## 7.1 Risk Assessment (taken from Chapter-7 of EIA report)

### 7.1.1 General

Industrial accidents result in great personal and financial loss. Managing these accidental risks in today's environment is the concern of every industry because the real or perceived incidents can quickly jeopardize the financial viability of a business. Many facilities involve various manufacturing processes that have the potential for accidents which may be catastrophic to the plant, work force and environment or public. The main objective of the risk management study is to propose a comprehensive but simple approach to carry out risk analysis and conducting feasibility studies for industries including planning and management of industrial prototype hazard analysis study in the Indian context.

Risk analysis and risk assessment should provide details on Quantitative Risk Assessment (QRA) techniques used world over to determine risk posed to people who work inside or live near hazardous facilities and to aid in preparing effective emergency response plans by delineating a Disaster Management Plan (DMP) to handle on-site and off-site emergencies. Hence, QRA is an invaluable method for making informed risk based process safety and environmental impact planning decisions, as well as being fundamental to any facility-sitting decision making. QRA whether site specific or risk specific for any plant is complex. It needs extensive study that involves process understanding, hazard identification, consequence modelling, probability date, vulnerability model/data, local weather, terrain conditions and local population data. QRA may be carried out to serve the following objectives:

- Identification of safety areas.
- Identification of hazard sources.
- Generation of accidental release scenarios for escape of hazardous materials from the facility.
- Identification of vulnerable units with recourse to hazard indices.
- Estimation of damage distances for the accidental release scenarios with recourse to Maximum Credible Accident (MCA) analysis.
- Hazard and Operability Study (HAZOP) in order to identify potential failure cases of significant consequences.
- Estimation of probability of occurrences of hazardous events through fault tree analysis

and computation of reliability of various control paths.

- Assessment of risk on the basis of above evaluation against the risk acceptability criteria relevant to the situation.
- Risk mitigation measures based on engineering judgment, reliability and risk analysis approaches.
- Delineation/up-gradation of DMP.
- Safety Reports with external safety report/ occupational safety report.

The Risk Assessment Report may cover the following in terms of the extent of damage with recourse to MCA analysis and delineation of risk mitigation measures with an approach to DMP

- Hazard identification: Identification of hazardous activities, hazardous materials, past accident records etc..
- Hazard quantification : Consequence analysis to assess the impacts.
- Risk presentation.
- Risk mitigation measures.
- Disaster Management Plan.

**7.1.2 Identification of Hazards**

Identification of hazards in the proposed plant is of primary significance in the analysis, quantification and cost effective control of accidents involving materials and process. A classical definition of hazard stated that hazard is in fact the characteristics of system /plant/ process that presents potential for an accident. Hence, all the components of a system/ plant/ process 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 accident. The following two methods for hazards identification have been employed in the study :

- Identification of major hazardous units based on Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 of Government of India (GOI Rules, 1989) and
- Identification of hazardous units and segments of plants and storage units based on relative ranking technique, viz. Fire-Explosion and toxicity Index (FE & TI).

**7.1.3 Exposure Limits**

The exposure limits for 8 hourly work-zone concentrations will be as per Factories Act and will be complied with.

### 7.2 Hazard Assessment & Evaluation

A preliminary hazard analysis shall be carried out to identify major hazards associated with storages in the facility. This is followed by consequence analysis to quantify these hazards. Finally the vulnerable zones are plotted for which risk reducing measures are deduced and implemented.

#### 7.2.1 Frequent Causes of Accidents

- Fire and explosion, explosives, flammable material.
- Struck by falling objects.
- Snapping of cables, ropes, chains & slings.
- Handling heavy objects.
- Electricity (electrocution).
- Poor illumination.
- Falls from height inside industrial units or on the ground.
- Struck by moving objects.
- Slipping on wet surfaces.
- Sharp objects.
- Oxygen deficiency in confined spaces.
- Lack of personal protective equipment (PPE), housekeeping practices Safety signs.
- Hackles, hooks & chains.
- Cranes, winches, hoisting and hauling equipment.

#### 7.2.2 Physical Hazards

- Noise.
- Extreme temperatures.
- Vibration.

