Chapter-7

Additional Studies (Risk Assessment Study)

7.1 Introduction

Hazard analysis involves the identification and quantification of the various hazards (unsafe conditions). On the other hand, risk analysis deals with identification and computation of consequence and risks. The personnel and the property in the proposed TSDF project are prone to accidents resulting from the hazards present in the site.

Risk analysis follows an extensive hazard analysis. It involves the identification and assessment of risks the neighboring populations are exposed to as a result of hazards present. This requires a thorough knowledge of probability of failure, credible accident scenario, vulnerability of population to exposure etc. Much of this information is difficult to get or generate. Consequently, the risk analysis is often confined to maximum credible accident studies. It provides basis for preparation of on-site and off-site emergency plan and also to incorporate safety measures. The risk and hazards assessment studies have been conducted for identification of hazards, to calculate damage distances and to spell out risk mitigation measures.

Risk Assessment

The word 'disaster' is synonymous with 'emergency' as defined by the Ministry of Environment and Forests (MoEF). An emergency occurring in the proposed project for manufacturing industries is one that may affect several sections within it and/ or may cause serious injuries, loss of lives, extensive damage to environment or property or serious disruption outside the plant. It will require the best use of internal resources and the use of external resources to handle it effectively. It may happen usually as the result of a malfunction of the normal operating procedures. It may also be precipitated by the intervention of an outside force such as a cyclone, flood or deliberate acts of arson or sabotage.

It is imperative to conduct risk analysis for all the projects where hazardous materials, fuels are handled. The risk assessment has been carried out as a few hazardous materials will be handled in the proposed plants.

The following have been addressed as part of the risk analysis.

- Introduction
- Hazard Identification and Risk Analysis
- Risk Reducing Measures

The Introduction deals with the objective and methodology of carrying out the risk analysis.

Hazard Identification and Risk Analysis discusses about the various types of hazards associated with the operation of the project consisting of CETP due to process, storage & handling, human errors, electric failures and natural calamities. It also presents the calculated frequencies of occurrence of different accident scenarios for the identified potential hazard occurrence in the proposed plants and the details of consequence modeling/ analysis for the identified potential accidents/disaster scenarios in the project. Risk Reducing Measures based on the calculated frequencies and consequences.

7.1.1 Scope of Study

The scope of work is to carry out risk analysis for the proposed plant covering all the hazardous chemicals to be handled and stored at the plant.

7.1.2 Study Objective

The objective of the risk analysis includes the following:

- Identification of hazards
- Selection of credible scenarios
- Consequences Analysis of selected accidents scenarios
- Risk Mitigation Measures

7.1.3 Study Approach

The risk assessment study broadly comprised of the following steps:

- System Description
- Identification of Hazards
- Selection of Credible Accident Scenarios

- Consequence Analysis
- Risk Mitigation Measures

7.1.4 Identification of Hazards

Hazards associated with the plant are identified. Summary of relevant accident cases was reviewed. Identification of hazards at the proposed TSDF is of primary significance of the analysis, and quantification of risk. Hazard indicates the characteristics of hazardous wastes that pose potential for an emergency situation. All the components of proposed TSDF need to be thoroughly examined to assess their potential for initiating or propagating an unplanned event/sequence of events, which can be termed as an emergency.

At the proposed TSDF site, following type of hazard wastes may be involved during operation of facility, which can create potential emergency situation in the event of spillage and accidental release of hazardous wastes from the site:

- Explosive wastes in form of explosive solid and explosive liquid. [No such materials are involved in the proposed project].
- Flammable wastes
- Corrosive wastes
- Reactive wastes
- Toxic wastes

Flammable wastes containing solvent residue, can form explosive mixture with air, and heating may cause pressure rise with risk of bursting and explosion (however in case of TSDF explosion probability is very less as highly reactive materials and pressure vessels are not there). Sometime vapour may be heavier than air and spreads along the ground, narcotic in high concentrations, gives off toxic or irritant fumes in a fire.

Various type of organic hazardous wastes, paint wastes, waste oil, etc are flammable in nature and can catch fire if getting source of ignition. There will release toxic fume at the time of burring in the event of fire.

7.2 Hazardous Activities at TSDF Site

During operation of the proposed TSDF, following activities can pose hazards and risk to human and surrounding environment:

- Maneuvering of Wastes and Manual Handling
- Loading and unloading hazardous wastes on vehicle – mechanical movements
- Removal of bungs from drums, cuts & abrasions
- Contact with hazardous chemicals.
- Chemical reaction – fire, gas (Not likely in proposed TSDF site)
- Access egress – fatigue, chemical exposure

7.3 Human Health Risk and Hazards from Proposed TSDF Site

Hazardous wastes managed in barrels or tanks can release COCs into the atmosphere via volatilization. During the operation of TSDF site, wastes may be entered into the environment though the following sources:

- Emission of particulate matters due to windblown erosion of disposed wastes.
- Volatization of organic liquid wastes; (Not likely in proposed TSDF site)
- Infiltration of leachate into ground and subsequently contamination of ground water in an unlikely event of damage to the liner system of TSDF site;
- Spillage of contaminated runoff from the TSDF site during heavy rains;

