RISK ASSESSMENT

7.0 Introduction

Distillery Industry is associated with potential hazards that effect to the employee and environment. It would normally require the assistance of emergency services to handle it effectively. The operation shall be taken out under the well management and control by the qualified safety manager.

Disaster management plan has to be formulated with an aim of taking precautionary steps to avert disasters and also to take such action after the disaster which limits the damage to the minimum.

7.1 Risk Assessment

Risk assessment study for the 130 KLPD distillery project done for construction and operational Phase.

7.1.1 Risk during Construction Phase

Construction phase of the proposed expansion of the project is divided into following activities:

a. Site Leveling;
b. Construction of Roads;
c. Excavation;
d. Construction of building;
e. Construction of high-rise structure (i.e. Stack);
f. Material Handling (Loading and Un loading);
g. Cutting and Welding; and
h. Installation of Machineries.

Risk and mitigation measures during the construction phase is given in **Table 7.1**

Table 7.1: Risk and Mitigation Measures during the Construction Phase

Activity	Hazards	Risk	Mitigation Measures
Site Leveling	Due to heavy vehicle movement accident may happen. Snakes may bites to workers.	Physical injury, Life loss and organ damage	Providing PPEs to workers Appointing the qualified persons for the particular job. Speed limit control

Activity	Hazards	Risk	Mitigation Measures
			Providing Training
Construction of Road	Loading and Unloading of material may cause accident. Heavy Vehicle movement may cause accident. Hot material cause burn injury.	Physical Injury Life loss Burn	Providing PPEs to workers Appointing the qualified persons for the particular job. Valid license for Heavy vehicle operator will be mandatory. Speed limit control Providing Training
Excavation	• Excavation collapses • Excavated material • Falling objects or objects near an excavation • Powered mobile equipment • Slips, trips, and falls • Hazardous atmospheres • Flooding/water hazards • Underground facilities	Property Loss Physical injury Life loss	Work Permit System will be followed. Only experienced person will asset to team. Excavated material will be stacked safely. Area will be barricaded. Training will be Provided to all workers PPEs will be provided. Unauthorized person entry will be banned.
Construction of building	Heavy Material may fall down during loading and unloading Structure may fall down if poor practice done Waste stored in open may cause cut in feet Storage of fuel may cause fire Workers may fall down from the height.	Physical Injury Life loss Physically handicapped Property Loss	Work permit system will be adopted. PPEs will be provided to all workers. IS code will be followed for Building construction. Fuel will be stored separately area will be isolated from ingenious material. Fire extinguisher will be provided Height work permit will be issued to the person. Safety belt will be provided to workers working on above 1.8 M height. Adequate trainings will be provided for specific job works.
Construction of high-rise structure	Material may fall down Fall Hazards	Physical injury Life loss	High rise structure will be constructed as per detailed

Activity	Hazards	Risk	Mitigation Measures
(i.e. 60-m height Stack);			engineering drawing. Safety belt will be provided to workers working on above 1.8 M height. Height work permit will be implemented Proper training will be provided for scaffolding. PPEs will be provided.
Material Handling (Loading and Un loading)	Extra weight lifting can cause strain in body mussels	Physical Injury	Material will lift as per safety norms. PPEs will be provided.
Cutting and Welding	Welding, cutting, and allied processes produce molten metal, sparks, slag, and hot work surfaces can cause fire or explosion if precautionary measures are not followed. Electric shock from electrical welding and cutting equipment can result in death or severe burns. Gas cylinder can cause fire accident.	Physical Injury Burn Injury Property loss Life loss	Hot work permit will follow. Standards Work Procedure will be developed. Training will be provided Job will be assigned to only authorized person Proper PPEs will be provided. Loose connection will be avoided. Area will be barricaded Gas cylinder will be stored as per guidelines
Installation of Machineries.	Due to over load lifting belt break out Un authorized operator of Lifting and Crain can create an emergency During placement of machinery structure may collapse	Property loss Physical Injury Life loss	Only authorized person will operate the machine Appropriate Belt will be used for lifting of material During lifting and placing of material area will be man free. Appropriate platform will be designed as per the load bearing calculation.

Additional Risk control Measures

- Detailed Construction Hazard Identification Risk Assessment study will be done and accordingly safety manual will be prepared.
- First aid facility will be provided.

- 24 hrs Ambulance facilities will be provided.
- Safety Gate meeting will be conducted.
- Authorized contractor will be selected.
- Safety officer will be appointed.
- Training to the workers will be provided.
- Top to bottom safety culture will be developed.
- Safety slogan and instruction will be pasted at appropriate location.
- Emergency control Numbers will be provided inside the project site at various locations.
- All safety instruction will also be provided to all contractors.

7.1.2 Risk during Operational Phase

Activities requiring assessment of risk due to occurrence of most probable instances of hazard and accident are both onsite and off-site.

On-site

- Exposure to fugitive dust, noise, and other emissions.
- Housekeeping practices requiring contact with solid and liquid wastes.
- Emission/spillage etc. from storage and handling.
- Unsafe condition and unsafe act.

Off-site

- Exposure to pollutants released from offsite/ storage/related activities
- Contamination due to accidental releases or normal release in combination with natural hazard
- Deposition of toxic pollutants in vegetation / other sinks and possible sudden releases due to accidental occurrences

7.1.3 Risk Analysis Methodologies

Risk assessment often requires the synthesis of risk profiles, which represent the probability distribution of total annual loss due to a certain set of events or activities. These assessments usually involve estimation of losses for several sub-classifications of the overall process and synthesis of the results into an aggregate risk profile.

Main risk assessment technologies are:

- Hazard and operability study (HAZOP), and
- Fault Tree Analysis (FTA)

HAZOP Study

The HAZOP study is a systematic technique of identifying hazards of operability problems of a process and lists all possible deviations from normal operating condition and how they might occur. The consequences of the process are assessed and the means available to detect and correct the deviations are examined. Thus, within the entire process all "credible" deviations that could lead to hazardous events or operability problems are identified.

Fault Tree Analysis (FTA)

FTA is primarily a means of analyzing non-identifiable hazards. Hazards of top events (the ultimate happening that is to be avoided) are first identified by other techniques such as HAZOP. Then all combinations of individual failures that can lead to that hazardous event show the logical format of the fault tree. Estimating the individual probabilities and then using the appropriate arithmetical expressions can calculate the top event frequency.