#### 7.2.3 Hazardous Substances & Wastes

- Heavy and toxic metals.
- Organo metallic substances.
- Lack of hazard communication (storage, labelling, material safety data sheets).
- Fire-fighting liquids.
- Welding fumes.

- Volatile organic compounds (solvents).
- Inhalation in confined and enclosed spaces.
- Physical hazards.
- Noise.
- Extreme temperatures.
- Vibration Radiation.
- (UV, radioactive materials).

### 7.2.4 Mechanical Hazards

- Trucks and transport vehicles.
- Scaffolding, fixed and portable ladders.
- Impact by tools, sharp-edged tools.
- Power-driven hand tools, saws, grinders and abrasive cutting wheels.
- Failure of machinery and equipment.
- Poor maintenance of machinery and equipment.
- Lack of safety guards in machines.
- Structural failure.

### 7.2.5 Ergonomic & Psychosocial Hazards

- Repetitive strain injuries, awkward postures, repetitive & monotonous work, excessive workload.
- Long working hours, shift work, night work, temporary employment.
- Mental stress, human relations (aggressive behavior, alcohol and drug abuse, violence).
- Poverty, low wages, minimum age, lack of education and social environment.

### 7.2.6 General Concerns

- Lack of safety and health training.
- Poor work environment.
- Inadequate housing and sanitation.

- Inadequate accident prevention and inspection.
- Inadequate emergency, first-aid and rescue facilities.
- Lack of medical facilities and social protection.

### 7.3 Possible Hazards & Risks from Secondary Metallurgical Industries

The various process operations, which are having potentially high risk to human exposure and which have high levels of attention area identified in **Table 7.1.**

**Table-7.1**
**Possible Risk**

| S.No. | Plant Area | Possible Deviation from normal operation | Likely Causes | Consequences |
|---|---|---|---|---|
| 1 | Furnace | Re-circulating and cooling water coming in contact with the molten iron or slag. | Leakage of water from the walls Spurting of metal/ slag. | Explosion under extreme cases. |
| | | Presence of Oil & Grease and other Impurities in raw materials. | Fire | Sudden catches fire & flames |
| 2 | High Power Transformer | Oil temperature being very high. | Varying room Temperatures. | Sudden flashing of fire or bursting. |
| 3 | High Tension Electrical Installation | Heavy sparking at the pot heads and the joints. | Loose joints, cable cut, burning of fuses, short circuits etc. | Sparks in the beginning, devastating fire if neglected. |

### 7.4 First Aid Measures

Following first aid measures will be taken:

a. **Eye Contact**: Rinse eyes thoroughly with water for at least 15 minutes, including under lids, to remove all particles. Seek medical attention for abrasions and burns.

b. **Skin Contact**: Wash with cool water and a pH neutral soap or a milk skin detergent. Seek medical attention for rash, burns, irritation and dermatitis.

c. **Inhalation**: Move person to fresh air. Seek medical attention for discomfort or if coughing or other symptoms.

d. **Ingestion**: Do not induce vomiting. If conscious, have person drink plenty of water. Seek medical attention.

### 7.5 Exposure Controls & Personal Protection

#### 7.5.1 Exposure Controls

- Control of dust through implementation of good housekeeping and maintenance.
- Proper fume and dust extraction system to control fume/dust emission in work zone.
- Use of PPE, as appropriate (e.g. masks and respirators).
- Use of mobile vacuum cleaning systems to prevent dust buildup on paved areas.

#### 7.5.2 Personal Protective Equipment (PPE)

- Respiratory Protection: When the dust level is beyond exposure limits or when dust causes irritation or discomfort use respirator.
- Eye Protection: Wear Safety goggles to avoid dust contact with the eyes. Contact lenses should not be worn when handling the materials.
- Skin Protection: Wear impervious abrasion and alkali resistant gloves, boots, long sleeved shirt, long pants or other protective clothing to prevent skin contact.

#### 7.5.3 Fire Fighting Facilities

- Keeping in view the nature of fire and vulnerability of the equipment and the premises, following fire protection facilities have been envisaged for the plant.