7.4 Hazards Due to Loss of Containment

Hazardous waste handled, stored and disposed at the TSDF will be mostly toxic in nature. In the event of spillage, leakage or accidental release of these there hazardous wastes, it will create localized effects within the short distances inside the site in the form of toxic material release on ground. However some of the wastes (carbon sludge are inflammable). Safety measures include toxic hazardous material collecting/handling facilities will be provided at the TSDF to attend any emergency due to handling and storage and disposal of such hazardous wastes. It includes post clean up the affected site. No toxic gas as hazardous wastes will be handled at the TSDF; therefore, dispersion of toxic vapour cloud is not an issue at the TSDF. At the proposed TSDF site, following type of hazard wastes may be involved during operation of facility, which can create potential emergency situation in the event of spillage and accidental release of hazardous wastes from the site:

- Corrosive Wastes
- Toxic wastes

7.4.1 Release of Flammable Wastes

Hazardous wastes containing fraction of organic waste and residue, paint wastes (not in proposed site), will be stored in drums and tanks of various sizes. At the time of leakage, spreading or fixed pool will be formed and in an unlikely event of fire, thermal radiation may cause damage to life and property within short distance.

7.4.2 Fire in Stored Hazardous Wastes at TSDF Sites

At TSDF, hazardous waste will be stored in bags/ containers and drums. The hazardous wastes stored may be in solid and semisolid state.

In normal condition, hazardous wastes at TSDF cannot initiate fire. However, in the event of fire, hazardous wastes can burn and sustain fire resulting generation of toxic fumes and smoke. Such toxic fume will complex of suspended particulate matter, shoots, carbon monoxide, carbon dioxide, oxides of nitrogen, and other toxic constituents, etc. In the event of fire, hazardous waste may act as area source of toxic gas emissions (depending upon waste involved/ its constituents) and disperse in to the atmosphere and responsible for deterioration of ambient air quality, subsequently, adverse impacts on the heath due to inhalation of toxic gases.

The extent of injury to people depends on the heat flux and duration of exposure. The extent of damage to property or environment depends on the size of the pool and the duration of fire. At this stage, precise characteristics of hazardous wastes and storage type (container size) are not known; therefore, computation of consequence analysis is not possible.

7.5 Consequence Analysis:

At the TSDF site HSD for DG set will be stored in 200 lt. drums. As there is no source of ignition in the storage area, possibility of fire and explosion is negligible. For worst case, 200 lt. drums filled with HSD have been considered ruptured for calculation of damage distances.

- HSD Tank Leakages; Heavy Spillage; Burning Puddle
- Wind: 4.5 meters/second from E at 3 meters
- Air Temperature: 25˚C

- Stability Class: C
- Relative Humidity: 50%

THREAT ZONE:

- Threat Modeled: Thermal radiation from pool fire
- Red: 17 meters --- (10.0 kW/(sq m) = potentially lethal within 60 sec)
- Orange: 23 meters --- (4 kW/(sq m)) 1st Degree burn
- Yellow: 30 meters --- (2.0 kW/(sq m) = pain within 60 sec)

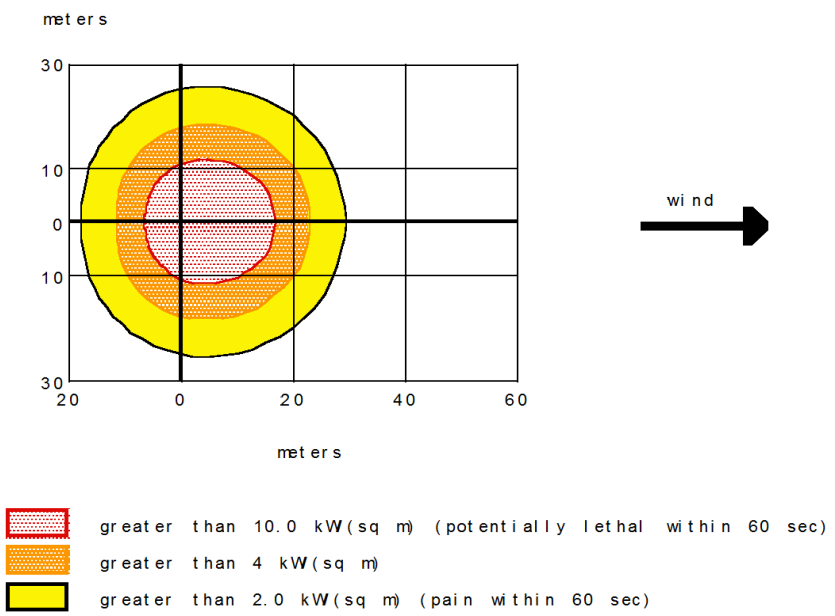

Figure 7.1: HSD drums heavy Spillage- Burning Puddle

The HSD fire drums will be limited to 23 m from the pool i.e. within the plant battery limit.

7.6 Risk Mitigation Measures for Proposed TSDF

Some of the risk mitigation measures have been described for the proposed TSDF site as given below:

- Collection and Transportation of Hazardous Wastes
- Transportation of waste by covered vehicles.
- Regular training to drivers to handle emergency situation during transportation of waste.

- Implementation of TREM card.
- Hazardous waste should be transported by manifest mechanism.