Hazard Identification and Risk Assessment (HIRA)

There are three steps used to manage health and safety at work:

1. Spot the Hazard (Hazard Identification)
2. Assess the Risk (Risk Assessment)
3. Make the Changes (Risk Control)

Spot the Hazard

A hazard is anything that could hurt you or someone else.

Examples of workplace hazards include:

- Frayed electrical cords (could result in electrical shock);
- Boxes stacked precariously (they could fall on someone);
- Noisy machinery (could result in damage to your hearing).

Assess the Risk

Assessing the risk means working out how likely it is that a hazard will harm someone and how serious the harm could be.

For example:

- Ask your supervisor for instructions and training before using equipment;
- Ask for help moving or lifting heavy objects;
- Tell your supervisor if you think a work practice could be dangerous.

Make the Changes

The best way to fix a hazard is to get rid of it altogether. This is not always possible, but your employer should try to make hazards less dangerous by looking at the following options (in order from most effective to least effective):

- **Elimination** - Sometimes hazards - equipment, substances or work practices - can be avoided entirely. (e.g. Clean high windows from the ground with an extendable pole cleaner, rather than by climbing a ladder and risking a fall.)
- **Substitution** - Sometimes a less hazardous thing, substance or work practice can be used. (e.g. Use a non-toxic glue instead of a toxic glue.)
- **Isolation** - Separate the hazard from people, by marking the hazardous area, fitting screens or putting up safety barriers. (e.g. Welding screens can be used to isolate welding operations from other workers. Barriers and/or boundary lines can be used to separate areas where forklifts operate near pedestrians in the workplace.)
- **Safeguards** - Safeguards can be added by modifying tools or equipment, or fitting guards to machinery. These must never be removed or disabled by workers using the equipment.
- **Instructing workers in the safest way to do something** - This means developing and enforcing safe work procedures. Students on work experience must be given information and instruction and must follow agreed procedures to ensure their safety.
- **Using personal protective equipment and clothing (PPE)** - If risks remain after the options have been tried, it may be necessary to use equipment such as safety glasses, gloves, helmets and ear muffs. PPE can protect you from hazards associated with jobs such as handling chemicals or working in a noisy environment.

Sometimes, it will require more than one of the risk control measures above to effectively reduce exposure to hazards.

Risk Classification Table: Based on Likelihood/Controls Rating x Severity Rating

Almost certain	5	5	10	15	20	25
Likely	4	4	8	12	16	20
Possible	3	3	6	9	12	15
Unlikely	2	2	4	6	8	10
Rare	1	1	2	3	4	5
Likelihood / Control Rating		1	2	3	4	5
		Severity Rating				

The definition of risk level and acceptance criteria is given below:

	Risk level	Category	Acceptability on necessry action and timescale
LOW RISK	1 – 3	Low	No additional controls are required unless they can be inplemented at very low cost (in terms of time, money and efforts), actions to further reduce these risks are assigned low priority. Arrangements should be made to ensure that the controls are maintained.
Moderate RISK	4 – 8	Medium	Consideration should be given as to whether the risks can be lowered, but the costs of additional risk reduction measures should be taken into account. The risk reduction measures should be implemented within a defined time period. Arrangement should be made to ensure that the controls are maintained, particulary if the risk levels are associated with extremely harmful consequences and very harmful consequences.
HIGH RISK	09 – 14	High	Substantial efforts should be made to reduce the risk. Risk reductino measures should be implemented urgently within a defined time period and it might be necessary to consider suspending or restricting the activity, or to apply interim risk contrls ar maintained, controls. Arrangements should be made to ensure that the controls are maintained, particulatly if the riks levels are associated with extremely harmful consequences and very harmful consequences.
	15 – 25	Very high	These risks are unacceptable. Substantial improvements in

			risk controls are necessary, so that the risk is reduced to an acceptable level. The work activity should be halted until risk controls are implemented that reduce the risk so that it is no longer very hign. If it is not possible to reduce risk the work should remain prohibited.

Review of HIRA Study

- At least once in a year;
- Amendments / addition in legal requirements;
- Change in process or products handled;
- Internal and external audit results, including Specialized / Third Party Audits;
- Occurrence of accident, emergency;
- While initiating any corrective and preventive action;
- While purchasing and erecting any new equipment / machinery / building.

7.2 Potential Risk Area assessment in 130 KLPD distillery Plant

The potential risk area inside the plant is given in **Table 7.2.**

Table 7.2: Potential Risk Area inside the Plant

Block/Area	Hazards Identification
Fuel Storage Area	Fire, Spontaneous Combustion, Dust emission
Boiler	Fire (mainly near oil burners), steam; Explosions, Fuel Explosions
Turbo-Generator Buildings	Fires in - a) Lube Oil systems b) Cable galleries c) Short circuits in i) Control Rooms ii) Switchgears Explosion due to leakage of Hydrogen and fire following it. Fire in Oil Drum Storage
Storage of LDO/HFO	Fire
Fermentation area	Fire, Short Circuits
Distillation	Fire
MEE area	Linkage of Hot Steam
Storage of Product	Fire

7.2.1 Model Used for Fire Radiation Analysis

The gas/liquid released in the vicinity of the storage area may be as a result of rupture in cylinders, mechanical defect and external interference. **Radiation Pool fire model** has been used to estimate radiation intensity distances for LDO and ENA.

Damage Criteria

The fuel storage and unloading at the storage facility may lead to fire and explosion hazards. The damage criteria due to an accidental release of any hydrocarbon arise from fire and explosion. The vapors of these fuels are not toxic and hence no effects of toxicity are expected.

Tank fire would occur if the radiation intensity is high on the peripheral surface of the tank leading to increase in internal tank pressure. Pool fire would occur when fuels collected in the dyke due to leakage gets ignited.

Fire Damage

A flammable liquid in a pool will burn with a large turbulent diffusion flame. This releases heat based on the heat of combustion and the burning rate of the liquid. A part of the heat is radiated while the rest is convicted away by rising hot air and combustion products. The radiations can heat the contents of a nearby storage or process unit to above its ignition temperature and thus result in a spread of fire.

