Chapter – 7

ADDITIONAL STUDIES

7.1 OCCUPATIONAL HEALTH & SAFETY

In order to ensure good health of workers, regular health check-up of the plant workers would be carried out. Occupational health surveillance programme will be taken as a regular exercise for all the employees and their record will be maintained.

Production of Rectified Spirit and ENA and subsequent production of IMFL involve storage handling and use of several chemicals. Some of these chemicals are toxic and hazardous in nature. Information about these chemicals is therefore important for the safety of the employees and the plant. Besides, the health status of the employees is also important which may be affected due to exposure to these chemicals. The exposures may be sudden and accidental or for a long period. In both the cases there will be different health effects. Therefore safety measures dealing with these chemicals are of vital importance.

Following table presents the major chemicals stored and handled in the plant

Table - 7.2.1

IMPORTANT CHEMICALS

S. No.	Name of each substances/chemical used, handled, produced as intermediate or end products raw materials, etc.	Boiling point	Flash point	Fire rating value	Health Rating	Reactivity rating
1.	Sulphuric Acid	290 °C	-	0	3	2
2.	Hydrochloric Acid	85 °C	-	0	3	0
3.	Rectified Spirit	78.4 °C	12 °C	4	-	N.A.
4.	Country Spirit/Rum Spirit	81°C	30 °C	2	-	N.A.
5.	Fusel Oil	137.9 °C	38 °C	2	-	N.A.

Health and Safety aspects of the Chemicals

Ethyl Alcohol : Ethyl Alcohol is a flammable liquid requiring a red label by DOT. Its flash point 12°C (closed cup). Vapour concentration between 3.3% and 19.0% by volume in air is explosive. It reacts vigorously with oxidizing materials. TLV for 8 hr.

is 1000 ppm (ACGIH). Minimum identifiable concentration has been reported as 350 ppm. Exposure to concentrations of 5000 - 10000 ppm results in irritation of eyes and mucous membranes of the upper respiratory tract.

Table – 7.2.2

EFFECT OF ETHYL ALCOHOL

mg/l	ppm	Effects in human
10-20	5300 – 10,640	Some transient coughing and smarting of eyes and nose, not tolerable
30	15,960	Continuous lacrimation and marked coughing; could be tolerated with discomfort.
40	21,280	Just tolerable for short period
> 40	>21,280	Intolerable

There is no evidence that inhalation of ethyl alcohol vapour can cause drunkenness or cause cirrhosis.

Hydrochloric Acid : Hydrochloric Acid is also known as muratic acid, chlorohydric acid, hydrogen chloride. It is a colourless gas or colourless fuming liquid, strongly corrosive. Its Mol.wt is 36.47, melting point -114.3°C, Boiling Point - 84.8°C, Vapour Pressure: 4.0 atm @ 17.8°. Acute Toxicity Data: Oral LD60 (rabbit) = 900 mg/kg; inhal LC50 (rat) = 3124 ppm for 1hr; inhal LC10 (human) = 1300 ppm for 1/2 hr. Toxicity Statement (THR): Irritation to skin, eyes, mucous and via oral and inhale routes. Hydrochloric acid is an irritant to the mucous membrane of the eyes and respiratory tract, and a conc. of 35 ppm causes irritation of the throat after short exposure. Conc. of 50-100 ppm is tolerable for 1 hr. More severe exposures result in pulmonary edema, and often-laryngeal spasm. Conc. of 1,000-2,000 ppm is dangerous, even for brief exposures. Mists of hydrochloric acid are considered less harmful than the anhydrous hydrogen chloride, since the droplets have no dehydrating action. In general, hydrochloric causes little trouble in industry, other than from accidental splashes and burns. It is used as a general-purpose food additive. It is a common air contaminant. Violent reactions with acetic anhydride, 2-amino ethanol, NH_4OH, Ca_3P_2, chlorosulphonic acid, ethylene diamine, ethylene imine, oleum, HClO4, B-propiolactone, propylene oxide, (AgClO4 + CCl4), NaOH, H_2SO_4, U_3P_4, vinyl acetate.Also CaC_2, CsC_2H, Cs_2C_2, Li_6Si, Mg_3B_2, $HgSO_4$, RbC_2H, Rb_2C_2, Na.

