fire Explosion and Toxicity Index (FETI) Approach;
b) HAZOP studies;
c) Maximum Credible Accident and Consequence Analysis (MCACA);
d) Classification of Major Hazard Substances;
e) Manufacture Storage and Import of Hazardous Chemical Rules, 1989 (GOI Rules, 1989);
f) Identification of Major Hazardous Units.

The interpretation of "The Manufacture Storage and Import of Hazardous chemicals"(GOI Rules, 1989) issued by the Ministry of Environment and Forests, GOI, which guides the preparation of various reports necessary for safe handling and storage of chemicals shows that the present project requires preparation of safety reports before commencing operation and risk assessment is not mandatory. The applicability of various rules is presented in **Table 7.2.**

Table 7.2 Applicability of GOI Rules to Storage/Pipeline

S.No	Name of Chemical	Inventory KL	Threshold Quantity (T) For Application of Rules		Applicable Rules
			5,7-9, 13-15	10 - 12	
1	Ethanol	2 x 30	1500	10000	4 (1) (a), (2), 5,15

7.5.3 Fire & Explosion Index (F & EI):

7.5.3.1 Methodology

Dow Chemical Company issued a guideline for hazard determination and protection. By this method a chemical process unit is rated numerically for hazards. The numerical value used is the Fire and Explosion Index (F&EI) which is most widely used for hazard evaluation in chemical process industries.

Hazard Ranking

The hazard ranking based on F&EI value is presented in **Table 7.3.**

Table 7.3 Degree of Hazard for F&EI

F&EI Index Range	Degree of Hazard
1 – 60	Light
61 – 96	Moderate
97 – 127	Intermediate
128 – 158	Heavy
159 & above	Severe

The estimated values of F&EI and hazard ranking are given in the **Table 7.4.**The radius of exposure is determined by 0.26-meter x respective F&EI. The estimated values of F&EI reflect light hazard in view of the low volume of chemicals. F& EI index value calculated considering the maximum storage capacity of ethanol (30 Kl) and value found to be moderate reflecting the threshold limits as prescribed in MSHC rules.

Table 7.4 Fire & Explosion Index for Tank farm

S. No.	Name of Solvent	Fire & Explosion Index (F1*F2*MF)	Radius of Exposure (m) F&EIx0.26	Degree of Hazard
1	Ethanol	64.48	16.76	Moderate

7.5.4 Hazard and Operability Study (HAZOP)

The preparative work for HAZOP studies consisted of four stages i.e., obtaining the data, converting into usable form, planning the sequence of the study and arranging the necessary meetings. The documents referred to for the study include process description, process flow diagrams, P&I diagrams plant layout, operating manuals including startup & shutdown, safety instructions etc., The parameters such as temperature, pressure, flow, level were investigated for deviation and hazard situations are identified.

Some basic definitions of terms frequently used in HAZOP studies are deviation, causes, consequences and guide words etc., Deviations are departures from the design intent which are discovered by systematically applying the guide words. Causes are the reasons why deviations might occur. Consequences are the reasons why deviations should they occur. Guide words are simple words used to understand a particular plant section in operating condition in order to guide and simulate the creative thinking process and so discover deviations. NO, less, more, as well as, part of, reverse, other than are guide words used.

Potential problems as represented by the consequences of the deviation should be evaluated as they arise and a decision reached on whether they merit further consideration or action. Except for major risk areas where a fully quantitative assessment is required this decision is made semi-quantitatively on the consequence (usually scaled as trivial, important or very probable).

