## RISK ASSESSMENT

An industry with its complex nature of activities involving various plant machineries, raw materials, products, operations, intermediates and environmental discharge has a number of associated hazards. A minor failure can lead to major failure resulting into a disaster causing heavy losses to life, property and environmental. Risk assessment studies are being conducted to ensure safety and reliability of any new plant, through a systematic and scientific methods to identify possible failures and prevent their occurrences before they actually cause disasters and production loss.

## OBJECTIVITES OF THE STUDY

The distillery involves storage and handling of large quantity of alcohol which is flammable under unfavorable situations. To ensure safe operation of the plant, it is proposed to carry out the Risk Analysis Study with the following objectives,

1. To identify the major hazards relating to fire, explosion and toxicity due to storage and handling of Alcohol.
2. To visualize maximum credible accident scenarios
3. To analyze and quantify primary and secondary effects and damage potentials of the identified maximum credible accident scenarios using standard procedure.
4. To study the nature of exposures, pathways and consequences of maximum credible accident scenarios and characteristics of risk levels.
5. To provide guidelines for disaster management plan.

Risk assessment studies have been carried out to assess the worst case scenarios of the plant operations to formulate an emergency management plan.

## PRELIMINARY HAZARD ANALYSIS

Technical information on project including plant, process, and material is given in Chapter-2.

Preliminary Hazard analysis is used to identify typical and often relatively apparent risk sources and damage events in a system. Hazards of significant nature whose consequence potential is of worth consideration, where in a specified area or where, more number of personnel likely to be present etc, is considered in identifying hazards. Alcohol being an organic solvent is flammable. Based on the preliminary hazard identification, the storage and handling facilities of alcohol has been recognized as distinctive and relatively evidential risk source. Loading and unloading from storage and forwarding of alcohol may lead to containment failure for various reasons. Such situation can cause fire or explosions depending upon the situation.

## 1. Characteristics of alcohol

Rectified spirit (RS), Absolute Alcohol and Extra Neutral Alcohol (ENA) are basically ethanol of different grades and have the same hazard characteristics. Hence, all these products are considered as ethanol in hazard analysis. Alcohol is a clear, colorless and flammable liquid. It has the boiling point of 78 $^0$C, ignition point of 365 $^0$C and explosive limits of 3.3 % - 19.0 % by volume. The characteristics of ethanol are given

**General Characteristics of Alcohol**

| | |
|---|---|
| Physical State | Liquid |
| Appearance | Clear |
| Color | Colorless |
| Physical Form | Volatile Liquid |
| Odour | Alcohol odour |
| Taste | Burning taste |
| Molecular Weight | 46.07 |
| Molecular Formula | $CH_3$ $CH_2OH$ |
| Boiling Point | 173.07 $^0$F ( 78.37 $^0$C) |
| Freezing point | -173 $^0$F (-78.33 $^0$C) |
| Vapor Pressure | 40 mm Hg @ 19 ºC |
| Vapor Density | 1.59 kg/m$^3$ |
| Specific Gravity | 0.789 g/cm$^3$ (at 25 $^0$C) |
| Water Solubility | Soluble |

| | |
|---|---|
| Volatility | 100 % |
| Odour Threshold | 5 – 10 ppm |
| Viscosity | 1.22 – 1.41 cp @ 20 $^{0}$C |
| Solvent Solubility | Benzene, ether, acetone, chloroform, methanol, organic solvents |

**2. Fire Hazard of Alcohol**

Alcohol falls under flammable category of high intensity. The probable fire hazard in the plant is in the areas of alcohol storage and handling. In case of leaks, invisible vapours spread easily and are set on fire by ignition sources. Therefore, it is important to control or eliminate all potential ignition sources in areas that might lead to ignition of vapour. All forms and types of energy can be considered a potential ignition source. The management will exert close control over the storage and handling of the ethanol. This is best done by proper training of personnel, confinement of the liquids and associated vapors to selected areas, ventilation to prevent vapor build up, control of potential ignition sources, and protection of the area with an extinguishing system.