Disaster Hazard: Dangerous; reacts with water or steam to produce toxic and corrosive fumes.

Sulphuric Acid: Sulphuric Acid is also known as oil of vitriol, dipping acid. It is a colourless, oily liquid. Formula H_2SO_4. Mol. Wt. is 98.08. Melting Point 330° Boiling Point 10.49°C. Acute Toxicity Data - Oral LD50 (rat) is 2140 mg/kg. [3] Toxicity Statement: MOD via oral route. Extremely irritating, corrosive and toxic to tissue. Contact with the body results in rapid destruction of tissue, causing severe burns. No systemic effects due to continual ingestion of small amounts of this material have been noted. There are systemic effects secondary to tissue damage caused by contact with it. However, repeated contact with dilute solutions can cause dermatitis, and repeated or prolonged inhale of a mist of sulphuric acid can cause an inflammation to the upper respiratory tract leading to chronic bronchitis. Sensitivity to sulphuric acid or mists or vapours varies with individuals. Normally 0.125-0.50 ppm may be mildly annoying and 1.5-2.5 ppm can be definitely unpleasant. 10-20 ppm is unbearable.

In order to prevent the workers of the industrial unit for any kind of accident, following Personnel Protective Equipment has been provided to them;

Goggles: The workers will be asked to use goggles who work on washing of bottles, filling, cap sealing of bottles for protection of their eyes in case bottles are broken.

Rubber Gumboots: These will be provided to person who handles sulphuric acid. Full suit having hand-gloves, goggles, helmet and aprons will be provided.

Face Shield Helmet: The person deputed for welding work will be provided with face shield helmet.

Medical Facilities: The Factory will be provided with the following medical facilities to handle any emergency:

1. Well equipped First Aid Boxes has been provided in each Section of the factory.
2. The First Aid Boxes has been distinctively marked with a Red Cross on greenbackground and contain the following equipment/accessories:
    a) Small sterilized dressings.
    b) Medium size sterilized dressings

c) Large size sterilized dressings

d) Large size sterilized burn dressings

e) Packets sterilized cotton

f) Snake bite Lancet

g) Pair of scissors

h) Bottle of Potassium Permanganate

i) Bottle containing 2% of alcoholic solution of iodine.

j) Bottle of Sol. Volatile having the dose and mode of administration indicated on the label

k) One copy of first aid leaf-let

l) Bandages

n) Adhesive plaster

o) Triangular bandage

p) Packets of safety pins

q) Supply of suitable splints

r) One tournequet

In case of need, factory is having dispensary to give effective medical facility to workers. In dispensary, sufficient stock of medicines has beenmade available to provide to workers in case of any major emergent situation. A vehicle has been always made available to shift the sick/injured person to District Hospital.

7.2 DISASTER AND EMERGENCY RESPONSE MANAGEMENT

Disaster, in this context, means a sudden, accidental event that causes many deaths and injuries. Most disasters also result in significant property damage. Common natural causes of disasters include earthquakes, floods, hurricanes and typhoons, and tornadoes. Tsunamis (popularly, but incorrectly, known as tidal waves), volcanic eruptions, wildfires, and landslides and avalanches rank among the other natural forces that sometimes create disasters.

Not all disasters are produced by the forces of nature. The “man-made” disasters can be traced to explosions, fires, uncontrolled release of hazardous substances/chemicals, acts of war and terrorism, etc., unintentionally or intentionally, triggered by humans.

The disaster management approach entails a National Disaster Framework (a roadmap) covering institutional mechanisms, disaster prevention strategy, early warning system, disaster mitigation, preparedness and response, and human resource development.

Major hazards can be generally associated with the potential of fire, flood, or earthquake. Hazard control system is meant to ensure the avoidance of the hazards, or in case of any mis-happening minimum possible impact on residents and surrounding environment. Disaster, in this situation, may include incidences of flood, earthquake, fire, or disruptive incidents of human extremism. While the incidences of natural disaster are remote, these may result in significant loss of life and property.