#### 7.5.4 Hydrant System

- Internal hydrants will be provided in all major plant units at suitable locations and in different levels inside the plant buildings. Internal hydrants will also be provided for conveyor galleries. Yard hydrants will be provided in the vicinity of each plant unit, normally along the road to meet the additional requirement of water to extinguish fire.

#### 7.5.5 Portable Fire Extinguishers

- All plant units, office buildings, laboratory, welfare buildings, etc. will be provided with adequate number of portable fire extinguishers to be used as first aid fire appliances. Sufficient quantities of the following extinguishers will be provided at strategic locations in the plant.

#### 7.5.6 Other Safety Measures

- Safety training to the workers will be given.
- PPE will be provided to the workers.

- The maintenance and cleaning of bag filters will be carried out regularly.
- The dust removal efficiency of bag filters will be check regularly.
- Work place environment monitoring will be carried out regularly and records will be maintained.
- Good housekeeping will be implemented in the plant.
- First aid box will be provided.
- The industry will provide adequate lighting facility inside the plant premises.
- General dilution ventilation will be provided to control dust levels below exposure limits.
- Fire extinguishers will be provided to withstand the fire or explosion condition.
- Pre-employment and periodical medical examination of workers will be done by government approved medical practitioners and the details will be recorded as per the Regulations.
- The industry will prepare on-site emergency plan.
- In case any emergency, arrangement of ambulance van will be done from nearest Hospital.
- Two main gates will be provided for entry and exit of the workers.

### 7.5.7 Safety requirement for the BF gas

The following are the safety requirements for the BF gas.

- No person is allowed to work in or go to the area where BF gas is present; if the carbon monoxide content in that area is more than 50 ppm then gas mask is to be used.
- On line monitoring system with alarm for carbon monoxide concentration is to be provided in the areas around equipment/process handling BF gas. Performance of on-line monitoring system is to checked once in a month for its proper operation and records are to be maintained.
- Either non sparking tools or grease coated tools are to be used while working on charged BF gas pipelines and gas handling system.
- No person is allowed to work on charged system (where there is possibility of presence of BF gas) without gas masks.

- Proper escape route and scaffolding is to be provided while working on charged BF gas system at height.
- The welding current is not to exceed 100 A while welding on charged BF gas system.
- Cutting or welding jobs are not to be allowed on isolated system without analysis and written clearance of the competent authority. It is to be done only by trained welders in the presence of a competent gas safety man. A minimum level of 20 % oxygen shall be ensured.
- Proper electrical jumpers are to be provided between flanges and equipments before a gap is created between them.
- Platform and adjoining structures are to be covered with fire resistant clothes while blanking and de-blanking and the person working is not to be allowed to wear nylon or other synthetic fabric/garments.
- Fire fighting machinery is to be kept in attendance at the place of work in charged BF gas system.
- All jobs within a radius of 40 m which could be a source of fire/ignition are to be stopped and unauthorized persons are not to be allowed to remain in the area during the shutting down of the gas system.
- Wherever necessary, lighting in enclosed area shall be done with portable spark proof electric lamp of 24 V or explosion proof fittings.
- All pipelines/systems shall be checked for leakage after completion of repair job. The leakages are to be detected by soap solution and all leakages shall be rectified before charging the system.
- Blanking/de-blanking jobs on gas lines are not to be taken up at the time of extreme bad weather conditions when the possibility of thundering/lightening exists.
- Drain pots and other auxiliaries of gas lines shall be inspected for proper operation at least once a month and records are to be maintained.
- Purging steam/gas is to be used through a detachable hose. Permanent connections shall be blanked after purging requirements are over.

- There must not be any discontinuity in blanking/ de-blanking. Once started it shall be completed at a stretch.
- Testing of leaks of running mains of BF gas is to be done only by soap water.
- Persons required to work in gaseous atmosphere shall be trained in first aid and methods of giving artificial respiration.
- Water seal/ valves are to be installed above ground level.