7.6.1 Storage area/TSDF site area

- Loading and unloading of wastes should only be done under the supervision of the well trained and experienced staff.
- Appropriate measures to prevent percolation of spills, leaks etc. to the soil and ground water, the approach area of TSDF site should be provided with concrete floor and the floor must be structurally sound and chemically compatible with wastes.
- Measures should be taken to prevent entry of runoff into the TSDF site area. The TSDF site area shall be designed in such a way that the floor level is at least 150 mm above the maximum flood level.
- The primary storage area should be provided with secondary containment such as proper slopes as well as collection pit so as to collect wash water and the leakages/spills etc.

7.6.2 Miscellaneous Risk Mitigation Measures

- Good housekeeping needs to be maintained around the TSDF site.
- Signboards showing precautionary measures to be taken, in case of normal and emergency situations should be displayed at appropriate locations.
- To the extent possible, manual operations within TSDF site are to be
- Avoided. In case of manual operation, proper precautions need to be taken, particularly during loading / unloading of hazardous waste.
- A system for inspection of checks the conditions of the spillages, leakages etc. should be established and proper records should be maintained.
- Only persons authorized to enter in the TSDF site.

7.6.3 General Working Conditions

House Keeping

- All the passages, floors and stairways should be maintained in good condition. The system should be available to deal with any spillage of dry or liquid waste at the site.

- Sufficient disposable bins should be clearly marked and these should be suitably located in the plant.
- Walkways should be clearly marked and free from obstructions.
- In the plant, precaution and instructions should be displayed at strategic locations.
- All pits, sumps should be properly covered or securely fenced.
- Roads/walkway within the plant should be maintained neat and clean.

7.6.4 Safe Operating Procedures

- Safe operating procedures should be available for mostly all operations at TSDF site.
- The workers should be informed of the consequences of failure to observe the safe operating procedures.

7.6.5 Fire Protection

- Adequate firefighting facilities should be available at the plant, including, dry chemical powder type, water CO_2 type, mechanical foam type, CO_2 type and sand buckets.
- The firefighting system and equipment should be tested and maintained as per relevant standards.
- The fire drills should be conducted once in six months.

7.6.6 Emergency Preparedness

- On-site emergency plan should be prepared and readily available for an unlikely event of emergency.
- Emergency telephone numbers should be available and display properly strategic locations.

7.6.7 Access

- Adequate safe access should be provided to all places where workers need to work and all such access should be in good condition.

7.6.8 Material Handling

- Material handling areas should be clearly defined.

- The workers should be made aware about the hazards associated with manual material handling.

7.6.9 Communication System

- Adequate communication facilities should be available at the plant and supported with uninterrupted power supply.
- Communication facilities should be checked periodically for its proper functioning.

7.6.10 First Aid Facilities

- First box should be provided at strategic locations within the plant.
- At least one stature should be available in first aid room.
- List of important telephone numbers should be displayed in first aid room.

7.6.11 Accident Reporting, Investigation and Analysis

A system should be initiated for accident and near miss reporting, investigation and analysis. To motivate and awareness among the personnel at the plant about safety, total accident (lost time injury) free days can be displayed on the board prominently at strategic location.

7.6.12 Safety Inspections

The system should be initiated for checklist based routine safety inspection and internal audit of the plant periodically. Safety inspection team should be formed from various disciplines and departments.

7.6.13 Safe Operating Procedures

Safe operating procedures should be formulated and updated, specific to process & equipment and distributed to concerned plant personnel.

Occupational Health and Safety

Some workplace hazards have the potential to cause so much injury or disease that specific regulations or codes of practice are warranted. These regulations and codes, adopted under state and territory OH & S Acts, explain the duties of particular groups of people in controlling the risks associated with specific

hazards. Codes of Practice provide advice on how to meet regulatory requirements. As such, codes are not legally enforceable, but they can be used in courts as evidence that legal requirements have or have not been met.

Safety in the workplace is critical to the success of running a business, no matter what size it is. As a small business owner one has certain rights and responsibilities regarding health and safety in the workplace. Even without any employees, one must ensure that the business doesn't create health and safety problems for the customers and the general public.

All safety gears will be provided to workers and care will be taken by EMC that these are used properly by them. All safety norms will be followed.