Disaster, in this situation, may include incidences of flood, earthquake, fire, or disruptive incidents of human extremism. While the incidences of natural disaster are remote, these may result in significant loss of life and property. The project is fire sensitive and accordingly all the suitable arrangements would be made to contain the incident without any damage, if it happens at any time. Adequate, fire fighting arrangement at micro level will be provided by the management.

Most of the situations are likely to be in the category of *Level 1 Emergency* (a local incident with a likely impact only to immediate surroundings of local site, where the impact radius may not be more than 15 m, such as, local fire, etc.) or *Level 3 Emergency* (an incident with likely impact area extending beyond the boundary limits of the project area, such as, floods, earthquakes, etc.).

On site emergency management will meet the exigency created due to all Level 1 emergencies. Level 3 emergencies need off-site management plan.

The construction specifications adopted by the promoters significantly incorporate fire-retarding properties. Adequate, fire fighting arrangement at micro level will be provided by the promoter. In case of mishap, suitable provisions for emergency evacuation will be incorporated.

Regarding earthquakes, the structures of the project will be got designed designed to include earthquake resistant features. These will be appropriately incorporated while erection of the structures.

To contain the retrospective effects, only government authorities and agencies, at local and state level got to be adequately prepared in its mechanism to contain or minimize

the losses arising thereof.

7.2.1 Risk Assessment

Pioneer Industries Ltd. (Distillery Unit) would be storing around 1000 KL of alcohol in the storage tanks at site. If the alcoholis released into the atmosphere, they may cause damage due to resulting fires or vapor clouds. Analysis has been done for the potential impact if the whole of the alcohol storage is released into atmosphere. The analysis was done with the use of computer software – EFFECT indicating the intensity of heat radiation, duration of fire ball, diameter of cloud and impact area. The results of the assessment as as below;

- Alcohol Storage Tanks – 1000 KL (~ 900000 kgs.)
- Intensity of Heat Radiation – 31.4 KW/m^2
- Duration of Fire Ball – 30.1 seconds
- Diameter of cloud – 558.1 meters

Impact Area due to the heat radiation is as below;

S. No.	**Distance (meters)**	**Max. Thermal Load (KW/m^2)**
1.	306.9	18.4
2.	334.9	14.5
3.	362.8	11.9
4.	390.7	10.0
5.	418.6	8.6
6.	558.1	4.5

Impact on surrounding environment due to heat radiation is as below;

S. No.	**Max. Thermal Load (KW/m^2)**	**Damage**
1.	37.5	100 % lethality, heavy damage to equipment
2.	25	50 % lethality, no piloted ignition

3.	14	Damage to normal buildings
4.	12.5	1 % lethality, piloted ignition
5.	6	Burns
6.	4.5	Non lethal, 1st degree burns

From the above data, it is clear that if whole of the alcohol storage is released into atmosphere, then the impact area would be upto 560 meters. Accordingly, the company has to take preventive measures for the potential risks associated with the storage of alcohol.

7.2.2 Planning for disaster

The management system, at industry level, needs to include;

a) Prevention and control at the onset

b) Setting up an authority, a core group, and control structure

c) Training and capacity building

d) Emergency planning for actions on site

e) Emergency planning for actions off site

f) Preparing a checklist of periodic requirements

g) Resource allocation

7.2.3 Prevention and control

Identification of hazards is the starting point for a system of prevention and control. The causes and sources need to be delineated. The probability and extent (magnitude) of their likelihood will also be estimated.

With this background information, every effort will be made to have a safest possible system, under the given constraints. The identified hazards need to be taken care of by;

a) Incorporating safety and precautionary features at design, execution, and commissioning stages of development

b) Identifying and setting early warning indicators

c) Carrying out preventive measures periodically

d) Identification and regular monitoring of the potentially accident/hazard prone

domains

Additionally, selection/design of vessels, machinery, equipments, pipelines, etc., must take care of the following;

a) Strict adherence to applicable standards and codes regarding performance and safety
b) Selection of appropriate MOC
c) Adequate indicators, proper instrumentation and control system with warning and safety triggering mechanisms

7.2.4 Response planning and management

The overall objectives of and emergency plan are;

a) To localise the emergency, and, if possible, eliminate it
b) To minimise the effects of the disaster on people and property

Emergency plans are separate for on-site and off-site matters, but that should be consistent to each other.