7.5.5 Hazard Factors

A study of past accident information provides an understanding of failure modes and mechanisms of process and control equipment and human systems and their likely effects on the overall plant reliability and safety. Some of the major contributing factors for accidents in chemical industries are:

S. No	Contributing Factor	Percent Loss
1	Equipment design faults	41
2	Process design faults	10
3	Operator errors	31
4	Maintenance deficiencies	12
5	Material hazards	6

7.5.6 Common Causes of Accidents

Engineering and Instrumental

Based on the analysis of past accident information, common causes of major chemical plant accidents are identified as:

- Poor house keeping
- Improper use of tools, equipment, facilities
- Unsafe or defective equipment facilities
- Lack of proper procedures
- Improving unsafe procedures
- Failure to follow prescribed procedures
- Jobs not understood
- Lack of awareness of hazards involved

- Lack of proper tools, equipment, facilities
- Lack of guides and safety devices
- Lack of protective equipment and clothing

Failures of Human Systems

An assessment of past chemical accidents reveals human factor to be the cause for over 60% of the accidents while the rest are due to other plant component failures. This percentage will increase if major accidents alone are considered for analysis. Major causes of human failures reported are due to:

- Stress induced by poor equipment design, unfavorable environmental conditions, fatigue, etc.
- Lack of training in safety and loss prevention.
- Indecision in critical situations.
- Inexperienced staff being employed in hazardous situations.

Often, human errors are not analyzed while accident reporting and accident reports only provide information about equipment or component failures. Hence, a great deal of uncertainty surrounds analysis of failure of human systems and consequent damages. The number of persons/materials are potentially exposed to a specific hazard zone is a function of the population density and distribution near the accident location. The failure rate data and ignition sources of major fires are presented in the following **Tables 7.5 and 7.6**.

Table 7.5 Failure Rate Data

S.No	Item	International Data
1.	Process Controllers	2.4×10^{-5} hr^{-5}
2.	Process control valve	2.0×10^{-6} hr^{-1}
3.	Alarm	2.3×10^{-5} hr^{-1}
4.	Leakage at biggest storage tank	5.0×10^{-5} yr^{-1}
5.	Leakage of pipe line	1×10^{-7} m^{-1} yr^{-1}
6.	Human Failure	1×10^{-4} $(demand)^{-1}$

Table 7.6 Ignition Sources of Major Fires

S.No	Ignition Source	Percent
1.	Electrical (wiring of motors)	23%
2.	Smoking	18%
3.	Friction	10%

4.	Overheated material	8%
5.	Burner flames	7%
6.	Combustion sparks	5%
7.	Spontaneous ignition	4%
8.	Cutting & welding	4%
9.	Exposure (fires jumping into new areas)	3%
10.	Mechanical sparks	2%
11.	Molten substances	1%
12.	Chemical actions	1%
13.	Static sparks	1%
14.	Lightening	1%
15.	Miscellaneous	1%

7.6 Maximum Credible Accident and Consequence Analysis (MCACA)

The potential hazards due to flammable and toxic nature of the raw materials, process streams and products can be quantified. However, it is necessary to carry out a hazard analysis study to visualize the consequences of an unexpected release from chemical plant, which consists of a number of process units and tank farm facilities. The present study provides quantified picture of the potential hazards and their consequences.

7.7Consequence Analysis

The accidental release of hazardous chemicals leads to subsequent events, which actually cause the damage. The damages are of three types.

1) Damage due to heat radiation.

2) Damage due to Over pressure effects subsequent to explosion

3) Damage due to toxic effects

The type of damage and extent of damage depends on nature of chemical, the conditions of release, atmospheric conditions and the subsequent events. The sequence of probable events following the release of a hazardous chemical is schematically shown in **Figure 7.3.**The best way of understanding and quantifying the physical effects of any accidental release of chemicals from their normal containment is by means of mathematical modeling. This is achieved by describing the physical situations by mathematical equations for idealized conditions and by making corrections for deviation of the practical situations from ideal conditions. In the present study ALOHA software from USEPA. These models for various steps are described in the following sub-sections.