**3. Potential Sources of Ignition**

The potential sources of ignition are:

- Open flames
- Electrical wiring / devices
- Smoking
- Heat sources / Hot surfaces
- Welding and cutting
- Friction
- Sparks and Arcs
- Static sparks
- Gas Compression.
- Lightning effect

**Precaution against Ignition**

Following are some of the precautions that will be taken to minimize the probability of ignition:

- Electrical equipment and wiring should be suitable to avoid hazard.
- If a heating operation is necessary, use only indirect heating methods.
- Do not allow any open flames.
- Provide grounding and bonding for all equipment handling using these liquids.
- Maintenance program will be established to assure that all equipment and safety controls are functioning satisfactorily.

**4. Health Hazards of Alcohol**

The following acute health effects may occur

- Can affect when breathed in and by passing through skin
- May cause mutations
- Can irritate the skin. Repeated contact can dry the skin with cracking, peeling and itching
- Exposure can cause headache, nausea, a feeling if heat and drowsiness, Higher exposure can cause unconsciousness
- Exposure can irritate the eyes, nose, mouth and throat
- Breathing of alcohol can irritate the lungs causing coughing and/or shortness of breath.

**Threshold limit value for Alcohol**

| Alcohol | OSHA | NIOSH | ACGIH |
|---|---|---|---|
| 8 – hour exposure | 1000 ppm | 1000 ppm | 1000 ppm |

The Threshold limit value of the alcohol is 30 to 50 ppm it is well within the permissible exposure level as per ACGIH recommendation

**5. Alcohol Storage Details**

Details of storage conditions and hazardous nature of alcohol are given below.

### Storage Conditions and Nature of Hazard

| Hazardous Chemical | Physical State | Material of Construction | Storage Pressure | Hazardous Nature |
|---|---|---|---|---|
| Alcohol | Liquid | MS/SS | Atmospheric. | Flammable & Toxic |

**Hazard Rating of Alcohol**

The rating of large number of chemicals based on flammability, reactivity and toxicity have been given in National Fire Protection Association codes 49 and 345 M. The NFPA rating for the ethanol is given below,

**NFPA Hazard Rating**

| CHEMICAL | NH (Health Factor) | NF (Fire Factor) | NR (Reactivity) |
|---|---|---|---|
| Alcohol | 2 | 3 | 0 |

(Least-0, Slight-1, Moderate-2, High-3, Extreme-4)

**IDENTIFICATION OF POSSIBLE HAZARDS**

In order to identify hazards the following two methods have been used.

- Identification based on storage and handling of Alcohol.
- Identification involving relative rating technique through Fire Explosion and Toxicity Index

**i. IDENTIFICATION** (Based On Manufacture, Storage and Import of Hazardous Chemical Rules, GOI Rules 1989)

In order to determine applicability of GOI Rules 1989 to the notified threshold quantities, analysis of products and quantities of storage in the plant has been carried out.

| Product | Listed In Schedule | Total Quantity | Threshold Quantity | | Applicable Rule |
|---|---|---|---|---|---|
| | | | Rules 5,7-9 and 13-15 | Rule 10-12 | |
| Alcohol | 1 (2) | 6000 KL (4800 T) | 1000 t | 50000 t | Rule 5, 7-9 and 13-15 |

Based on the above, it is noted that ethanol produced and stored in the plant attract the rules of GOI 1989.

### ii. IDENTIFICATION INVOLVING RELATIVE RATING TECHNIQUE

(Through Fire Explosion and Toxicity Index.)

Fire Explosion & Toxicity Indexing (FETI) is a rapid ranking method for identifying the degree of hazard. The basic objectives that characterize Fire Explosion and Toxicity Index are,

- Identification of equipment within the plant that would contribute to the initiation or escalation of accidents.
- Quantification and classification of the expected damage potential of fire explosion and toxicity index in relative terms.
- Determination of area of exposure.

In preliminary hazard analysis, alcohol is considered to have Toxic and Fire hazards. The application of FETI would help to make a quick assessment of the nature and quantification of the hazard in these areas. Before hazards index is applied, the installation in question is sub divided into logical, independent elements or units. The unit is logically characterized by the nature of the process that takes place in it.

Fire explosion and Toxicity Index is a product of Material Factor and Hazard Factor. Material factor represents the flammability and reactivity of the chemicals. The hazards factor itself is a product of general process and special process hazard.