The radiations can also cause severe burns or fatalities of workers or fire fighters located within a certain distance. Hence, it will be important to know beforehand the damage potential of a flammable liquid pool likely to be created due to leakage or catastrophic failure of a storage or process vessel. This will help to decide the location of other storage/process vessels, decide the type of protective clothing the workers/fire fighters' need, the duration of time for which they can be in the zone, the fire extinguishing measures needed and the protection methods needed for the nearby storage/process vessels.

Table-7.3 tabulates the damage effect on equipment and people due to thermal radiation intensity.

Table-7.3 :Damage due to Incident Radiation Intensities

S. No.	Radiation Intensity (kw/m^2)	Type of Intensity Damage (m)
1	Greater than 10.0	Potential Lethal within 60 sec
2	Greater than 5.0	2nd Degree Burns within 60 sec
3	Greater than 2.0	Pain within 60 Sec

Storage of LDO

Bulk storages for LDO and storage of raw materials are separately located. Single 2.0 KL capacity tank is located to store the fuel oil. Failure of hose pipe or catastrophic failure of any storage tanks can result in spread out of the contents. The details of release of LDO from the storage facilities are presented in **Table 7.4**. If these vapours come in contact with source of ignition, it can result in a major fire and intensities of radiation of this fire are computed to know the damage distances and to assess the risk involved. The damage distances for LDO have been estimated for instantaneous spill; the result is presented in **Table-7.5** and is shown in **Figure-7.1**.

Table-7.4: Release of LDO from the Storage Facilities

Scenario	Release of Quantity of LDO
One Storage tank on fire	2.0 KL

Table - 7.5: Radiation Intensities vs. Distance for LDO (2.0 KL)

Radiation Intensity (kw/m^2)	Distance from the Centre of the Pool (m)
Greater than 10.0	9.90
Greater than 5.0	13.0
Greater than 2.0	21.0

Storage of ENA

Bulk storage for ENA of raw materials is separately located. 2840 KL capacity tanks ENA will be located near the Production building. The details of release of ENA from the storage facilities are presented in **Table 7.6**. If these vapours come in contact with source of ignition, it can result in a major fire and intensities of radiation of this fire are computed to know the damage distances and to assess the risk involved. The damage distances for ENA has been estimated for instantaneous spill; the results are presented in **Table-7.7**and are shown in **Figure-7.2**.

Table-7.6: Release of ENA and Sprit from the Storage Facilities

Scenario	Release of Quantity of LDO
storage tank for ENA	2840 KL

Table - 7.7: Radiation Intensities vs. Distance for ENA

Radiation Intensity (kw/m^2)	Distance from the Centre of the Pool (m)
Greater than 10.0	44.0
Greater than 5.0	61.0
Greater than 2.0	94.0

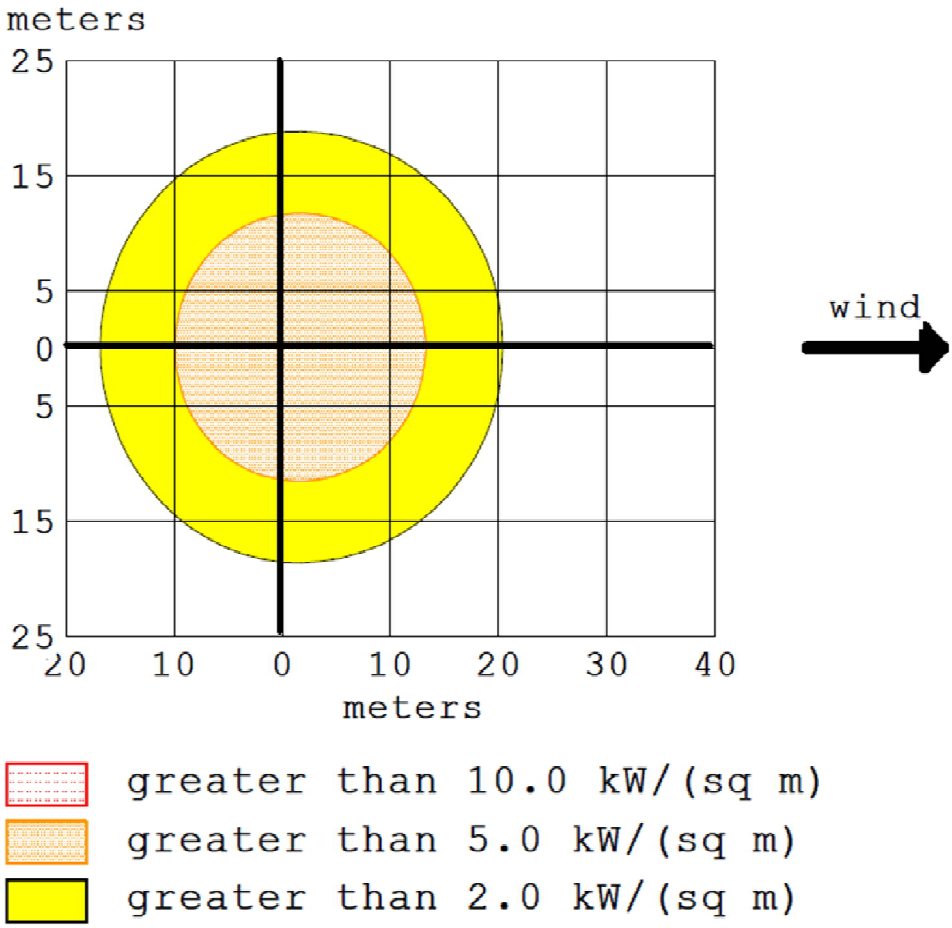

Figure 7.1: Radiation Intensity vs Distance for LDO (2.0 KL)