7.7.1 Release Models and Source strength

This depends on the nature of failure of the unit and the content of the unit and operating temperature and pressure of the unit. The release may be instantaneous due to total failure of storage unit or continuous due to leakage or rupture of some component of the storage facility. The material discharged may be gas or liquid or the discharge could be manifested through two phase flow. The models that are used to calculate the quantity of liquid/vapor released are:

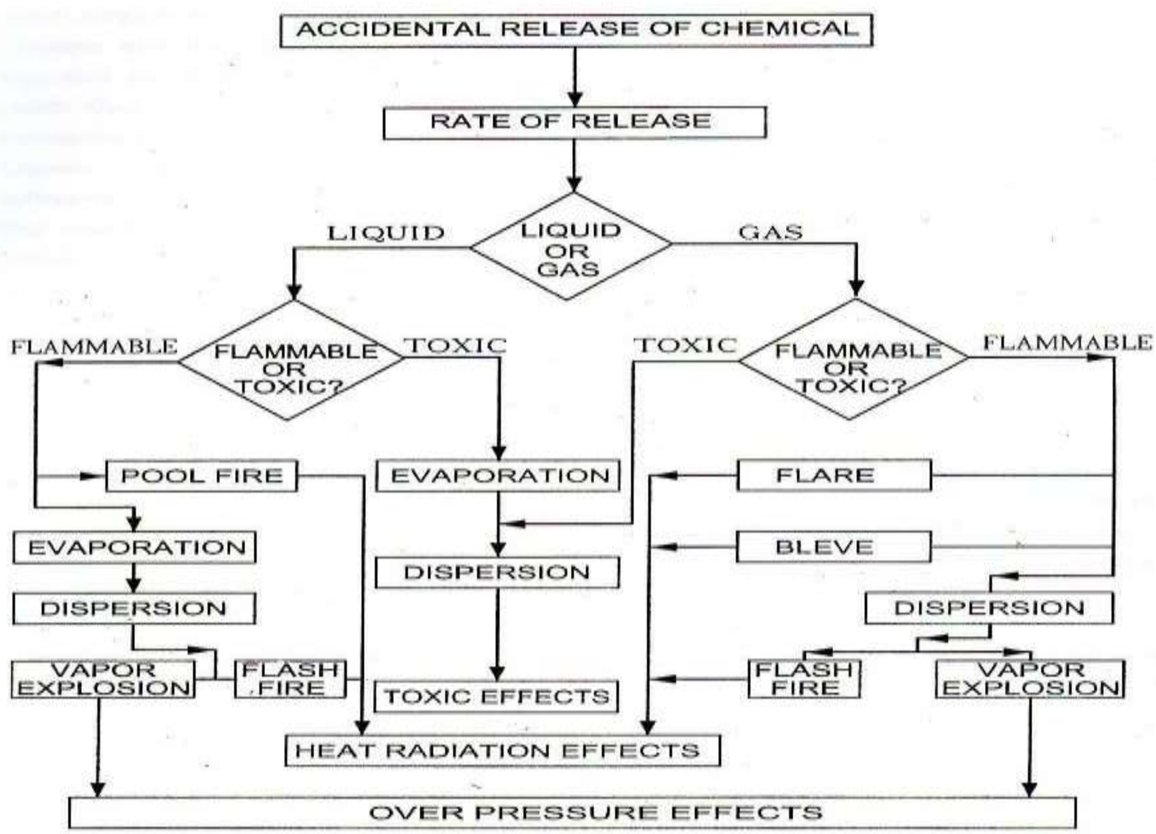

Fig 7.3Steps in Consequence Calculations

The following criteria tables present heat radiation intensities (**Table 7.7**), radiation exposure and lethality (**Table 7.8**), and damage due to peak over pressure is presented in **Table 7.9.**

Table 7.7Damage Due to Incident Radiation Intensities

S. No	Incident Radiation (KW/m2)	Type of Damage Intensity	
		Damage to Equipment	Damage to the People
1	37.5	Damage to process Equipment	100% lethality in 1 min. 1% lethality in 10 sec.
2	25.0	Minimum energy required to ignite wood at indefinitely long exposure without a flame	50 % lethality in 1min. Significant injury in 10 sec.
3	19.0	Maximum thermal radiation intensity allowed n thermally unprotected adjoining equipment.	---
4	12.5	Minimum energy to ignite with a flame, melts plastic tubing	1% lethality in 1 min.
5	4.0	--	Causes pain if duration is longer than 20 sec, overflattering is unlikely (First degree burns)
6	1.6	--	Causes no discomfort on Longer exposure