Respective Material Factor (MF), General Hazard Factors (GHF), Special Process Hazard factors (SPH) are computed using standard procedure of awarding penalties

based on storage, handling and reaction parameters. Material factor is a measure of intrinsic rate of potential energy release from fire and explosion produced by combustion or other chemical reaction. General factor is a measure of intrinsic rate of potential energy release from fire and explosion produced by combustion or other chemical reaction.

**General Process Hazard**

The plant activities, which contribute to a significant enhancement of potential for Fire and Explosion, have been identified. The measured values of penalties have been added to obtain the value of General Process Hazard as given IN DOW's Fire & Explosion Index Hazard classification guide.

**Special Process Hazard**

The Special Process Hazard includes the factor that contributes the probability and occurrence of accident. They are:

- Process temperature
- Low pressure
- Operation in or near flammable range
- Operation pressure
- Low temperature
- Quantity of Flammable and toxic material
- Corrosion and erosion
- Leakage, Joints

FEI (Fire Explosion Index) = MF x (1 + GPH) x (1 + SPH)

**Classification of Hazards into Categories**

By comparing the indices Fire and/or Toxicity to the criteria in the following table the unit in the question classified in one of the three categories established for this purpose.

**Dows Fire and Explosion Index Hazard Classification, Degree of Hazard for F & E I**

| F & EI Range | Degree of Hazard |
|---|---|
| 01-60 | Light |
| 61-96 | Moderate |
| 97-127 | Intermediate |
| 128-158 | Heavy |

| | |
|---|---|
| 159 and more | Severe |

Based on the above, the degree of potential hazard based on DOW's classification for alcohol is given below.

| Section | Material Factor | General Process Hazard | Special Process Hazard | Fire & Explosion Index | Radius of Explosure M | Category of Potential Hazard |
|---|---|---|---|---|---|---|
| Alcohol | 16 | 2.85 | 2.6 | 118.56 | 30 | Intermediate |

**Toxicity Index**

Toxicity index is primarily based on the index figures for health hazards established by the NFPA in codes NFPA 704, NFPA 4 n and NFPA 325 m. NFPA Index figures of toxicity factor for Health Hazard index Nh are given below:

| NFPA Index | Toxicity Factor |
|---|---|
| 0 | 0 |
| 1 | 50 |
| 2 | 125 |
| 3 | 250 |
| 4 | 325 |

NFPA Health hazard index of ethanol is 2, which give toxicity factor of 125. In addition, the toxicity factor has to be corrected for the Maximum Allowable Concentration (MAC) values of the toxic substance by adding a penalty Ts. Ts values are arranged according to the following Criteria.

| MAC (ppm) | Penalty Ts |
|---|---|
| < 5 | 125 |
| 5-50 | 75 |
| > 50 | 50 |

MAC value for ethanol is 1000 ppm. Toxicity index is evaluated suing the following equation

$$\text{Toxicity Index} = \frac{Th + Ts\,(1+GPH+SPH)}{100}$$

By comparing the indices of FEI and Toxicity index, the unit under consideration is classified into one of the following three categories,

**Classification of FEI and Toxicity Index**

| **Category** | **Fire Explosion Index** | **Toxicity Index** |
|---|---|---|
| Light | <65 | <6 |
| Moderate | 65-95 | 6-10 |
| Severe | > 95 | >10 |

**Fire Explosion and Toxicity Index for Storage Facility**

Fire explosion and Toxicity Index values obtained for rectified Spirit and ENA both combined through FETI are given below:

**Fire Explosion and Toxicity Index for Storage Facility**

| Section | Quantity Processed | Material Factor | Fire Explosion Index | Toxicity Index |
|---|---|---|---|---|
| Alcohol | 6000 KL | 16 | 118.56 | 3.6 |

Degree of Hazard based on Fire explosion and Toxicity indices computed for the storage units is categorized as below:

**Degree of Hazard**

| **Section** | **Fire Explosion** | **Toxicity** |
|---|---|---|
| Alcohol | Intermediate | Light |

**Minimum Preventive and Protective Measures for Fire and Explosion**

Based on the categorization of Degree of Hazard, the following minimum preventive and protective measures are recommended.