### 7.6 Disaster Management Plan (DMP)

#### 7.6.1 Disaster

Disaster is an unplanned event that can cause death or significant injuries to employees, customers or public. It is a catastrophic situation in which suddenly, people are plunged into helplessness and suffering. As a result, they need protection, clothing, shelter, medical, social care and other necessities of life.

Disasters can be divided into two main groups, namely, natural and manmade. There can be no set criteria for assessing the gravity of a disaster, since this depends to a large extent on the physical, economic and social environment in which it occurs. However, all disasters bring in similar consequences that call for immediate action, whether at the local, national or international level for the rescue and relief of the victims.

#### 7.6.2 Objectives of Disaster Management Plan

Disaster Management Plan (DMP) is the process of preparing for mitigating measures, responding to and recovering from an emergency. The DMP is aimed at ensuring safety of life, protection of environment, protection of installation, restoration of production and salvage operations, in this same order of priorities. For effective implementation of the DMP, it should be widely circulated and personnel training should be provided through rehearsals/ drills.

The DMP should reflect the probable consequences of the undesired event due to deteriorating conditions or through ‘Knock on’ effects. Further the management should be able to demonstrate that their assessment of the consequences uses good supporting evidence and is based on available and reliable information, incident data from internal and external sources, and, if necessary, the reports of outside agencies.

The objective of the industrial DMP is to make use of the combined resources of the plant and the outside services to achieve the following:

- Effect the rescue and medical treatment of causalities.
- Safeguard other people.
- Minimize damage to property and the environment.
- Initially contain and ultimately bring the incident under control.
- Provide authoritative information to the news media.
- Secure the safe rehabilitation of affected area.
- Preserve relevant records and equipment for the subsequent inquiry into the cause and circumstances of the emergency.
- In effect, it is to optimize that the operational efficiency to rescue, rehabilitate and render medical help and restore normalcy.

### 7.6.3 Emergency Plan

Emergency planning is primary for the protection of plant personnel and people in nearby areas and the environment that could be affected by unplanned hazardous events. The emergency may arise from the leakage, explosion caused by over pressure in equipment, chemical storage and handling, fire due to combustible material and social disorder.

### 7.6.4 Furnace Hazard

Furnaces are associated with fire and electrical hazard due to sudden generation of pressure or temperature that leads to damage, injury and death. Temperature and pressure are closely related, and when flammable or combustible mixture is present in process equipment that leads to worst consequences. Thus, an engineering evaluation will be done for worst-case scenario.

### 7.6.5 Safety Measures

- Installation of automatic alarm.
- Explosion suppression system with detector technique and suppressant.
- Means of shutting off the power and raw material supply.

- Standard Operating Practices (SOPs) for starting sequence of furnace should include along with checkup for exhaust system prior to ignition
- Piping, valves and fitting should be metallic and be in accordance with NFPA-30. (Flammable & combustible liquid code)

**7.6.6 Fire & Explosion**

Fire consequences can be disastrous, since they involve high voltage current and huge quantities of raw material with fuel either stored or in dynamic inventory in conveyors or hoppers or in nearby areas. Toxic releases can affect persons working around.

Preliminary Hazard Analysis has provided a basis for consequence estimation. Estimation can be made by using various pool fires, tank fire consequence calculations.

During the study of Risk Assessment, the nature of damages is worked out and probability of occurrence of such hazards is also drawn up. The aim of DMP is to introduce the pragmatic guidelines for safe storage and warehousing of hazardous/ combustible materials, thus protecting human health and environment. The following control/ mitigating measures should be adopted :

- Eliminate all sources of ignition. However, it is difficult to ascertain.
- All the sources of ignition, especially if there are any moving parts.
- DCP type extinguishers are recommended.
- All emergency and safety related equipment must be frequently and regularly checked and maintained to ensure that their condition is satisfactory. Records should be kept of all checks and maintenance carried out on this equipment.
- The necessary first aid equipment should include emergency showers and eyewash facilities.
- The firefighting media should be selected according to mode of action and their use in combating or preventing the spread of fire. It may be water, dry chemical powder, carbon dioxide and foam.
- Extinguishers should be fitted with means to provide visual indications that the unit has partially or wholly been discharged.