Source: Techniques for Assessing Industrial Hazards by World Bank

Table 7.8 Radiation exposure and lethality

Radiation Intensity (KW/m2)	Exposure Time (seconds)	1% Lethality	Degree Burns
1.6	--	0	No Discomfort even after longer exposure
4.5	20	0	1st
4.5	50	0	1 st
8.0	20	0	1 st
8.0	50	<1	3 rd
8.0	60	<1	3 rd
12.0	20	<1	2 nd
12.0	50	8	3 rd
12.5	--	1	--
25.0	--	50	--
37.5	--	100	--

Table 7.9Damage Due to Peak Over Pressure

Human Injury		Structural Damage	
Peak Over Pressure(bar)	Type of Damage	Peak over Pressure(bar)	Type of Damage
5 – 8	100% lethality	0.3	Heavy (90%Damage)
3.5 – 5	50% lethality	0.1	Repairable (10%Damage)
2 – 3	Threshold lethality	0.03	Damage of Glass
1.33 – 2	Severe Lung damage	0.01	Crack of Windows
1 – $1^{1/3}$	50% Eardrum rupture	-	-

Source : Marshall, V.C.(1977)' How lethal are explosives and toxic escapes.

7.7.2 Results of Consequence Analysis

The damages due to the accidental release of chemicals are of three types.

a) Damage due to heat radiation

b) Damage due to Over pressure effects subsequent to explosion

c) Damage due to Toxic effects

7.7.2.1 Analysis of Hazardous Scenarios

The hazardous chemicals involved are stored within the threshold limits of storage and hence few representative chemicals mainly solvents were studied.

7.7.2.1.1 Heat radiation effects *(Terms of Reference No. Sp. TOR (13))*

When a non-boiling liquid spills, it spreads into a pool. The size of the pool depends on the availability of the bund and obstacles. The heat load on objects outside a burning pool of liquid is calculated with the heat radiation model. The heat radiation effects for the three levels of intensity are calculated for ethanol storage tank (30 Kl), the heat radiation damage distance for three levels are found to be less than 10 m from storage tank.

Table 7.10 Heat Radiation Damage Distances – Tank Farm (Pool Fire)

S.No	Name of Raw material	Tank Capacity (KL)	Diameter (m)	Height (m)	Release Rate (Kg/sec)	Heat radiation damage distances in m for KW/m2		
						37.5	12.5	4.0
1	Ethanol	30	3.1	4.0	0.38	<10	<10	<10

7.7.3 Observations:

From the previous incident records published in literature and hydrocarbon release data bases, it has been observed that pinhole leaks contribute highest percentage whereas the second cause is small sized leaks of 25 mm diameter in tank farm. Accordingly, the consequence analysis was carried out for 25 mm sized leaks in the tank farm.

7.7.4 Recommendations:

The following are the recommendations to minimize the hazards and improve the safety of the proposed plant. Plants of this nature, which handle a variety of chemicals, face problems of fire and vapor cloud explosions. It has been observed that the damage distances are more or less confined to the plant area only. Taking precautionary safety measures as outlined below can further minimize these effects.

- In view of hazardous nature of operations, it is recommended to adopt best practices with respect to design, operation and maintenance.
- It is recommended that all flammable areas and process area be maintained free of ignition sources. Ensure that sources of ignition, such as pilot lights, electrical ignition devices etc., at strategic locations like solvent storage areas are avoided**.**
- All electrical fittings involved in and around the pipeline and operation system should conform to flame/explosion proof regulations.
- Strict hot work control and display of danger signs should be ensured.
- It is recommended to provide one fire hydrant point in the tank-farm area to take care of any emergency. Installation of fire water hydrant network is suggested.
- It is suggested to provide fire extinguishers in process plant at solvent storage area and the vents of solvent tanks to be provided with PESO approved flame arrestors.
- Fire protection equipment should be well maintained so that it is available when required. They should be located for quick accessibility. Provide carbon dioxide fire extinguishers and DCP extinguishers for Electrical fires.
- It is suggested to have a periodical review of safety awareness and safety training requirements of plant employees with respect to hazards present in the plant.