| **Features** | **Light** | **Moderate** | **FE & I Rating** | | **Severe** |
|---|---|---|---|---|---|
| | | | **Intermediate** | **Heavy** | |

| | | | | | |
|---|---|---|---|---|---|
| Fire Proofing | 2 | 2 | 3 | 4 | 4 |
| Water Spray Directional | 2 | 3 | 3 | 4 | 4 |
| Area | 2 | 3 | 3 | 4 | 4 |
| Curtain Special Instr. | 1 | 2 | 2 | 2 | 4 |
| Temperature | 2 | 3 | 3 | 4 | 4 |
| Pressure | 2 | 3 | 3 | 4 | 4 |
| Flow Control | 2 | 3 | 4 | 4 | 4 |
| Blow down-spill | 1 | 2 | 3 | 3 | 4 |
| Internal Explosion | 2 | 3 | 3 | 4 | 4 |
| Combustible gas Monitors | 1 | 2 | 3 | 3 | 4 |
| Remote Operation | 1 | 2 | 2 | 3 | 4 |
| Dyking | 4 | 4 | 4 | 4 | 4 |
| Blast and Barrier wall separation | 1 | 2 | 3 | 4 | 4 |
| 1= Optional 2=Suggested 3=Recommended 4= Required | | | | | |

**HAZARD ANALYSIS**

**1. MAXIMUM CREDIABLE ACCIDENT ANALYSIS**

Maximum Credible Accident Analysis (MCA Analysis) is one of methodologies evolved to identify worst credible accident with maximum damage distance which is still believed to be probable. The analysis does not include quantification of probability. The following is an attempt in that direction.

Hazardous substance may be released as a result of failures or catastrophes, causing damage to the surrounding area. The physical effects resulting from the release of hazardous substances can be calculated by means of models. The results thus obtained through modeling are used to translate the physical effects in terms of injuries and damage to exposed population and environment.

The probable fire hazard in the plant is in the area of ethanol and is due to storage and handling. It is proposed to store about 60 day’s production of both the products within a common dyke of 40x55 m. As a worst case it is assumed that the entire contents are leaked out. In the event of spilling its contents through a small leakage or due to rupture of the pipeline connecting the tank and on ignition fire will eventually forming pool of fire. In order to assess the radiation levels, Heat Radiation model has been used the algorithm of the models is based on the formulae published in the yellow book by the TNO, Netherlands. Details of the model are given below:

**2. Heat Radiation Model – Pool Fire**

The heat load on objects outside the burning pool of liquid can be calculated with the heat radiation model. This model uses an average radiation intensity which is dependent on the liquid. Account is also taken of the diameter to height ratio of the fire, which depends on the burning liquid. In addition, the heat load is also influences by the following factors:

**3. Distance from the fire**

The relative humidity of the air (water vapour has a relatively high heat absorbing capacity)

**4. Visualization and Simulation of Maximum Accidental Scenarios**

The worst case scenario which is considered for MCA analysis is Pool fire due to failure of storage of alcohol storage tanks in the farm area. The proposed industry will provide 10 days storage of the final product within the plant premises.

As a worst case it is assumed that the entire contents are leaked out. In the event of spilling its contents through a small leakage or due to rupture of the pipeline connecting the tank and on ignition fire will eventuate forming pool fire. As the tanks are provided within the dyke the fire will be confined within the dyke wall.

Fires affect surroundings primarily through radiated heat, which is emitted. If the level of heat radiation is sufficiently high, other objects, which are inflammable, can be ignited. In addition, any living organism may be burned by heat radiation. The damage caused by heat radiation can be calculated from the dose of radiation received, a measure of dose is the energy per unit area of surface exposed to radiation over the duration of exposure.

### 5. Effects of Pool Fire

Pool fire may result when bulk storage tanks will leak/burst, and the material released is ignited. As these tanks are provided with dyke walls to contain the leak and avoid spreading of flammable material, the pool fire will be confined to the dyke area only. However, the effects of radiation may be felt to larger area depending upon the size of the plant and quantity of material involved.

Thermal radiation due to pool fire may cause various degrees of burns of human bodies. Moreever, their effects on objects like piping, equipment are severe depending upon the intensity. The heat radiation intensities due to the pool fire of the above tank farms are computed using the pool fire model. The results obtained are presented in the following Table.