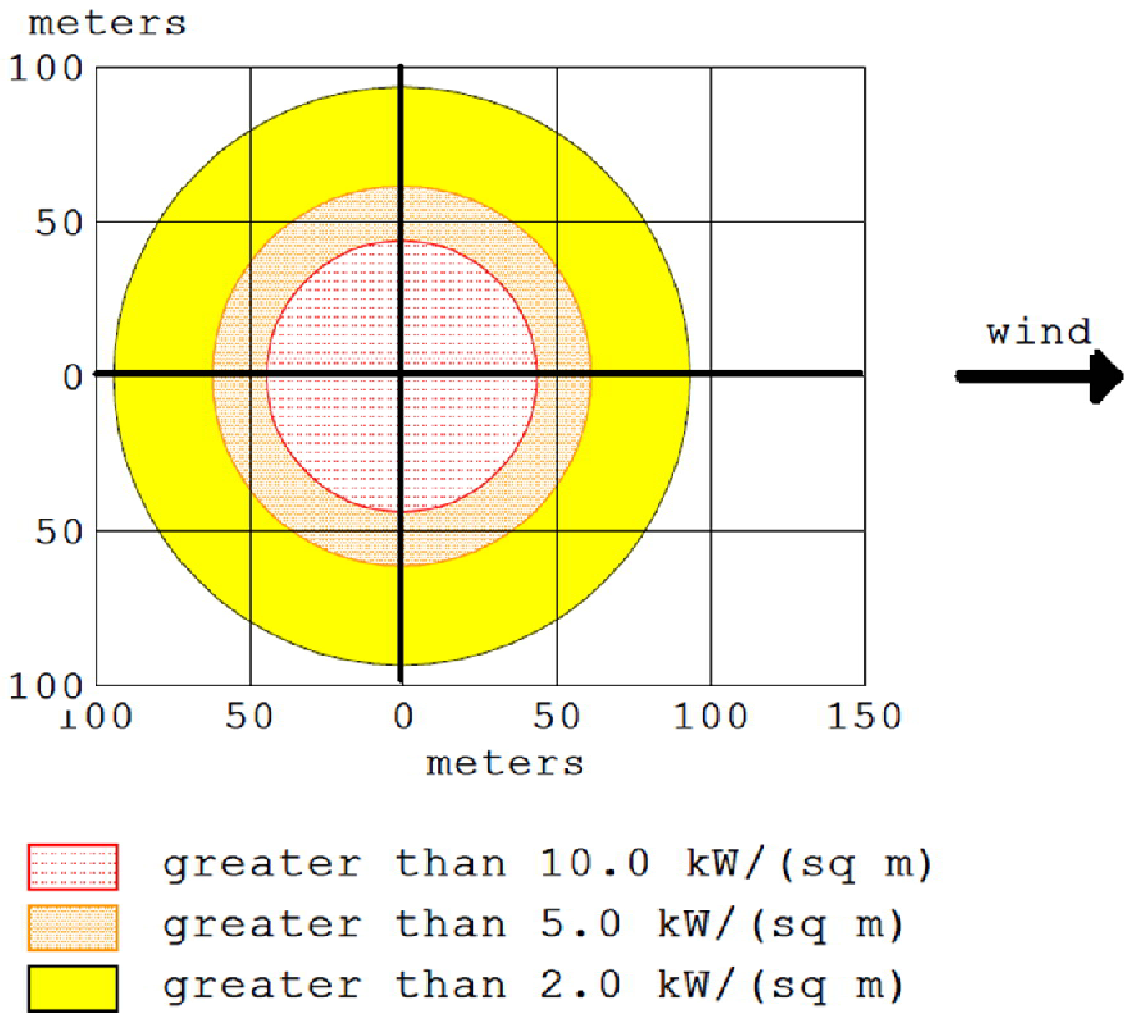

Figure 7.2: Radiation Intensity vs Distance for ENA

7.3 Disaster Management Plan

7.3.1 Definition

A major emergency in an activity/project is one which has the potential to cause serious injury or loss of life. It may cause extensive damage to property and serious disruption both inside and outside the activity/project. It would normally require the assistance of emergency services to handle it effectively.

7.3.2 Scope

An important element of mitigation is emergency planning, i.e. identifying accident possibility, assessing the consequences of such accidents and deciding on the emergency procedures, both on site and off site that would need to be implemented in the event of an emergency.

Emergency planning is just one aspect of safety and cannot be considered in isolation from the proposed 130 KLPD capacity Grain based ethanol unit and hence before starting to prepare the plan, works management will ensure that the necessary standards, appropriate to safety legislation, are in place.

7.3.3 Objective

The overall objectives of the emergency plan will be:

- To localize the emergency and, eliminate it; and
- To minimize the effects of the accident on people and property.

Elimination will require prompt action by operations and works emergency staff using, for example, fire–fighting equipment, water sprays etc.

Minimizing the effects may include rescue, first aid, evacuation, rehabilitation and giving information promptly to people living nearby.

7.3.4 Identification of Hazards

The following types of hazards may be identified at Ethanol plant.

- Fire in Electric Panels, Oil room and alcohol storage.
- Waste treatment processes.
- Cleaning of barrels, which have held chemical substances.

To deal the above emergencies, the Emergency Plan is prepared.

7.3.5 Safety Measures for Storage and Handling of Alcohol

The alcohol will be directly fed to the bottling unit mechanically and no manual handling will be involved which will reduce the risk of spillage in the storage area. Following precautionary measures would be taken for safety

- **Handling and Storage;** Keeping away from heat, sparks and open flame, care will be taken for avoidance of spillage, skin and eye contact, well ventilation, Use of approved respirator if air contamination is above acceptable level will be promoted. For Storage and handling following precautions will be taken:

- Keeping away from oxidizers, heat and flames.
- Avoidance of plastics, rubber and coatings in the storage area.
- Cool, dry, and ventilated storage and closed containers.
- Grounding of the container and transferring of equipment to eliminate static electric sparks.

In case of any emergency following measures would be taken:

- **First Aid Measures**: For Skin contact, Eye contact, and Inhalation.
- **Fire Fighting Measures:**

- Use of extinguishing media surrounding the fire as water, dry chemicals (BC or ABC powder), CO_2 Sand, dolomite, etc
- Foam System for firefighting will be provided to control fire from the alcohol storage tank. The foam thus produced will suppress fire by separating the fuel from the air (oxygen), and hence avoiding the fire and explosion to occur in the tank. Foam would blanket the fuel surface smothering the fire. The fuel will also be cooled by the water content of the foam.
- The foam blanket suppresses the release of flammable vapors that can mix with the air.
- Special Fire Fighting Procedures; Keeping the fire upwind. Shutting down of all possible sources of ignition, keeping of run-off water out of sewers and water sources. Avoidance of water in straight hose stream which will scatter and spread fire. Use of spray or fog nozzles will be promoted, cool containers will be exposed to flames with water from the side until well after the fire is out.