7.7.5Transportation (*Terms of Reference No. 7(iii)*

All the raw materials and finished products are transported by road. Dedicated parking facility will be provided for transport vehicles. The plant is located near state national highway, and there will not be any unauthorized shop or settlements along the road connecting the plant site. There will be 4-5 truck trips per day to the factory. Safety signages placed at various locations in the battery limit. The drivers of the vehicles will be provided with TREM cards and will be explained the measure to be adopted during various emergencies.

Transportation of raw materials may result in accidents due to high speed collision, low speed collision, overturning and non-accident-initiated release. The initiating and contributing causes are presented in **Table 7.11**

Table 7.11 Truck Incidents – Initiating and Contributing Causes

Human Errors	Equipment Failures	System or Procedural Failures	External Events
Driver Impairment Speeding Driver Overtired Contamination Overfilling	Non-dedicated trailer RR crossing guard Failure Leaking Valve Leaking Fitting	Driver incentives Driver training Carrier selection Container Specification Route selection	Vandalism/ Sabotage Rain Fog Wing Flood/washout
Other Vehicle's Driver Taking Tight	Brake Failure Insulation/Thermal Protection Failure	Emergency response training Speed Enforcement	Fire at rest areas/parking areas Earthquake
Unsecured Load	Relief device failure Tire failure Soft shoulder Overpressure Material defect Steering failure Sloshing High center of gravity Corrosion; Bad Weld; Excessive Grade Poor Intersection design Suspension system	Driver rest periods Maintenance Inspection Time of day Restrictions	Existing accident

The scenarios presented for storages are calculated for transport related incidents/accidents and presented in **Table 7.12.**

Table 7.12 Transportation Specific Concerns

Concern	Road
Spill on Water	Over or near a body of water
Unconfined Pools	In an undisturbed flat area
BELVE-Induced catastrophic vessel failure	Possible if sufficient quantity in car with small leak to feed fire or if double tank trailer or burning fuel leak
Toxic products of combustion or reaction	Dependent on material and whether ignition occurs

7.7.6Control Measures for Accidental Spillage of Chemicals

Name of the Chemical Stored	Storage Details		Hazard Rating Systems			Type of Hazards Involved	Persons Effected	Control Measures
	Quantity (KL)	Pressure/ Temp	TLV (PPM)	STEL (PPM)	FP (^{O}C)			
Ethanol	30	NTP	1000	1000	14	Highly flammable liquid and vapor.	Operators Maintenance Technicians	Keep away from heat/sparks/open flames/hot surfaces. Use personal protective equipment. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas.

7.8Disaster Management Plan *(Terms of Reference No. 7(xiii)*

7.8.1 Introduction

A disaster is a catastrophic situation in which suddenly, people are plunged into helplessness and suffering and, as a result, need protection, clothing, shelter, medical and social care and other necessities of life.

Disasters can be divided into two main groups. In the first, are disasters resulting from natural phenomena like earthquakes, volcanic eruptions, storm surges, cyclones, tropical storms, floods, avalanches, landslides, and forest fires. The second group includes disastrous events occasioned by man, or by man's impact upon the environment. Examples are armed conflict, industrial accidents, radiation accidents, factory fires, explosions and escape of toxic gases or chemical substances, river pollution, mining or other structural collapses, air, sea, rail and road transport accidents and can reach catastrophic dimensions in terms of human loss.

There can be no set criteria for assessing the gravity of a disaster in the abstract since this depends to a large extent on the physical, economic and social environment in which it occurs. However, all disasters bring in their wake similar consequences that call for immediate action, whether at the local, national or international level, for the rescue and relief of the victims. This includes the search for the dead and injured, medical and social care, removal of the debris, the provision of temporary shelter for the homeless, food, clothing and medical supplies, and the rapid re- establishment of essential services.