**Pool Fire Scenarios and Radiation Distances**

| **Alcohol Storage Tanks Farm** | **Quantity of Storage : 4700 KL** |
|---|---|
| | **Dyke area : 40 m x 50 m** |
| **Damage Criteria** | **Damage Distance** |
| 100 % Lethality (35.5 $kW/m^2$) | 5.0 |
| 50% Lethality (25.0 $kW/m^2$) | 25.0 |
| 1 % Lethality (12.5 $kW/m^2$) | 65.0 |
| First Degree burns ( 4.5 $kW/m^2$) | 140 |
| Normal Intensity with no discomfort (1.6 $kW/m^2$) | 170 |

| **Sl. No.** | **Type of Damage** | **Incident Radiation Intensity ($kW/m^2$)** |
|---|---|---|
| 1 | i. Spontaneous ignition of wood | 62.0 |
| 2 | ii. Sufficient to cause damage to process equipment. | 37.5 |
| 3 | iii. Minimum energy required to ignite wood at infinitely long exposure(non piloted) | 25 |

| | | |
|---|---|---|
| 4 | iv. Minimum energy required for piloted ignition of wood, melting plastic tubing | 12.5 |
| 5 | v. Sufficient to cause pain to personnel if unable to reach cover within 20 seconds; however blistering of skin (1st degree burns) is likely. | 4.5 |
| 6 | vi. Will cause no discomfort to long exposure | 1.6 |
| 7 | vii. Equivalent to solar radiation | 0.7 |

**6. Damage Criteria for Heat Radiation**

The following table indicates likely damage level for different levels of heat radiations:

**7. Critical Radiations of Interest on Human Body**

| | |
|---|---|
| Un protected skin continuous | 1.5 $kW/m^2$ |
| Blisters in skin at 30 sec | 5 $kW/m^2$ |
| Protected skin | 5 $kW/m^2$ |
| Special protection | 8 $kW/m^2$ |

For continuous presence of persons, thermal radiation intensity levels of 4.5 kW /$m^2$ for plant operators and 1.6 $kW/m^2$ for outside population are usually assumed. These criteria are followed where peak load conditions may occur for a short time but mostly without warning. If the operators are properly trained and clothed, they are expected to run to shelter very quickly. For the secondary fires, a thermal incident radiation of 12.5 kW / $m^2$ is adopted as minimum criteria.

**8. Physiological Effect of Threshold Thermal Doses**

The effects of heat radiation depend upon the intensity and duration of exposure. Intensity and duration put together is the thermal dose. The consequences on human body for different thermal doses are tabulated here:

| Dose Threshold (kW/m2) | Effects |
|---|---|
| 37.5 | 3rd degree burns |
| 25.0 | 2nd degree burns |

| | |
|---|---|
| 4.5 | 1st degree burns |

## CONSEQUENCE ANALYSIS

Consequence analysis is a part of hazard analysis and it provides a relative measure of likelihood and severity of various possible hazardous events and enables those responsible to focus on the potential hazards. For practical purposes, the risk analysis may be based on subjective common-sense evaluation. Thus, this study concerns itself with the adverse effects of accidental and short-term release of hazardous materials on people in the surrounding area. The long-term effects of continuous pollutants are not dealt with.

### 1. Failure Frequencies

Failure rates for various critical equipments are very important in risk assessment. Very limited data in this regard is available in our country. However, Safety and Reliability Directorate of UK and IEEE of USA have certain data in this regard. Relevant data are extracted and used in estimating failure rates leading to release of chemical. This data has different norms such as per hour, per vessel year, failures per year, errors per million operations etc.

### 2. Failure Data

| | |
|---|---|
| Process Control Failure | 3.0 e (-) 5 per hour |
| Process Control Valve | 2.4 e (-) 6 per hour |
| Alarm | 4.6 e (-) 5 per hour |
| Leakage at largest Storage tank | 3.0 e (-) 5 per year |
| Leakage of pipeline (150 mm dia) Full Bore | 8.0e (-) 8 per meter per year |
| Leakage of pipeline (150 mm dia.) 20 % rupture 2.6 e (-) | 8 per meter per year |
| Human failure | 1.8 e (-) 3 demand |

### 3. Probability of Occurrence of Identified Hazards

The probability and consequence for each identified hazard event considering the method and procedure of plant operation and existing infrastructure for hazard control is evaluated.