On-site emergency plan includes the following issues;

a) Formulation of the plan and of emergency services
b) Alarm and communication mechanisms
c) Appointment of personnel and definition of duties
d) Emergency control centers
e) Voluntary organizations
f) Chemical/material information
g) Action on site
h) Rehearsing emergency procedures
i) Plan appraisal and updating

An off-site emergency plan will include the detailed information on following aspects;

a) Organization – details of command structure, warning systems, implementation procedures, emergency control centers, details of the key officers.
b) Communications – identification of personnel involved, communication centre, call signs, networks, list of telephone numbers, etc.

c) Specialized emergency equipment

d) Specialized knowledge

e) Meteorological information

f) GIS based database

g) Humanitarian arrangements

h) Public information

i) Assessment

7.2.5 Fire protection system

The following systems of fire protection are proposed to be provided for the power plant:

a) Fire alarm system

b) Fire containment

c) Hydrant system for the entire plant

d) High velocity water spray (HVWS) system

e) Carbon dioxide flooding system

f) Portable fire extinguishers.

7.2.5.1 Fire alarm system

A fire alarm system has been installed to provide visual and audible alarm in the plant for fire detection at the incipient stage. This system comprise manual call points located at strategic locations in areas which are normally manned, and automatic smoke and heat *detectors* located at important points such as the cable vault, the control room, switchgear room etc., to detect fire at an early stage, and provide visual and audible alarm.

7.2.5.2 Fire containment

Strategic areas in the plant have been separated by adequately rated firewalls. All openings for switchgears and cable entry have been sealed by fireproof seals to preventspread of fire from one area to another.

7.2.5.3 Reserve water storage for fire demand

Reserve storage of 500 m^3has been provided in the treated effluent storage tank with asuitable partition to cater to the water requirements of the fire protection system.

7.2.5.4Hydrant system

The hydrant system comprises the following:

a) Four pumps, two motor driven and two diesel engine driven, each of 10 m^3/hour, capacity have been provided to keep both the hydrant and HVWS system mains pressurized. These pumps will take the suction from the water storage tank.

b) External as well as internal fire hydrants in all areas of the industry.

7.2.5.5 High velocity water spray system

The HVWS system has been provided for the fuel storage area. Since the parameters for the HVWS system will be identical to that of the hydrant system, the diesel engine driven pump described in the hydrant system serve as a common standby for both HVWS system and hydrant system.The HVWS system consists of a number of high velocity water projectors. Smoke and heat detectors have been used strategically.

7.2.5.6 Portable fire extinguishers

Wall/column mounted type portable fire extinguishers in various areas of the plant including the control room, administration building, canteen, stores, workshop, etc. have been provided. These portable fire extinguishers are basically of carbon dioxide and dry power type.

7.2.6 Lightening protection system

A lightning protection system has been provided as per IS:2309 and Indian Electricity Rules. The protections consist of roof conductors, air terminals and down- comers, and would be provided for high-rise (of more than 10 m height) structures.

7.2.7 Safety earthing system

A safety earthing system consisting of a buried mild steel conductor earthling grid has been provided for the power plant transformer yard, switchyard and other outlying areas. These are connected to the earth grids in various buildings. The buried earthling

grid are further connected to earthling grid are further connected to earthling electrodes buried under ground and located at representative points.

7.2.8 Communication system

Adequate provision of inter-communication telephones, public address system, and walkie-talkie sets along with cellular phone based communication have been made to ensure that communication works fail safe during emergency response planning.

7.2.9 Training and information

While technical measures are essential for the safety, the role of people in management of disasters cannot be ignored. The people can have a negative as well as a positive influence on the safety.