An emergency may be said to begin when operator at the plant or in charge of storage of hazardous chemicals cannot cope up with a potentially hazardous incident, which may turn into an emergency. The emergencies could be a major fire or explosion or release of toxic gas or a combination of them.

The proposed plant will store fuels, which are flammable in nature, and the storage will be as per the Controller of Explosives and OISD norms. The hierarchy of the employees is yet to be determined and the project is still in the initial stages of designing. Hence a tentative disaster management plan is prepared to be suitably modified before commissioning of the plant.

7.8.2 Objectives of Emergency Management Plan (ON-SITE)

(Terms of Reference No. 7(xiii)

A quick and effective response during emergency can have tremendous significance on whether the situation is controlled with little loss or it turns into a major emergency Therefore, the objectives of this Onsite Emergency Plan (ONSEP);

During Emergency: Is to provide basic guidance to the personnel for effectively combating such situations to minimize loss of life, damage to property and loss of property.

- To localize the emergency and if possible, eliminate it;
- To minimize the consequences of an emergency;
- To prevent spreading of the damage in other areas;
- To give necessary warning to plant personnel and neighborhood;
- To maximize resource utilization and combined efforts towards the emergency operations;
- To mobilize internal resources and utilize them in the most effective way;
- To arrange rescue of persons, transport and treatment of causalities;
- To seek necessary help from industries in neighborhood or local authorities;
- To provide information to government agencies and to provide information to public.

During Normal Time:

- To keep the required emergency equipment in stock at right places and ensure their working condition;
- To keep the concerned personnel fully trained in the use of emergency equipment;
- Preserving records, evidence of situation for subsequent emergency etc.

7.8.3 Scope of ONSEP

This ONSEP is prepared for industrial emergencies like fires, explosions, toxic releases, asphyxia and does not cover natural calamities and societal disturbances related emergencies (like strikes, bomb threats, civil Commissions etc.). Also, the scope of this ONSEP is limited to onsite emergencies and does not include measures for offsite Emergency Management. Necessary information with regards to Off Site Emergency Management will be furnished to district authorities.

7.8.4 Methodology of Developing ONSEP

The consideration in preparing this Emergency Plan includes the following steps:

- Identification and assessment of hazards and risks;
- Identifying, appointment of personnel & Assignment of Responsibilities;
- Identification and equipping EmergencyControlCenter;
- Identification of Assembly, Rescue points, Medical Facilities;
- Formulation of plan and of emergency sources;
- Training, Rehearsal & Evaluation;
- Action on Site.

Earlier, a detailed Hazard Analysis and Risk Assessment were carried out for the plant facilities and the hazards are quantified. The likely locations of hazards and consequences are evaluated, duly following the standard procedure.

7.8.5 Elements of Onsite Emergency Plan

Important elements considered in this plan are:

- Identification of emergencies
- Emergency organization
- Emergency facilities
- Emergency procedures
- Communications during emergency
- Rescue, Transport and Rehabilitation

- Roles and responsibilities of key personnel and essential employees
- Mutual aid.

7.8.5.1 Emergencies Identified

Spillage, pool fire, are the possible emergencies in the pipelines, fire near storage, DG set, and Transformers are the other possible emergencies.

The other emergencies are asphyxiation of persons, apart from risks due to cyclonic conditions, earth quake, lightning, floods (natural calamities), sabotage, bombing (social and other reasons) etc. which are not under the management control.

Priority of protection in the event of an emergency is; Life and safety of personnel, preservation of property, restoration of normalcy.

7.8.5.2 Emergency Organization

The project employs a total of 120people in 3 shifts. The general shift will be for the administrative employees, while the three shifts of 8 hours each are for technical employees. Key personnel and essential employees are identified and are assigned emergency responsibilities.

Security personnel, all operators, fitters, electricians etc. in the shifts are designated essential employees. During emergencies, their services are drafted for essential operations.

7.8.5.3 Emergency Facilities

a) Emergency Control Center (ECC)

It is a location where all key personnel like Chief Coordinator, Emergency controller, maintenance coordinator can assemble and monitor aspects related to emergency and take decisions related to emergency. The office room is designated as ECC. In case if this area is affected, zone security room is designated as alternative ECC.