The following criterion is adopted related to ignition probabilities:

For instantaneous releases, immediate ignition may occur 0.25 times. There could be delayed vapour cloud explosions for such releases, towards residential areas 0.9 times. Flash fire probability is 0.5.

When the release, continuous, the chance of immediate ignition is 0.1 and delayed ignition is 0.75. A directional probability of 0.2 is considered with regards to wave propagation direction in case of explosions.

**4. Ignition Sources of Major Fires**

| | |
|---|---|
| Electrical Wiring | 23% |
| Smoking | 18% |
| Friction-bearings/broken parts | 10% |
| Overheated materials | 08% |
| Hot surfaces-boilers-lamps | 07% |
| Burner flame-torch | 07% |
| Combustion sparks | 05% |
| Spontaneous ignition | 04% |
| Cutting, Welding | 04% |
| Exposure fires | 03% |
| Incendiaries | 02% |
| Mechanical sparks | 02% |
| Molten substances | 01% |
| Chemical action | 01% |
| Static charge | 01% |
| Lightning | 01% |

| | |
|---|---|
| Miscellaneous | 01% |

**5. Site Specific Consequences**

In order to assess the site-specific consequences, information pertaining to the site such as nearest habitation, nearest industry etc was collected. The nearest village to the plant site is Alaganchi village with a population of about 2000 located at distance of 2.0 km from the plant site in the West direction. Site specific consequence analysis of failure cases are carried out with the objective to study how many persons are involved in an accident and are likely to get killed or injured, or how large is the area which is likely to be destroyed or rendered unusable so that a true assessment of the safety of the plant can be made.

**6. Consequences of Heat Radiation – Alcohol Storage Tanks Failure**

Failure of alcohol storage tanks showed 100%, 50% and 1% lethality upto a distance of less than 85m due to radiation intensity of 37.5 $kW/m^2$, 25.5 $kW / m^2$, and 12.5 $kW /m^2$. Radiation of this intensity will cause damage to process equipment.

Radiation intensity of 4.5 $kW/m^2$ which cause first degree burns when exposed for 20 seconds will extend to a maximum distance of 160 m from the edge of the pool. Nearest Habitation is located at a distance of 2.0 km from the plant site. Therefore the pool fire scenario of storage tank farm does not call for offsite damage. However the major effect will be on the onsite personnel. The employees located with the 4.5 $kW/m^2$, contour will get affected. As the project is located for away from any human habitation and surrounded by dry lands & hillocks with scrubs the offsite damage to the general public and property is negligible.

**FIRE FIGHTING FACILITIES IN ALCOHOL PLANT**

**1. POSSIBLE FIRE HAZARDS**

i. Fire in fuel/bio-mass storage yard
ii. Fire in Alcohol storage tanks Electric static electricity and consequent fire accident.

**2. FIRE FIGHTING FACILITIES**

**a. Water Hydrant System**

Fire hydrant system with hose pipe of 7 $kg/cm^2$ pressure with hydrants are located at in bio-mass yard, distillery house, ethanol storage area

- A jockey pump and accessories. 50 $m^3/hr$ at 90 m head
- Corrosion protected M.S. underground piping 150 mm dia. and 100 mm and around the plant as closed loop
- 8 nos. single headed hydrants distributed around the plant at about 30 m spacing to supply pressurized water for fire fighting.
- 10nos. MS hydrant hose cabinet adjacent to each section.

**b. Fire Extinguishers**

Foam water : 2 each at main office and store.

$CO_2$ type : 6 nos. one each at departmental office and electrical installations.

DCP type : 8 nos. each at distillery plant and power plant.

Sand buckets: At different locations

**c. Fire Protective Appliances**

Two sets of fire safety appliances each consisting of following units are located at store and alcohol storage, respectively.

- Face masks & gas masks (2),
- Face shield (2),
- Helmet (6),
- Safety belts (2),
- Safety ladder (1)

**d. Fire Brigade**

Fire brigade facilities available at Nanjangud and Mysore will be utilized whenever need arises.

**DISASTER MANAGEMENT PLAN (DMP)**

The project includes the existing sugar unit and power and proposed expansion of distillery unit. A comprehensive DMP will be implemented in the industry as presented below.