- Hazardous Decomposition Products: gases of Carbon Monoxide (CO) and Carbon Dioxide (CO_2).

➢ **Accidental Release Measures;** For Spill Cleanup well Ventilation, Shutting off or removal of all possible sources of ignition, absorbance of small quantities with paper towels and evaporate in safe place like fume hood and burning of these towels in a safe manner), Use of respiratory and/or liquid-contact protection by the Clean-up personnel will be promoted.

7.4 Emergency Planning

7.4.1 General

Disaster Management Plan for an industrial unit is necessarily a combination of various actions which are to be taken in a very short time but in a present sequence to deal effectively and efficiently with any disaster, emergency or major accident with an aim to keep the loss of men, material, plant/machinery etc. to the minimum.

The main functions of the Disaster Management Cell are to prepare a detailed Disaster Management Plan, which includes:

➢ Identification of various types of expected disaster depending upon the type of the industrial unit.

➢ Identification of various groups, agencies, departments etc. necessary for dealing with a specific disaster effectively.

➢ Preparation – by intensive training of relevant teams/groups within the organization to deal with a specific disaster and keep them in readiness.

➢ Establishment of an early detection system for the disaster.

➢ Development of a reliable instant information/communication system.

➢ Organization and mobilization of all the concerned departments/ organizations / groups and agencies instantly when needed.

➢ A major disaster that can be expected due to fire in this proposed distillery.

7.4.2 Emergency Planning for Disaster due to Fire

Cable rooms, transformer, unit, auxiliary transformers, oil tanks, etc. within the plant are the likely areas for which disaster management plan is to be made to deal with any

eventuality of fire. Stores, workshop, canteen and administrative building will be included.

7.4.2.1 Classification of Fire

Class (A)

Fire involving combustible materials like wood, paper, cloth etc.

Class (B)

Fire due to liquid materials like oil, diesel, petroleum products and all inflammables.

Class (C)

Fires involving domestic and industrial gases like butane and propane etc.

Class (D)

Metal fires etc.

Class (E)

Electrical fires due to short circuiting etc.

7.4.3 Need of Establishing a Fire Fighting Group

A small spark of fire may result into loss of machines and the damage by fire may high economic losses. This type of losses can be avoided by preventing and controlling the fire instantly for which fire–fighting group will be established.

Establish which would house and keep in readiness, the following types of equipment and arrangements.

- CO_2 extinguishers
- Dry powder chemical extinguishers
- Foam extinguishers
- 80 mm. spray hoses
- Fire brigade
- Fire hydrant
- Protocol (chemical to combat oil fires).

In order to avoid fire in cable galleries, all the power and control cables of FRLS type (Fire Resistant Low Smoke) will be used.

7.4.4 Inspection

Fire alarm panel (electrical) will cover the entire plant. The inspection group will periodically inspect fire extinguishers in fire stations and machines and other places.

The groups will display emergency telephone number boards at vital points.

The group will regularly carry out general inspection for fire.

7.4.5 Procedure for Extinguishing Fire

The following steps will be taken during a fire accident in the system:

As soon as the message is received about fire, one of the systems will be diverted to the place of the fire accident along with a staff member.

Simultaneously plant fire station will be informed by phone walkie for fire brigades and fire stations of nearby area.

In the meanwhile, the pipe system will be operated to obtain maximum pressure on output. In case cables are within the reach of fire, power supply will be tripped and the cables shifted.

7.4.6 Fire Fighting with Water

Adequate and reliable arrangement is required for fighting the fire with water such as:

1. Provision for Fire brigade and Fire hydrant.
2. Arrangement of pipelines along and around all vulnerable areas.
3. Provision of valves at appropriate points to enable supply of water at the required place/area or divert the same to another direction/pipe line.
4. Provision of overhead tanks which will be providing with the water during power failure and it would work by the gravitational force.

7.4.7 Sources of Water for Fire Fighting

The following two sources of water have been considered for firefighting:

- Overhead Tank
- Raw Water Reservoir

7.4.8 Fire Fighting with Fire Extinguishers

To deal with fire – other than carbonaceous fires, which can be deal with by water – suitable fire extinguishers are required to do the job effectively. It is therefore,

necessary to keep adequate number of extinguishers in readiness at easily approachable places. Adequate number of fire stations would be:

- Further, other spray groups from the system will be diverted to the spot.
- In case of fire in the belt, belt will be cut near the burning portion to save the remaining parts.
- After extinguishing the fire, the area will be well prepared for reuse.
- Foam System for firefighting will be provided to control fire from the alcohol storage tank. The foam thus produced will suppress fire by separating the fuel from the air (oxygen), and hence avoiding the fire and explosion to occur in the tank. Foam would blanket the fuel surface smothering the fire. The fuel will also be cooled by the water content of the foam.
- The foam blanket suppresses the release of flammable vapors that can mix with the air.

7.5 On–Site Emergency Plan

7.5.1 Introduction

The views of the possible hazards that can arise out of the daily operations in the distillery plant, various measures are adopted to prevent the occurrence of a major accident. This comprises of:

- Built in safety measures, alarms, trips and interlocks etc.
- Standard safe operating and maintenance procedures permit system etc.
- Training of all the involved staff in normal and emergency operating procedures.
- Training of all employees in safety, fire fighting and first aid.

However, in spite of these precautions, it is required to foresee situation of major accident and plan for taking timely action to minimize the effects of such incident on the safety and health of persons working in the plant as well as those living around the premises.

7.6 Preparation of Plan

7.6.1 Alarm System

A siren shall be provided under the control of Security office in the plant premises to give warning. In case of emergencies this will be used on the instructions to shift in

charge that is positioned round the clock. The warning signal for emergency shall be as follows:

- Emergency Siren: Waxing and waning sound for 3 minutes.
- All clear signal: Continuous siren for one minute.

7.6.2 Communication

Walkies and Talkies are located at strategic locations; internal telephone system EPBX with external P&T telephones would be provided.