The following information and facilities would be maintained at the ECC in Plant Control room:

Latest copy of Onsite Emergency Plan and Offsite Emergency Plan (as provided by District Emergency Authority)

- Intercom Telephone;
- P& T Telephone;
- Telephone directories (internal and P&T);
- Factory Layout, site plan;
- P&I diagrams, electrical connections plans indicating locations of hazardous inventories, sources of safety equipment, hydrant layout, location of pump house, road plan, assembly points, vulnerable zones, escape routes;
- Hazard chart;
- Emergency shutdown procedures for generators and fuel supply system;
- Nominal roll of employees;
- List and addresses of key personnel;
- List and addresses of emergency coordinators;
- List and addresses of first aid providers;
- List and addresses of employees trained in firefighting;
- List and addresses of qualified trained persons;
- Material safety data sheets of raw materials;
- Duties of key personnel;
- Important addresses and telephone numbers including those of fuel supplying company, government agencies, neighboring industries and other sources of help, outs side experts;

b) Assembly points

Office room is identified as Assembly point and is in a low intensity fire affected zone. Additionally the following places in plan are designated as safe assembly points: Time office, and green belt area near the main road. The locations of assembly points would be reviewed later.

c) Firefighting Facilities

The firefighting facilities which shall be provided are presented in **Table 7.13.**

Table 7.13 List of Fire Extinguishers

S.No	Description of Item	Quantity
1.	DCP 10 kg	10 Nos.
2.	CO_2 22.5 kg	5Nos.
3.	CO_2 6.8 kg	5 Nos.
4.	Fire Buckets with stand	15 Nos.

d) Location of First aid Boxes

The first aid boxes will be located at the following places: preparation areas, administrative office, time office, and will be under the charge of security coordinator.

e) Emergency siren

Emergency siren will be provided with 0.5 km range of audibility and the location will be time office. The siren will operate on regular supply and also on emergency electrical supply. Shift electrical engineer of plant on receipt of information from shift in-charge, is authorized to operate the siren.

f) Emergency escapes

Emergency escapes in the plant area and floor wise emergency escapes will be conspicuously marked.

g) Wind sock

Wind socks to observe the wind directions will be installed on the top of Turbine Plant house.

7.8.5.4 Emergency Procedures

a) Procedure for Raising Emergency alarm

Whenever and whoever notices an emergency or a situation with a potential emergency should forthwith raise alarm by calling on the available communication network or shouting or approaching the shift in-charge, furnishing details. Anybody noticing fire should inform the plant control room immediately. The shift electrical engineer at control room informs the site controller.

b) Control Room staff

If an emergency is reported then plant control room staff must, request for the location, nature and severity of emergency and obtain the caller's name, telephone number, and inform the shift in-charge or site controller who ever are available in the shift.

c) Emergency communication

The following communications will be used during emergencies; P&T Telephones, intercom, walkie-talkies, hand bell and siren. If any of the equipment is not working, runners would be engaged to send the communication.

d) Warning/Alarm Communication of emergency

Emergency siren would be operated to alert all other employees on the orders of manager (electrical). The emergency is communicated by the Emergency siren mode of wailing for 3 minutes. When the emergency has been brought under control, the Emergency controller will direct plant control staff giving an 'all clear signal', by way of normal siren (continuously for 3 minutes).

7.8.5.5 Rescue and Rehabilitation

Emergency vehicle will be made available round the clock under the charge of manager (electrical) who is emergency coordinator. Security personnel are trained in rescue operations. Persons rescued would be taken to First aid centre for further medical attention or Safe Assembly Points as per the condition of the rescued person.

a) Transport Vehicles and Material Trucks

The transport vehicles and vehicles with materials would immediately withdraw to outside the factory. Security guard of the shift is responsible for this. Transport vehicles would wait at the security at the main entrance to provide emergency transport. This is ensured by security coordinator.

b) Mock drill

Occasional mock drill is essential to evaluate that the ONSEP is meeting the objectives. Adequate training is given to all staff members before conducting the mock drill. Mock drills will be initiated with table top exercise, followed by pre-informed mock drills, and few uninformed mock drills in the first phase. Functional exercises (communication, Emergency shut down, fire fighting at different locations, rescue etc.) are carried out in the second phase.