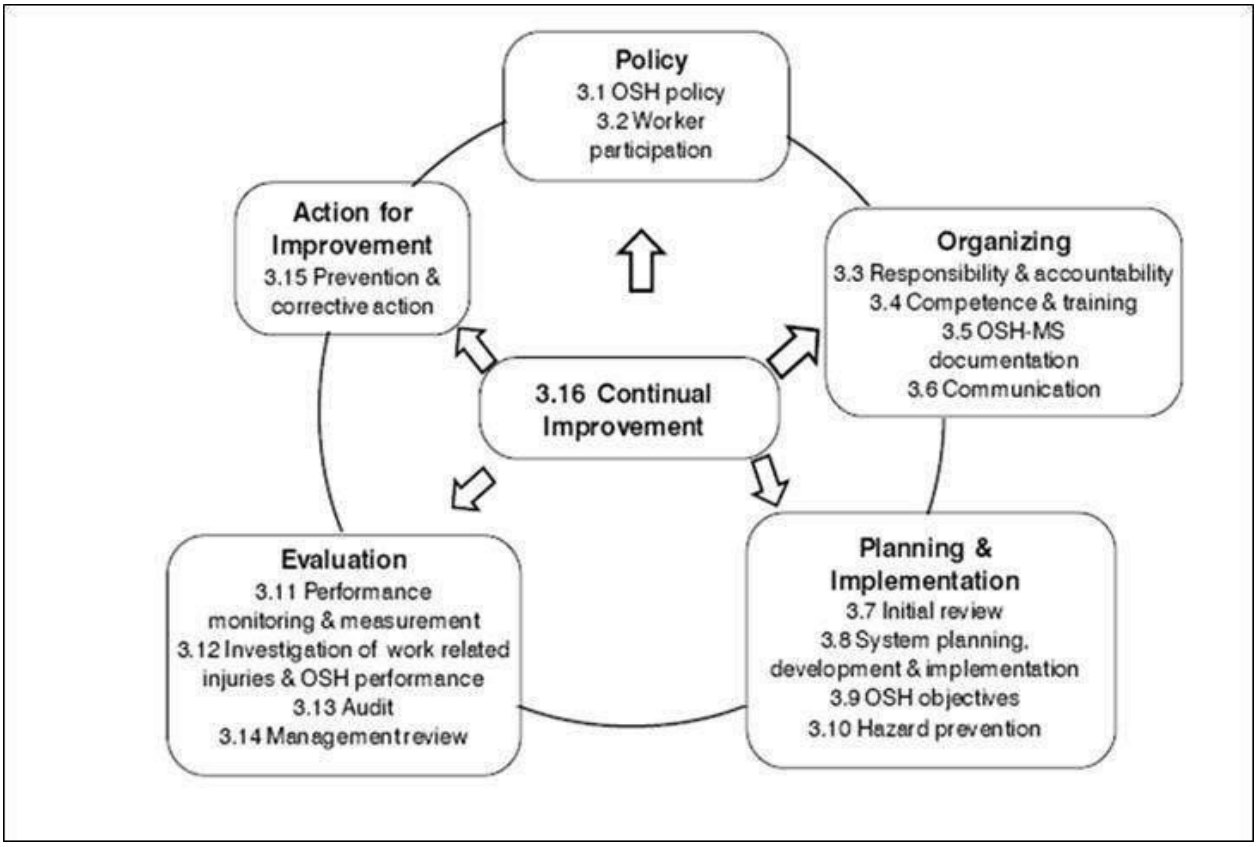

Figure No. 7.1: OHS Cycle

Preventing Fires & Explosions

Regular safety audits should be undertaken to ensure that hazards are clearly identified and risk- control measures maintained at an optimum level.

Personal Protective Equipment (PPE)

General Provisions

- As a supplementary protection against exposure to hazardous conditions where the safety of workers cannot be ensured by other means, such as eliminating the hazard, controlling the risk at source or minimizing the risk, suitable and sufficient PPE, having regard to the type of work and risks, and in consultation with workers and their representatives, should be used by the worker and provided and maintained by the employer, without cost to the workers.
- Items of PPE provided should comply with the relevant national standards and criteria approved or recognized by the competent authority.
- Those responsible for the management and operation of the personal protection programme should be trained in the selection of the proper equipment, in assuring that it is correctly fitted to the people who use it, in the nature of the hazards the equipment is intended to protect
- against, and provide adequate comfort, and in the consequences of poor performance or equipment failure.
- PPE should be selected considering the characteristics of the wearer and additional physiological load or other harmful effects caused by the PPE. It should be used, maintained, stored and replaced in accordance with the standards or guidance for each hazard identified at the facility and according to the information given by the manufacturer.
- PPE should be examined periodically to ensure that it is in good condition.
- Different PPE & their components should be compatible with each other when worn together.
- PPE should be ergonomically designed and, to the extent practicable, should not restrict the
- user's mobility or field of vision, hearing or other sensory functions.
- Employers should ensure that the workers who are required to wear PPE are fully informed of the requirements and of the reasons for them, and are given adequate training in the selection, wearing, maintenance and storage of this equipment.
- When workers have been informed accordingly, they should use the equipment provided throughout the time they may be exposed to the risk that requires the use of PPE for protection.

- The PPE should not be used for longer than the time indicated by the manufacturer.
- Workers should make proper use of the PPE provided, and maintain it in good condition, consistent with their training and be provided with the proper means for doing so.

Protection from Falls

- When other measures do not eliminate the risk of falling, workers should be provided with and trained in the use of appropriate fall protection equipment, such as harnesses and lifelines. Workplaces and traffic lanes in which there are fall hazards or which border on a danger zone should be equipped with devices which prevent workers from falling into or entering the danger zone.
- Devices should be provided to prevent workers from falling through floors and openings.
- Safety harnesses should be worn where required and the lifeline should be attached to an adequate anchor point.
- Harnesses should be chosen that are safely used with other PPE that may be worn simultaneously.
- Appropriate and timely rescue should be provided when using fall-arrest equipment to prevent suspension trauma.