**OBJECTIVES**

Even though all safety measures are adopted, the hazards leading to emergency situations are likely occur in the industries under unforeseen circumstances. The project proponents are therefore prepared an "Emergency Management Plan" (EMP) for the proposed industry with the main objective to keep the organization in a state of readiness to contain the emergency and its cascading effect and to bring the incident under control with priority to saving of life, preventing injury and loss of property and also to bring back the plant to normality and working condition. EMP is the systematic information along with a set of instructions and preparatory details to meet such eventualities with a view to contain it to be minimum in terms of damage or loss to health, life, property within the industry or outside the industry. In the distillery, the eventualities are likely to cause emergency situation confined to the industry itself, and therefore, on-site emergency management plan is prepared for the proposed industry. Before starting to prepare the EMP it is ensured that all the necessary standards and codes of safety including electrical, insurance etc., are followed from the design stage itself in the industry. For convenience of planning the emergencies are classified in to on-site and off-site emergencies.

**1. ON-SITE EMERGENCY**:

It consists of those situations affecting one or more plants of the industrial facility and manageable by a planned resources of the industry itself.

**2. OFF-SITE EMERGENCY:**

It consists of more serious situations affecting several plants of the industry, even spreading outside and requiring outside assistance including state or national level resources mobilization to manage them.

In the distillery, the eventualities are likely to cause emergency situation confined to the industry itself, and therefore, on-site emergency management plan is prepared for the proposed industry.

**3. PROJECT FEATURES**

Knowledge of manufacturing process, plant, machineries and layout plan of plant and site are required for planning emergency management and these are given in Chapter-2.

**RISK ASSESSEMENT**:

To work out EMP, it is necessary to assess the risk involved in and around the proposed industry. The detailed information on risk assessment is furnished in Chapter-7.2.

**ORGANIZATION**

**TABLE 7.1 Organization Chart**

| **Chief Controller of Disasters (Factory General Manager)** | | | | | |
|---|---|---|---|---|---|
| Team-1 | Team-2 | Team-3 | Team-4 | Team-5 | Team-6 |
| Area Co-Ordinator | Medical Co-Ordinator | Material Co-Ordinator | Fire-Safety Co-Ordinator | PR Co-Odinator | Security Co-Ordinator |
| Distillery Manager | Chemist | Civil Engineer | Power plant Manager | HR Manager | Security Officer |

**DUTY ALLOCATION**

**1. Chief Disaster Controller (General Manager)**

- Take control and declare emergency
- Be there
- Contact Authorities

2. **Area Co-ordinator**

- Take steps. Make Emergency shut-down of activities. Put everything in Safe condition.
- Evacuate.
- Commence initial fire-fighting, till Fire Department comes to take up.
- Identify materials requirements and call Material Manager.

**3. Medical Co-Ordinator**

- Establish Emergency Center, Treat affected persons, Transfer/Remove Patients
- Assign and Deploy staff
- Contact Authorities

**4. Material Co-Ordinator**

- Dispatch necessary Supplies
- Arrange Purchases

**5. Fire & Safety Co-Ordinator**

- Be Overall incharge for Fire and Safety.
- Coordinate with Area Coordinator and Direct the Operations
- Coordinate with City and Other Fire-tenderers.

6. **PR & Security Co-Ordinator**

- Remove Crowd
- Arrange Gate security
- Contact Police
- Arrange evacuation
- Contact outside Agencies if asked.
- Handle news media
- Mobilize vehicles
- Arrange Food, clothing’s to Officers inside.

## 7. Emergency Control Center

- Adequate Internal phones
- Adequate external phones
- Workers Tally
- Map showing hazardous storages, Fire safety equipments, Gates and side gates, Assembly points, List of persons.

## 8. Action on Site

- Evacuate. Non-essential people first at Assembly point
- Persons Accounting
- Record of Next-of-kins
- Public Relation

## 9. Post Disaster Analysis.

- Why happened
- Whether on-site operations failed? In what respect?
- How to avoid such failure in future
- Report to be submitted in detail to Authorities
- Compensation arrangements if any, commenced?
- Call suggestions on shortfalls observed.
- Give rewards openly, pull defaulters individually