It is important to train not only the persons directly involved by the virtue of official authority or institutional affiliations (including NGOs), but also the general public by appropriately disseminating information on;

a) Possible disaster prone situations and extent of impact

b) Experience in similar situations elsewhere

c) Expected response and measures

d) Role of various constitutional authorities

7.3 OFF-SITE EMERGENCY MANAGEMENT

The Off-Site disaster management plan is as per the requirement of Schedule 12 of MSIHC Rules, 2000. Organizations involved, their responsibilities and liaison arrangements between them are discussed in following paragraphs.

7.3.1 City fire services

It is to combat fire and carry out other emergency operations as per the need. In case of fire, the fire brigade is the best help from outside. Even in a disaster not involving fire, the fire brigade could be of good help, inside the plant and outside, in view of their specialized equipments and expertise in rescue and relief.

Responsibilities;

- To reach the accident spot as soon as possible with all necessary equipment to extinguish the fire

- To provide all other necessary help depending on nature of emergency

7.3.2 Police

Police is required to manage and control the mob, violence, sabotage or outbreak, if any, cordoning of the area and help in fire fighting and other emergency operations. In case of emergency the police department has a number of functions to perform.

Responsibilities;

- Maintain law and order situation around the premises
- To control the traffic to facilitate the victims to reach hospitals as early as possible
- To restrict entry of any unauthorized persons
- To set up communication to assist in disaster management operation
- To take control of surrounding transport facilities and assist in disaster management operation by shifting injured persons and causalities to nearbyhospitals
- Shifting injured persons and causalities to nearby hospitals
- To assist in fire fighting and other emergency operations

7.3.3 Hospital

Hospitals are required to provide first aid, treatment, and also to arrange for removal of victims/casualties. Prompt and efficient medical aid is important in an emergency situation. The first center, inside the industrial premises, cannot cope up with all the treatment requirements. The right approach to this problem is to have arrangements with nearby hospitals so that in case of an emergency, services and facilities available with the nearby hospitals can be utilized.

Responsibilities;

- Depute doctors and nurses to site with ambulance
- To provide immediate medical relief to casualties
- Augmentation of equipments, drugs and doctors
- To provide first aid on the spot to casualties
- To take all out efforts on war-footing to save maximum lives

- To continue treatment to casualties till all of them are attended and properly shifted to medical centers

7.3.4 District administration

Civil administration is meant to provide overall supervision of all off-site emergency operations including order to evacuate off-site population. Local administration means those who are responsible for administration of the geographical area where the industrial facility is located.

Responsibilities;

- To protect the citizens
- To assess the situation for overall control
- To monitor the functioning and need of various agencies in rescue operation at site
- To requisite and make available the services and facilities available in the area like additional fire tenders, hospitals, doctors, transport, police, fire brigade, requisition of army and so on
- To coordinate the activities outside the industrial facility in view of their authority and experience in coordinating rescue and relief operations.

7.3.5 Regional transport office

RTO services may be needed to clear all approach roads to and from accident area for free flow of vehicular traffic, which is engaged in combating the emergency, and demarcate parking area for vehicles to evacuate population.

7.3.6 Controller of Explosives and Factory Inspectorate

These authorities are meant to provide expert advice and help in coordinating emergency operations with government agencies.

The inspector of factories is expected to be friend and a guide to industrial establishments. His involvement is a matter of course since he would be officially connected with inquiries after the disaster.

Responsibilities;

- To coordinate with local government body e.g., civil administration, civil

hospital, police department, etc., as well as surrounding voluntary organizations

- To act as off-site emergency controlling authority
- To inform public for precautionary measures

7.3.7 Voluntary organizations

Voluntary organizations should help in relief and humanitarian services to victims in case of any emergency.

Responsibilities;

- To assist in rescue operations and first aid to the victims.
- To arrange transport, refreshment and shelter
- To take necessary assistance from social organizations like Red Cross Society, Scouts, NCC, Rotary, Lions clubs, etc.,

7.3.8 Other industrial installation in the vicinity

Industrial installations present near the site should help to combat the emergency with the available equipment/infrastructure present in their locations.

Responsibilities;

- To provide the strongest possible support and resources to the plant managers so that the best accident prevention and emergency preparedness procedures are in place in the industrial facility
- To encourage their facility managers to commit themselves fully to the awareness and preparedness for emergencies at local level process.