Occupational Health –Proposal for Surveillance

The choice and the implementation of specific measures for preventing workplace injury and ill health in the work-force depends on the recognition of the principal hazards, and the anticipated injuries and diseases, ill health and incidents. Below are the most common causes of injury and illness:

- Slips, trips and falls on the same level; falls from height; unguarded machinery; falling objects;
- Engulfment; working in confined spaces; moving machinery, on-site transport, forklifts and cranes;
- Exposure to controlled and uncontrolled energy sources; exposure to mineral wools and fibres; inhalable agents (gases, vapours, dusts and fumes);
- Skin contact with chemicals (irritants acids, alkalis), solvents and sensitizers); contact with hot objects;

- Fire and explosion; extreme temperatures; radiation (non-ionizing, ionizing);
- Noise and vibration; electrical burns and electric shock;
- Manual handling and repetitive work; failures due to automation; ergonomics;
- Lack of OSH training; poor work organization;
- Inadequate accident prevention and inspection; inadequate emergency first-aid and rescue facilities; lack of medical facilities and social protection
- Dust may enter into the systemic circulation and thereby reach the essentially all the organs of body and affects the different tissues.
- Working near heavy noise generating equipments may cause hearing and blood pressure related diseases
- Continuous working and improper working position leading to pain & exhaustion.

Plan of evaluation of health of workers

- By pre designed format during pre placement and periodical examinations.
- Proper schedule will be devised and followed with help of occupational health experts and doctors.
- Health effects of metals used and health hazard plans based on monthly correlation of these metal related diseases and people affected.

Schedule of medical check-up during operational phase

- Comprehensive Pre-employment medical check up for all employees
- General check up of all employees once every year.
- Medical examination will be done for all the employees after retirement and all those employees with more than 5 years of service leaving the company. After retirement, medical examination facility will be provided for a period of 5 years.
- Local hospitals and Govt. health monitoring system will be engaged.
- Dispensary and ESI facility will be provided to all workers as applicable
- All safety gears will be provided to workers and care will be taken by EMC that these are used properly by them. All safety norms will be followed

Disaster Management Plan

This DMP has been designed based on the range, scales and effects of "Major Generic Hazards" described in the Risk Assessment and prediction of their typical

behavior. The DMP addresses the range of thermal and mechanical impacts of these major hazards so that potential harm to people onsite and off-site, plant and environment can be reduced to a practicable minimum. The scenarios of loss of containment are credible worst cases to which this DMP is linked.

The project is in its formative stage and detail engineering is yet to be done, so the elements of the DMP are based on concepts.

Capabilities of DMP

The emergency plan envisaged will be designed to intercept full range of hazards such as fire, explosion, major spill etc. In particular, the DMP will be designed and conducted to mitigate those losses of containment situations, which have potentials to escalate into major perils.

Another measure of the DMP's capability will be to combat small and large fires due to ignition, of flammable materials either from storage or from process streams and evacuate people from the affected areas speedily to safe locations to prevent irreversible injury. Emergency medical aids to those who might be affected by incident heat radiation flux, shock wave overpressures and toxic exposure will be inherent in the basic capabilities.

The most important capability of this DMP will be the required speed of response to intercept a developing emergency in good time so that disasters such as explosion, major fire etc. are never allowed to happen.

Disaster Control Philosophy

The principal strategy of DMP is "Prevention" of identified major hazards. The "Identification" of the hazards will employ one or more of the techniques [e.g. Hazard and Operability Study (HAZOP), accident consequence analysis etc.]. Since these hazards can occur only in the event of loss of containment, one of the key objectives of technology selection, project engineering, construction, commissioning and operation is "Total and Consistent Quality Assurance". The Project Authority will be committed to this strategy right from the conceptual stage of the plant so that the objective of prevention can have ample opportunities to mature and be realised in practice.

The DMP or Emergency Preparedness Plan (EPP) will consist of:

- On-site Emergency Plan
- Off-site Emergency Plan

Disaster Management Plan preparation under the headlines of On-site Emergency Plan and Off-site Emergency Plan is in consonance with the guidelines laid by the Ministry of Environment and Forests (MOEF) which states that the "Occupier" of the facility is responsible for the development of the On- site Emergency Plan. The Off-site Emergency Plan should be developed by the Governments district emergency authorities/district collector.

On-Site Emergency Plan

Objectives

The objective of the On-site Emergency Plan should be to make maximum use of the combined resources of the plant and the outside services to

- Effect the rescue and treatment of casualties
- Safeguard other personnel in the premises
- Minimise damage to property and environment
- Initially contain and ultimately bring the incident under control
- Identify any dead
- Provide for the needs of relatives
- Provide authoritative information to the news media
- Secure the safe rehabilitation of affected areas
- Preserve relevant records and equipment for the subsequent enquiry into the cause and circumstances of emergency

Action Plans

The Action Plan should consist of:

- Identification of Key Personnel
- Defining Responsibilities of Key Personnel
- Designating Emergency Control Centres and Assembly Points
- Declaration of Emergency

- Sending All Clear Signal
- Defining actions to be taken by non-key personnel during emergency

Key Personnel

The actions necessary in an emergency will clearly depend upon the prevailing circumstances. Nevertheless, it is imperative that the required actions are initiated and directed by nominated people, each having specified responsibilities as part of co-ordinated plan. Such nominated personnel are known as Key Personnel.