- A fire detection alarm and automatically activated $CO_2$ or equal fire suppression system should be provided in the electrical room.

### 7.7 On-Site Emergency Plan

On-site emergency is caused by an accident that takes place in a hazardous installation and the effects are confined to factory premises involving the people working in the factory. Preparation of On-site Emergency plan is the responsibility of Factory Management. When the consequences of an emergency situation are restricted essentially within plan boundaries/ premises, it becomes an on-site emergency. Site - Emergency is under the control of senior offer of the organization not below the rank of General Manager. Separate cell will be created to handle emergency occurred due to natural or man–made disasters. Evacuation plan will be prepared. Fire tenders, ambulance and mobile hospital facilities will be provided to the victims at the shortest time. One Health Centre equipped with modern technology will be identified which has tied up with Government district hospital to get services of the various areas.

#### 7.7.1 Emergency Communication

Whoever notices an emergency situation such as fire, growth of fire, leakage etc. should inform his immediate superior and Emergency control center. The person on duty in the Emergency Control Centre should appraise the Site Main Controller (SMC).

#### 7.7.2 Emergency Responsibilities

**a. Site Controller**

On receiving information about emergency, he would rush to Emergency Control Center (ECC). Declares Emergency and orders for operation of emergency siren. He has to organize announcement by public address system about the location of emergency. He would assess which areas are likely to be affected, or need to be evacuated or are to be alerted.

**b. Incident Controller**

The incident controller assembles the incident control team, directs operations within the affected areas, directs the shutting down and evacuation of plant, ensures that all key

personnel help is sought, provides advice and information to the Fire and Security Officer, coordinates with emergency services at the site.

**c. Emergency Coordinator**

- Rescue, Fire Fighting.
- Medical, Mutual Aid, Rehabilitation, Transport and Communication.
- Updating emergency plan, organizing mock drills verification of inventory of emergency facilities and furnishing report to site controller.
- Maintains liaison with Civil Administration.
- Controls rehabilitation of affected areas on discontinuation of emergency.
- Maintains essential services like Diesel Generator, Water, Firewater, Compressed Air/ Instrument Air, Power Supply for lighting.
- Ensures availability of adequate quantities of protective equipment and other emergency materials & spares.

### 7.7.3 General Responsibilities of Employees during an Emergency

It becomes more enhanced and pronounced when an emergency warning is raised, the workers, if they are in-charge of process equipment, should adopt safe and emergency shut down and attend any prescribed duty as essential employee. If no such responsibility is assigned, he should adopt a safe course to assembly point and wait for instructions. He should not resort to spread panic. On the other hand, he must assist emergency personnel towards objectives of DMP.

### 7.7.4 Emergency Facilities

**a. Emergency Control Centre**

Emergency Control Centre (ECC) with intercom, telephone, self contained breathing apparatus, fire suit, hand tools, wind direction indications, public address megaphone, hand bell, telephone directories, factory layout, site plan, emergency lamp, hazard chart, emergency shut-down procedures, address with telephone numbers and key personnel, emergency coordinator, and essential employees.

**b. Assembly Point**

Number of assembly point depending upon the plant location would be identified wherein employees who are not directly connected with the disaster management would be assembled for safety and rescue. Emergency breathing apparatus, minimum facilities like

water, etc. would be organized there. In this project there is two assembly points in opposite direction.

**c. Emergency Power Supply**

Plant facilities would be connected to DG and would be placed in auto mode. Thus, water pumps, plants lighting and emergency control center, administrative building and other auxiliary services are connected to emergency power supply.

**d. Fire Fighting Facilities**

First Aid and Fire Fighting equipment suitable for emergency should be maintained in each and at bulk storage of fuel.

**e. Location of Wind Sock**

On the top of the administration block / security block / production blocks, wind socks would be installed to indicate direction of wind for emergency escape.

**f. Emergency Medical Facilities**

Stretchers, gas masks and general first aid materials for dealing with fire burns etc. Apart from plant first aid facilities, external facilities would be augmented. Names of medical personnel, medical facilities in that particular area would be prepared and updated.