7.6.3 Fire Protection System

7.6.3.1 Fire Fighting System

The fire protection system for the unit is to provide for early detection, alarm, containment and suppression of fires. The fire detection and protection system has been planned to meet the above objective an all–statutory and insurance requirement of Tariff Advisory Committee (TAC) of India. The complete fire protection system will comprise of the following.

(a)Fire brigade

Automatic / manual fire detection and alarm system

(b)Fire Hydrant

Fire hydrant will be provided at all around in the plant as per TAC Norms.

(c)Portable fire extinguishers

Various areas of the plant will have one or more of the above system depending upon the particular nature of risk involved in that area.

(d)Portable Chemical Fire Extinguishers

These are intended as a first line of defense, and hence will be stationed at strategic locations in different buildings and also for outdoor facilities. Portable fire extinguishers will be foam type; carbon dioxide type and multipurpose dry chemical (MPDC) type.

(e)Fire Detection and Alarm System

Fire detection and alarm system an effective means of detection, visual indication of fire location and audible alarm of any fire at its incipient stage. This system will comprise fire alarm panels, automatic fire detectors, manual call points and fire siren (hooter).

The main fire alarm panel will provide both visual and audible alarm of fire in any protected areas of the plant.

Manual break glass type fire alarms will be provided at strategic locations where high hazards exits.

Automatic fire detectors will be provided for coal handling areas and in plant areas such as control rooms, switchgear rooms, cable galleries etc.

7.6.4 First Aid

A first aid centre with adequate facilities shall be provided. It shall be maintained round the clock by a compounder cum dresser and a doctor. An Ambulance shall also be provided at site to carry affected people to hospital.

7.6.5 Security

The security requirements of the company premises shall be taken care of by CSO assisted by a Fire In charge. The team, apart from the normal security functions will manage the role required during a disaster management operation as a part of the crisis control team.

7.6.6 Safety

The safety wing led by a Safety Manager will meet the requirement of emergencies round the clock. The required safety appliances shall be distributed at different locations of the plant to meet any eventualities. Poster/placards reflecting safety awareness will be placed at different locations in the plant area.

7.6.7 Evacuation Procedure

As the major hazard is only due to fire, which has more or less localized impact no mass evacuation, procedures are required. Evacuation would involve only the people working very close to the fire area.

7.6.8 Emergency Control Center

Provision is made to establish an Emergency Control Centre (ECC) from which emergency operations are directed and coordinated. This centre is activated as soon as on–site emergency is declared.

The ECC consists of one room, located in an area that offers minimal risk being directly exposed to possible accidents.

During an emergency, the Emergency Management Staff, including the site controller will gather in the ECC. Therefore, the ECC is equipped with adequate communication systems in the form of telephones and other equipments to allow unhampered organisations and other nearby facility personnel.

The ECC provides shelter to its occupants against the most common accidents; in addition, the ECC's communication systems are protected from possible shutdown. The ECC has its own emergency lighting arrangement and electric communication systems operation.

Only a limited and prearranged number of people are admitted to the ECC, when in use. This eliminates unnecessary interference and reduces confusion.

The ECC is always ready for operation and provided with the equipment and supplies necessary during the emergency such as:

- Updated copies of the On–site Disaster Management Plan.
- Emergency telephone numbers.
- The names, phone number, and address of external agencies, response organizations and neighbouring facilities.
- The adequate number of telephone (more than two).
- Emergency lights, Clocks, Personal protective equipment.
- List of fire extinguishers with their type no. and location, capacity, etc.
- Safety helmets – List of quantity and location.
- Status boards/message board.
- Material safety data sheets for chemicals handled at the facility.
- Several maps of the facility including drainage system for surrounding area showing:

❖ Areas where hazardous materials are stored.

❖ Plot plans of storage tanks, routes of pipelines, all water permanent lines etc.

❖ The locations where personal protective equipment are stored.

❖ The position of pumping stations and other water sources.

❖ Roads and plant entrances.

❖ Assembly areas and layout of Hydrant lines.

7.6.9 Communication Equipments and Alarm Systems

This kind of equipment is absolutely vital for notifying accident; make the emergency known both inside and outside of the facility, and coordinating, the response actions among the various groups involved in response operations.

In particular, this equipment is used to communicate within the facility; communicate between the facility and outside organizations; and inform the public.

Different communications systems can vary in effectiveness, depending on the task. The most common types installed in the plant are given below.

7.6.9.1 Sirens

These are audible alarm systems commonly used in facilities. In case of any emergency siren will be operated short intermittently for 1.5 minutes.

An alarm does more than just emergency warning. It also instructs people to carry out specific assignments, such as reach to assembly point for further instructions and actions, or carry out protective measures; this can be achieved only if the people are familiar with the alarm systems and are trained to respond to it.

7.6.10 Personal Protective Equipments

This equipment is used mainly for three reasons; to protect personnel from a hazard while performing rescue/accident control operations, to do maintenance and repair work under hazardous conditions, and for escape purposes. The list of Personal Protective Equipment provided at the facility and their locations are available in ECC.

Effective command and control accomplish these functions necessitates personal trained in this On–site Disaster Management Plan with adequate facilities and equipments and equipment to carry out their duties and functions. These organizations and the facilities required to support their response are summarized in the following subsections.