The Key Personnel are:

- Site Controller (SC)
- Incidental Controller (IC)
- Liaison and Communication Officer (LCO)
- Fire and Security Officer (FSO)
- Team Leaders (TL)

Site Controller (SC)

In the emergency situation, decisions have to be taken which may affect the whole or a substantial part of the plant and even places outside. Many of these decisions will be taken in collaboration with the other officers at the plant and the staff. It is essential that the authority to make decision be invested in one individual. In this plan, he is referred to as the 'Site Controller'. The Plant Manager (however called) or his nominated deputy will assume responsibility as SC.

Incident Controller (IC)

In the emergency situation, someone has to direct the operations in the plant area and co-ordinate the actions of outside emergency services at the scene of incident. The one who will shoulder this responsibility is known as 'Incident Controller' in this plan.

A Senior Operations Officer or an officer of similar rank of the unit may be nominated to act as the IC.

Liaison and Communication Officer (LCO)

Operations Officer or any other officer of deputy rank will work as LCO and will be stationed at the main entrance during emergency to handle Police, Press and other enquiries. He will maintain communication with the IC

Fire and Safety officer (FSO)

The Fire and Safety Officer will be responsible for fire fighting. On hearing the fire alarm he shall contact the fire station immediately and advise the security staff in the plant and cancel the alarm. He will also announce on PAS (public Address System) or convey through telephones or messengers to the SC, IC and LCO about the incident zone. He will open the gates nearest to the incident and stand by to direct the emergency services. He will also be responsible for isolation of equipment from the affected zone.

Team Leaders (TL)

A number of special activities may have to be carried out by specified personnel to control as well as minimize the damage and loss. For this purpose designated teams would be available. Each team will be headed by a Team Leader (TL).

Following teams are suggested:

- Repair Team
- Fire Fighting Team
- Communication Team
- Security Team
- Safety Team
- Medical Team

Responsibilities of Key Personnel

Site Controller (SC)

- On getting information about emergency, proceed to Main Control Centre
- Call in outside emergency services
- Take control of areas outside the plant, which are affected
- Maintain continuous communication, review situation and assess possible course of events
- Direct evacuation of nearby settlements, if necessary

- Ensure that casualties are getting enough help
- Arrange for additional medical help and inform relatives
- Liaison with Fire and Police Services and Provide advice on possible
- effects on outside areas
- Arrange for chronological recording of the emergency
- Where emergency is prolonged, arrange for relieving personnel, their catering needs etc.
- Inform higher officials in head office
- Ensure preservation of evidence
- Direct rehabilitation work on termination of emergency

Incident Controller (IC)

- On getting emergency information, proceed to Main Control Centre
- Activate emergency procedure such as calling in various teams

Direct all operations within plant with following priorities:

a) Control and contain emergency
b) Secure safety of personnel
c) Minimize damage to plant, property and the environment
d) Minimize loss of material

- Direct rescue and repair activities
- Guide fire-fighting teams
- Arrange to search affected area and rescue trapped persons
- Arrange to evacuate non-essential personnel to safe area/assembly point
- Set up communications network and establish communication with SC
- Arrange for additional help/equipment to key personnel of various teams
- Consider need for preserving all records, information for subsequent enquiries

Liaison and Communications Officer

- To ensure that casualties receive adequate attention, arrange additional help if required and inform relatives
- To control traffic movements into the plant and ensure that alternative transport is available when need arises

- When emergency is prolonged, arrange for the relief of personnel and organize refreshments/catering facility
- Advise the Site Controller of the situation, recommending (if necessary) evacuation of staff from assembly points
- Recruit suitable staff to act as runners between the Incident Controller and himself if the telephone and other system of communication fail. -Maintain contact with congregation points
- Maintain prior agreed inventory in the Control Room
- Maintain a log of the incident on tape
- In case of a prolonged emergency involving risk to outside areas by windblown materials - contact local meteorological office to receive early notification of changes in weather conditions

Fire and Safety Officer

- Announce over the PAS in which zone the incident has occurred and on the advice of the Shift Officer informs the staff to evacuate the assembly
- Inform the Shift Officer In-charge, if there is any large escape of products
- Call out in the following order:

a) Incident Controller or his nominated deputy
b) Maintenance Officer
c) Personnel and Administrative Officer
d) Departmental Head in whose area the incident occurred
e) Team Leaders (TL)

Emergency Control Centre

The Emergency Control Centre will be the focal point in case of an emergency from where the operations to handle the emergency are directed and coordinated. It will control site activities.

Emergency management measures in this case have been proposed to be carried from single control

Centre designated as Main Control Centre (MCC)

MCC is the place from which messages to outside agencies will be sent and mutual aids and other helps for the management of emergency will be arranged. It will be located in the safe area. It will be equipped with every facility for external and internal communication, with relevant data, personal protective equipments to assist hose manning the centre to enable them to co-ordinate emergency control activities. CC will be attended by SC.

Following facilities would be available in the MCC:

- P&T phones, mobile phones, intercoms, and wireless
- Fax and telex
- Emergency manuals
- Blown up area maps
- Internal telephone directories
- District telephone directories
- Emergency lights
- Wind direction and speed indicator
- Requisite sets of personal protective equipment such as gloves, gumboots and aprons

MCC will be furnished with call out list of key persons, fire, safety, first aid, medical, security, police and district administrative authorities. MCC will also contain safety data pertaining to all hazardous materials likely to cause emergency and well-defined procedures of fire fighting, rescue operations, first aid etc.