**g. Emergency Warning**

Communication of emergency would be made familiar to the personnel inside the plant and people outside. An emergency warning system would be established.

**h. Emergency Shutdown**

There could be more number of persons in the storage area and other areas in the vicinity. The area would have adequate number of exits, staircases, etc.

### i. All Clear Signal

At the end of an emergency, the Site Controller orders for an all clear signal. When it becomes essential, the Site Controller communicates to the District Emergency Authority, Police and Fire Service personnel regarding help required or development of the situation into an Off-Site Emergency.

### j. Mutual Aid

Mutual aid in the form of technical personnel, runners, helpers, special protective equipment, transport vehicles, communication facility, etc., should be sought from the neighboring industrial management.

### k. Mock Drills

Emergency preparedness is an important aspect of planning in Industrial Disaster Management. Personnel would be trained suitably and prepared mentally as well as physically in emergency response through carefully planned and simulated procedures. Similarly, the key personnel and essential personnel should be trained in the operations. List of Key persons during emergency situation will be mentioned in the **Table 7.2**

**Table-7.2**
**List of Key persons**

| S. No. | Emergency Coordinator |
|---|---|
| 1 | General Manager |
| 2 | Manager (Project) |
| 3 | Manager(Maintenance) |
| 4 | Shift In charge |

### 7.8 Hazardous Chemicals & Associated Hazards

There is no storage of any hazardous chemical in the Industry.

### 7.9 Off-Site Emergency Plan

Major emergencies like bursting of tankers are classified as offsite emergency and it is not possible for single factory to handle the situation. The task of preparing the off-Site Emergency Plan lies with the District Collector. However, the off-site plan could be prepared as a Composite off-site Emergency Plan with the help of the local district authorities and the nearby industries in the Industrial Estate.

Off-site emergency plan follows the on-site emergency plan. When the consequences of an emergency 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 should 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 should be based on those events, which are most likely to occur, but other less likely events, which have severe consequence, should also be considered. An early decision will be required in many cases on the advice to be given to people living within the range of the accident. The main aspects, which should be included in the emergency plans, are:

**a. Organization**

Details of command structure, warning systems, implementation procedures, emergency control centers should be there. Names and appointments of the incident controller, site main controller, their deputies and other key personnel should be available.

**b. Communications**

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

**c. Specialized Knowledge**

Knowledge includes details of specialist bodies, firms and people upon whom it may be necessary to call, for example those with specialized knowledge, laboratories.

**d. Chemical Information**

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

**e. Meteorological Information**

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

**f. Humanitarian Arrangements**

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

**g. Public Information**

Arrangements for dealing with the media press office and informing relatives.

**h. Assessment**

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

**i. Role of the Emergency Co-ordination Officer (ECO)**

The ECO should co-ordinate various emergency services. The ECO should coordinate closely with the site main controller. The external control should be passed to a senior local authority administrator or even an administrator appointed by the central or state government.

**j. Role of the Local Authority**

The duty to prepare the off-site plan lies with the local authorities. The Emergency Planning Officer (EPO) appointed should carry out his duty in preparing for a whole range of different emergencies within the local authority area. Rehearsals for off-site plans shall be organized by the EPO.

**k. Role of Police**

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

**l. Role of Fire Authorities**

The cessation of a fire should normally be 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.

**m. Role of Health Authorities**

Health authorities including doctors, hospitals, ambulances and so on are a vital part of the emergency plan. Major off-site incidents are likely to require medical equipment and facilities additional to those available locally. A medical "mutual aid" scheme should exist to enable the assistance of neighboring authorities to be obtained in the event of an emergency.

**n. Role of Government Safety Authority**

In the event of an accident, local arrangements regarding the role of the factory inspector will apply. List of key persons will be mentioned in the Off- Site Emergency Plan in **table 7.3.**

**Table-7.3**

**List of Key persons off site EP**

| S. No. | Emergency Coordinator |
|---|---|
| 1 | District Magistrate |
| 2 | Fire Brigade |
| 3 | Controller of Explosive |
| 4 | SP |
| 5 | DHO |
| 6 | SPCB |