Emergency Control Plan is given in **Figure 7.4.**

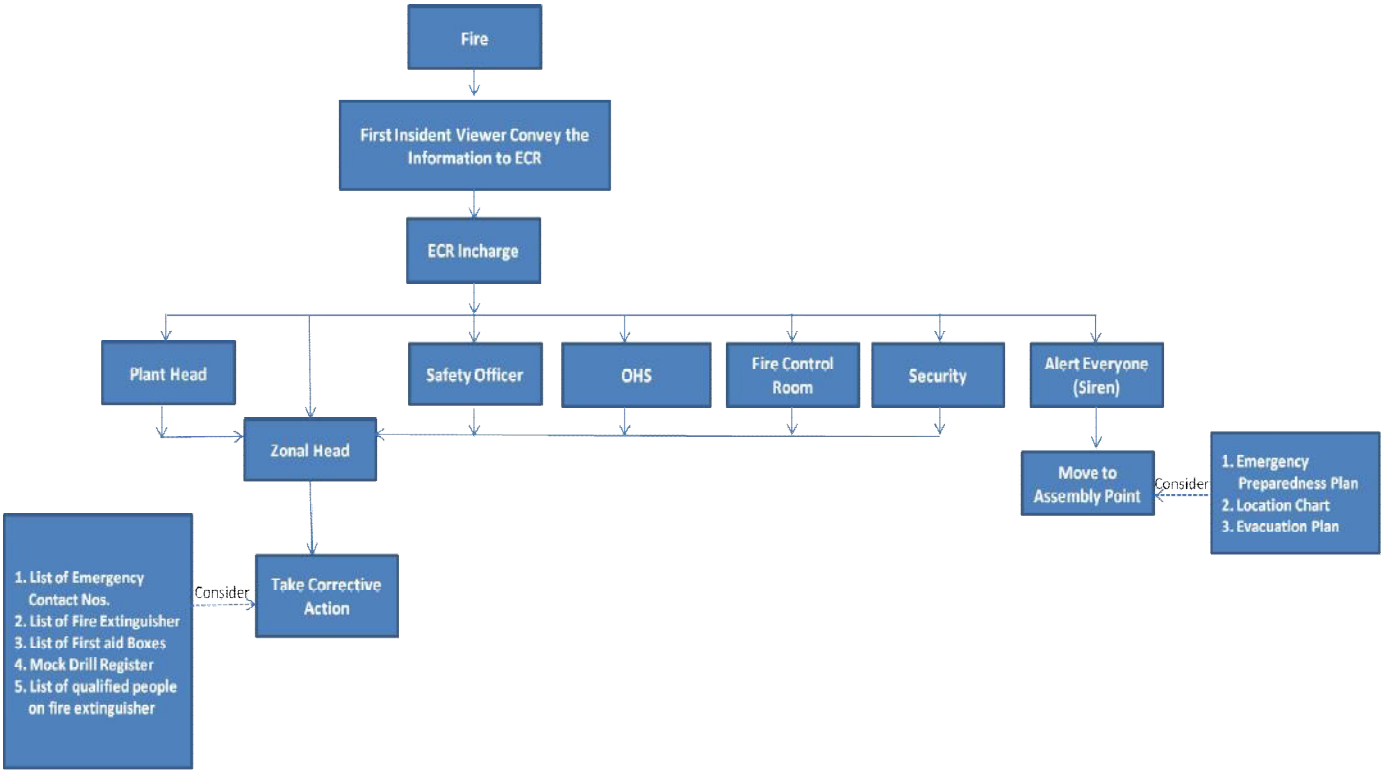

Figure 7.3: Emergency Control Plan

7.6.11 Procedure for Testing and Updating the Plan

Simulated emergency preparedness exercises and mock fire fighting exercises including mutual aid scheme resources and in conservation with district emergency authority to be carried out time to time.

7.6.12 Disclosure of Information to Worker and Public Awareness System in Existence and Anticipated

- Safety awareness among workers by conserving various training programmes and Seminars, competition, slogans etc.
- Practical exercise.
- Distribution and practices of safety Instructions.
- Safety Quiz contests.
- Display of Safety Posters and Safety Slogans.
- Developing Safety Instructions for every Job and ensuring these instructions/booklets or manuals by the workers.

7.7 Off-Site Emergency Preparedness Plan

The task of preparing the Off-Site Emergency Plan lies with the district collector; however the off-site plan will be prepared with the help of the local district authorities. The proposed plan will be based on the following guidelines.

Introduction

Off-site emergency plan follows the on-site emergency plan. When the consequences of an emergency situation go beyond the plant boundaries, it becomes an off-site emergency. Off-site emergency is essentially the responsibility of the public administration. However, the factory management will provide the public administration with the technical information relating to the nature, quantum and probable consequences on the neighboring population.

The off-site plan in detail will be based on those events which are most likely to occur, but other less likely events which have severe consequence will also be considered. Incidents which have very severe consequences yet have a small probability of occurrence will also be considered during the preparation of the plan. However, the key feature of a good off-site emergency plan is flexibility in its application to emergencies other than those specifically included in the formation of the plan.

The roles of the various parties who will be involved in the implementation of an off-site plan are described below. Depending on local arrangements, the responsibility for the off-site plan will be either rest with the works management or, with the local authority. Either way, the plan will identify an emergency co-coordinating officer, who would take the overall command of the off-site activities. As with the on-site plan, an emergency control center will be setup within which the emergency co-coordinating office can operate.

An early decision will be required in many cases on the advice to be given to people living “within range” of the accident - in particular whether they should be evacuated or told to go indoors. In the latter case, the decision can regularly be reviewed in the event of an escalation of the incident. Consideration of evacuation may include the following factors.

- In the case of a major fire but without explosion risk (e.g an oil storage tank), only houses close to the fire are likely to need evacuation, although a severe smoke hazard may require this to be reviewed periodically;
- If a fire is escalating and in turn threatening a store of hazardous material, it might be necessary to evacuate people nearby, but only if there is time; if insufficient time exists, people should be advised to stay indoors and shield themselves from the fire.

Aspects to be considered in the Off-Site Emergency Plan

The main aspects, which will be included in the emergency plan, are:

Organization

Details of command structure, warning systems, implementation procedures, emergency control centers.

Names and appointments of incident controller, site main controller, their deputies and other key personnel.

Communications

Identification of personnel involved, communication center, call signs, network, lists of telephone numbers.

Specialized Knowledge

Details of specialist bodies, firms and people upon whom it may be necessary to call i.e. those with specialized chemical knowledge, laboratories.

Voluntary Organizations

Details of organizers, telephone numbers, resources etc

Chemical Information

Details of the hazardous substances stored or procedure on each site and a summary of the risk associated with them.

Meteorological Information

Arrangements for obtaining details of weather conditions prevailing at the time and weather forecasts.

Humanitarian Arrangements

Transport, evacuation centers, emergency feeding, treatment of injured, first aid, ambulances, temporary mortuaries.

Public Information

Arrangements for dealing with the media press office; informing relatives, etc.

Assessment

Arrangements for: (a) collecting information on the causes of the emergency; (b) reviewing the efficiency and effectiveness of all aspects of the emergency plan.