Assembly Point

In an emergency, it will certainly be necessary to evacuate personnel from affected areas and as precautionary measure, to further evacuate non-essential workers, in the first instance, from areas likely to be affected, should the emergency escalate. The evacuation will be effected on getting necessary message from i.e. On evacuation, employees would be directed to a predetermined safe place called Assembly Point.

Proposed Location: Area opposite to service building will be the Assembly Point where all non-key personnel would assemble on getting direction over Public-Address System.

Outdoor assembly points, predetermined and pre-marked, will also be provided to accommodate evacuees from affected plant area(s). Roll call of personnel collected at these assembly points, indoor and outdoor will be carried out by roll call crew of safety team to account for any missing person(s) and to initiate search and rescue operations if necessary.

Declaration of Emergency

An emergency may arise in the plant due to major leakage of oil or major outbreak of fire/explosion. In case of major leak or major outbreak of fire the state of emergency has to be declared by the concerned by sounding Emergency Siren.

Upon manual or sensor detection of a major loss of containment of volatile hazardous substance, the DMP is activated by raising an audible and visual alarm through a network of geographically dispersed gas/vapour and heat detectors and also "break glass" type fire alarm call points with telephone hand sets to inform the Central Control Room.

A separate siren audible to a distance of 5 km range will be available for this purpose. The alarm is coded such that the nature of emergency can be distinguished as a leakage or major fire.

The Control Centre and Assembly point will be located at an area of the minimum risk or vulnerability in the premises concerned, taking into account the wind direction, areas which might be affected by fire/explosion, leakage etc.

After cessation of emergency, FSO will communicate to IC. After verification of status, IC will communicate with SC and then announce the "All Clear" by instructing the Time Office to sound the "All Clear Signal".

Alarms would be followed by an announcement over Public Address System (PAS).In case of failure of alarm system, communication would be' by telephone operator who will make announcement in the complex through PAS. Walkie-talkie system is very useful for communication during emergency with predetermined codes of communication. If everything fails, a messenger could be used for sending the information.

Two 5.0 km, range variable pitch electric sirens (one in service and the other standby)will generate the main alarm for the entire site as well as for the district fire

brigade. The alarm is coded such that the nature of emergency can be distinguished as a leakage or major fire. Fire and Gas alarm matrices are provided at the Central Control room, security gate, on-site fire station and main administrative office corridor to indicate location of the site of emergency and its nature.

Mutual Aid

Procedure

All factories may not be equipped with an exhaustive stock of equipment/materials required during an emergency. Further, there may be a need to augment supplies if an emergency is prolonged. It would be ideal to pool all resources available in the and nearby outside agencies especially factories during an emergency, for which a formal Mutual Aid scheme should be made among industries in the region.

Essential Elements

Essential elements of this scheme are given below:

- Mutual aid must be a written document, signed by Location In-charge of all the industries concerned
- It should specify available quantity of materials/ equipment that can be spared (not that which is in stock)
- Mode of requisition during an emergency.
- It should authorize the shift-in-charge to quickly deploy available material/equipment without waiting for formalities like gate pass etc.
- It should spell out mode of payment/replacement of material given during an emergency
- It should specify key personnel who are authorized to requisition materials from other industries or who can send materials to other industries
- It should state clearly mode of receipt of materials at the affected unit without waiting for quantity/quality verification etc.
- Revision number and validity of agreement should be mentioned
- This may be updated from time to time based on experience gained

Emergency Management Training

The Key Personnel would undergo special courses on disaster management. This may preferably be in-plant training. The Managers, Senior Officers and Staff would undergo a course on the use of personal protective equipment.

The Key Personnel belonging to various Teams would undergo special courses as per their expected nature of work at the time of emergency.

The plant management should conduct special courses to outside agencies like district fire services to make them familiar with the plant layout and other aspects, which will be helpful to them during an emergency.

Mock Drills

It is imperative that the procedures laid in this Plan are put to the test by conducting Mock Drills. To avoid any lethality, the emergency response time would be clocked below 2 minutes during the mock drill.

1st Step: Test the effectiveness of communication system

2nd Step: Test the speed of mobilization of the plant emergency teams

3rd Step: Test the effectiveness of search, rescue and treatment of casualties

4th Step: Test emergency isolation and shut down and remedial measures taken on the system

5th Step: Conduct a full rehearsal of all the actions to be taken during an emergency

The Disaster Management Plan would be periodically revised based on experiences gained from the mock drills.

Proposed Communication System

The instrument and control system will take care of the following operating philosophy of the plant:

- The project will be provided with a control system located in a central control room.
- The shift engineer will operate the plant from his console panel.
- All operations will be represented in a graphic panel on the console and every operation will be depicted as operating sequences.
- All operating parameters will be displayed in digital format.
- Alarms will be provided for all parameters, when they exceed set values.

- High-High/Low-Low alarms and trip functions will be provided to trip
- Pumps/compressors to bring the entire system to a safe shutdown.