Mock drills will familiarize the employees with the concept and procedures and help in evaluating their performance. These scheduled and unscheduled mock drills are conducted during shift change, public holidays, in night shift once in 6 months. Response time, strict adherence to discharge of responsibilities, difficulties and inconsistencies experienced are recorded and evaluated. Fire officer will assists Emergency coordinator in designing and extending such mock drills and in evaluating the response.

c) Review

The Emergency plan is reviewed periodically to evaluate the effectiveness, and during change in organizational structure, isolation of equipment for longer duration, and during increase in inventory of fuel and other chemicals. Manger Electrical and Emergency coordinator initiates and authorizes such review as and when required, and the changes if any will be duly informed to all the employees concerned.

7.8.6 Remedial Action

The cause of emergency is identified and action is taken from operation point of view such as isolating or shutdown etc.

I. **<u>Failure of pipelines</u>:** feeding into the pipeline is stopped. Isolate the leaking pipeline by closing the relevant valves. Transfer the material present to other pipelines. Shutdown the pump. Close the suction and discharge valves of the pump

II. **<u>Personal Protection</u>:** The people, who are assigned to the rescue operations, must wear suitable personnel protective equipment such as self-contained breathing apparatus and fire suit. They should remain in the incident area as long as he can safely stay there. In spite of the wearing safety protective equipment if he is unable to stay in the contaminated area, he should leave immediately.

7.8.7 BASIC ACTION IN EMERGENCIES

Immediate action is the most important factor in emergency control because the first few seconds count, as fires develop and spread very quickly unless prompt and efficient action is taken.

- Take immediate steps to stop leakage/fire and raise alarm simultaneously.
- Initiate action as per fire organization plan or disaster management plan, based on gravity of the emergency.
- Stop all operations and ensure closure and isolation valves.
- All effort must be made to contain leakage/fire.
- Saving of human life shall get priority in comparison to stocks/assets.
- Plant personnel with specific duties should assemble at the nominated place.
- All vehicles except those required for emergency use should be moved away from the operating area, in an orderly manner by the predetermined route.
- Electrical system except for control supplies, utilities, lighting and fire fighting system should be isolated.
- If the feed to the fire cannot be cut off, the fire must be controlled and not extinguished.
- Start water spray system at areas involved or exposed to fire risks to avoid domino effects.
- In case of leakage of chemicals without fire and inability to stop the flow, take all precautions to avoid source of ignition.

- Block all roads in the adjacent area and enlist police support for the purpose if warranted.

7.8.8 FIRE FIGHTING OPERATIONS

Enlist support of local fire brigade and neighboring industries.

- Firefighting personnel working in or close to unignited vapor clouds or close to fire must wear protective clothing and equipment including safety harness and manned lifeline. They must be protected continuously by water sprays. Water protection for fire fighters should never be shut off even though the flames appear to have been extinguished until all personnel are safely out of the danger area.

- Exercise care to ensure that static charge is not generated in vapor cloud. For this purpose solid jet of water must be avoided, instead fog nozzles must be used.

- Fire fighters should advance towards a fire in down wind direction.

- If the only valve that can be used to stop the leakage is surrounded by fire, it may be possible to close it manually. The attempt should be directed by trained persons only. The person attempting closure should be continuously protected by means of water spraying (thorough fog nozzles), fire entry suit, water jet blanket or any other approved equipment. The person must be equipped with a safety harness and manned lifeline.

- Any rapid increase in pressure or noise level of should be treated as a warning of over pressurization. In such case all personnel should be evacuated immediately.

- In case of any emergency situation, it is of paramount importance to avoid endangering human life in the event of fire, involving or seriously exposing plant equipment.