Role of the Emergency Co-coordinating Officer

The various emergency services will be co-ordinate by an emergency coordinating officer (ECO), who will be designated by the District Collector. The ECO will liase closely with the site main controller. Again depending on local arrangements, for very severe incidents with major or prolonged off-site consequences, the external control will be passed to a senior local authority administrator or even an administrator appointed by the central or state government.

Role of the Local Authority

The duty to prepare the off-site plan lies with the local authorities. The emergency planning officer (EPO) appointed will carry out his duty in preparing for a whole range of different emergencies within the local authority area. The EPO will liase with the works, to obtain the information to provide the basis for the plan. This liaison will ensure that the plan is continually kept up-to-date.

It will be the responsibility of the EPO to ensure that all those organizations which will be involved off site in handling the emergency, know of their role and are able to accept it by having for example, sufficient staff and appropriate equipment to cover their particular responsibilities. Rehearsals for off-site plans will be organized by the EPO.

Role of Police

Formal duties of the police during an emergency include protecting life and property and controlling traffic movements.

Their functions will include controlling bystanders evacuating the public, identifying the dead and dealing with casualties, and informing relatives of death or injury.

Role of Fire Authorities

The control of a fire will be normally the responsibility of the senior fire brigade officer who would take over the handling of the fire from the site incident controller on arrival

at the site. The senior fire brigade officer will also have a similar responsibility for other events, such as explosions. Fire authorities in the region will be apprised about the location of all stores of flammable materials, water and foam supply points, and fire-fighting equipment. They will be involved in on-site emergency rehearsals both as participants and on occasions, as observes of exercises involving only site personnel.

Role of Health Authorities

Health authorities, including doctors, surgeons, hospitals, ambulances, and so on, will have a vital part to play following a major accident, and they will form an integral part of the emergency plan.

For major fires, injuries will be the result of the effects of thermal radiation to a varying degree, and the knowledge and experience to handle this in all but extreme cases may be generally available in most hospitals.

Major off-site incidents are likely to require medical equipment and facilities additional to those available locally, and a medical "mutual aid "scheme should exist to enable the assistance of neighboring authorities to be obtained in the event of an emergency.

Role of Government Safety Authority

Factory Inspectors of the region may like to satisfy themselves that the organization responsible for producing the off-site plan has made adequate arrangements for handling emergencies of all types including major emergencies. They may wish to see well documented producers and evidence of exercise undertaken to test the plan.

In the event of an accident, local arrangements regarding the role of the factory inspector will apply. These may vary from keeping a watching brief to a close involvement in advising on operations.

7.8 Occupational Health and Safety

Large industries, in general, and chemical plants in particular where multifarious activities are involved during construction, erection, testing, commissioning, operation & maintenance, the men, materials and machines are the basic inputs. Along with the boons, the industrialization generally brings several problems like occupational health and safety.

Occupational Health

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

Construction & Erection

The occupational health problems envisaged at this stage can mainly be due to constructional accident and noise.

To overcome these hazards, in addition to arrangements to reduce it within TLV's personal protective devices should also be supplied to workers.

Operation and Maintenance

The problem of occupational health, in the operation and maintenance phase is due to Respirable dust and noise. With suitable engineering controls the exposures can be reduced to less than TLV limits and proper personnel protective devices should be given to employees.

The working personnel should be given the following appropriate personnel protective devices.

- Industrial Safety Helmet
- Crash Helmets
- Zero power plain goggles with cut type filters on both ends.
- Zero power goggles with cut type filters on both sides and blue colour glasses
- Chemical goggles
- Welders equipment for eye & face protection
- Cylindrical type earplug
- Ear muffs
- Dust masks
- Canister Gas mask
- Self contained breathing apparatus
- Leather apron
- Aluminized fiber glass fix proximity suit with hood and gloves
- Boiler suit

- Safety belt/lime man's safety belt
- Leather hand gloves
- Asbestos hand gloves
- Acid/Alkali proof rubberized hand gloves
- Canvas cum leather hand gloves with leather palm
- Lead hand glove
- Electrically tested electrical resistance hand gloves
- Industrial safety shoes with steel toe
- Rubber boots (alkali resistant)
- Electrical safety shoes without steel toe and gum boots

Full fledged hospital facilities should be made available round the clock for attending emergency arising out of accidents, if any. All working personnel should be medically examined at least once in every year and at the end of his term of employment. This is in addition to the pre-employment medical examination.

Safety Plan

Safety of both men and materials during construction and operation phases is of concern. The preparedness of an industry for the occurrence of possible disasters is known as emergency plan. The disaster in the plant is possible due to leakage of hazardous chemicals, collapse of structures and fire/explosion etc.

Keeping in view the safety requirement during construction, operation and maintenance phases, power plant has formulated safety policy with the following regulations:

- To allocate sufficient resources to maintain safe and healthy conditions at work;
- To take steps to ensure that all known safety factors are taken into account in the design, construction, operation and maintenance of plants, machinery and equipment;
- To ensure that adequate safety instruction are given to all employees;
- To provide wherever necessary protective equipment, safety appliances and clothing, and to ensure their proper use;
- To inform employees about materials equipment or processes used in their work which are known to be potentially hazardous to health or safety;

- To keep all operations and methods of work under regular review for making necessary changes from the point of view of safety in the light of experience and upto date knowledge;
- To provide appropriate facilities for fist aid and prompt treatment of injuries and illness at work;
- To provide appropriate instruction, training, retraining and supervision to employees in health and safety, first aid and to ensure that adequate publicity is given to these matters;
- To ensure proper implementation of fire prevention methods and an appropriate fire fighting service together with training facilities for personnel involved in this service;
- To organize collection, analysis and presentation of data on accident, sickness and incident involving personnel injury or injury to health with a view to taking corrective, remedial and preventive action;
- To promote through the established machinery, joint consultation in health and safety matters to ensure effective participation by all employees;
- To publish/notify regulations, instruction and notices in the common language of employees;
- To prepare separate safety rules for each types of occupation/processes involved in a project; and
- To ensure regular safety inspection by a competent person at suitable intervals of all buildings, equipment, work places and operations.

Safety Organization

Construction & Erection Phase

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