Proposed Fire Fighting System

Elaborate fire fighting system will be available for fighting fires in any corner of the plant. A comprehensive fire detection and protection system is envisaged for the project Area.

Other safety Measures

Considering that fire and explosion is the most likely hazard in such installations, the plant is being provided with systems to guard against such hazards. Salient among these are:

- A proper layout to prevent and minimize the effects of any hazardous situation
- Design of storage vessels and all components to codes and standards to withstand the rigorous duty
- Provision of operating systems to conduct the process through well established safe operating procedures
- A control system, which monitors all, plant parameters and give alarms
- Control system, which has trip provisions to prevent hazard conditions escalating
- A gas detection system which will provide early warning of any leaks
- Provision of a fire protection system to control fire
- Provision of flame-proof lighting system in the fire prone areas

Proposed First Aid and Medical Facilities

The First Aid Medical Centre has been proposed. It will be fully equipped with emergency facilities. It will be open round the clock. A Medical attendant will always be available in the centre. Emergency cars will be available in all the shifts. Adequate number of first aid boxes will be kept at strategic locations. Required stock of first aid medicines will be maintained. Trained first aiders will be available in all departments.

Facilities to be kept in the Medical Room along with others will include: Oxygen Cylinders, Injection Corarnine, Glucose Saline, LV. Sets, Syringes, Injection Needles, Stretchers and medicines.

Proposed Emergency Power Supply

Strategic areas will be provided with emergency lights fed through stationed battery system. Portable emergency lamps will be also available at required points. A Diesel Driven Generator of adequate capacity will be available to keep the operations running in case of power failure. Diesel Engine operated fire pumps will be available.

Off Site Emergency Plan

Objective: If the effects of the accident or disaster inside the plant are felt outside its premises, it calls for an off- site emergency plan, which should be prepared and documented in advance in consultation with the District Authorities.

Key Personnel

The ultimate responsibility for the management of the off-site emergencies rests on the Collector / District Magistrate / Deputy Commissioner. He will be assisted by representatives from all concerned organisations, departments and services at the District level. This core group of officers would be called the District Crisis Management Group (CMG). The members of the group will include:

1. Collector/District Magistrate Deputy Commissioner
2. Commissioner of Police
3. Municipal Commissioner, if municipalities are involved
4. Deputy Director, Health
5. Pollution Control Board Representative

An Operation Response Group (ORG) will then be constituted to implement the directives of the CMG. The various government departments, some or all of which will be concerned, depending on the nature of the emergency, could include:

- Police
- Health & Family Welfare
- Medical
- Revenue
- Fire Service
- Transport
- Electricity
- Animal Husbandry

- Agriculture
- Civil Defense
- PWD
- Civil Supplies
- Panchayats

The SC and IC, of the on-site emergency team, will also be responsible for communications with the CMG during the off-site emergency.

Education to Public

People living within the influence zone should be educated on the emergency in a suitable manner. This can be achieved only through the Local and District Authorities. However, the Project Authority can extend necessary information to the Authorities.

Training

- Training sessions need to be provided in which personnel are briefed on their specific duties in an emergency.
- To provide training to all emergency responders. The concerned personnel are shown how to wear and properly use personal protective clothing and devices.
- Periodic drills to be conducted to test the overall efficiency and effectiveness of the emergency response plan and emergency response capabilities.
- The types of training required for emergency response personnel with responsibilities in any or all phases of the response is based upon the types of incidents most likely to occur and the related response and planning activities.
- Responsibility, Frequency and Procedure for Evaluation The CEC is responsible for evaluating the effectiveness of the on- site emergency plan. Emergency mock drill should be conducted at an interval of six months. Experts should be invited to observe the mock drill in order to know their response and opinion. The recommendations following the discussions will help to identify the loopholes in the plan and response capability of the organization. Such periodic recommendations of the mock drill should be kept in order to update the plan.
- The CEC will be responsible to update their on-site emergency plan regularly. A regular review of the plan at least once in a year should be carried out to replace outdated information or to incorporate the results of mock drill.

Post Emergency – Recovery

When an emergency is over, it is desirable to carry out a detailed analysis of the causes of accidents to evaluate the influence of various factors involved and to propose methods to eliminate or minimize them in future. Simultaneously, the adequacy of the disaster preparedness plan will be evaluated and any shortcomings will be rectified.

Accident Investigation

a.	As soon as possible after the emergency is over and plant operation has become normal, the investigation will be carried out to determine the cause of the event.
b.	Representatives from various disciplines will be members of the investigating team.
c.	The area of the event will be sealed off so that tampering or alteration of the physical evidence will not occur.
d.	Key components will be photographed and logged with time, place, direction, etc.
e.	Statements will be taken from those who were involved with the operation or who witnessed the event.

Damage Assessment

This phase of recovery establishes the quantum of replacement machinery considered necessary for bringing back the plant to normal operation, property and personnel losses, and culminates in a list of necessary repair, replacement and reconstruction work.

Insurance companies will be informed of the damage and requested to pay the compensation as per claim.

Cleanup and Restoration

- This phase will only begin after the investigation is complete.
- Reporting documentation will be prepared and forwarded to appropriate authorities.
- Repairs, restoration and cleanup will begin.
- Insurance claims will be prepared and submitted.