ADDITIONAL STUDIES

(HAZARD IDENTIFICATION & RISK ASSESSMENT, DISASTER MANAGEMENT PLAN AND PUBLIC CONSULTATION)

Considering the generic structure of the EIA/EMP report prescribed in EIA Notification dated 14.09.2006, this chapter is to comprise of public consultation, disaster management, social impact assessment and R&R Action plan. This chapter deals with identification of hazards and disaster and preventive measures for disaster. The proposed expansion Steel plant may face certain types of hazards which can disrupt normal activities abruptly and lead to disaster like fires, inundation, failure of machinery, hot metal spill, electrocution to name a few. Disaster management plan is formulated with an aim of taking precautionary step to control the hazard propagation and avert disaster and also to take such action after the disaster which limits the damage to the minimum.

Industrial activities, which produce, treat, store and handle hazardous substances, have a high hazard potential to safety of man and environment at work place and outside. Recognizing the need to control and minimize the risks posed by such activities, the Ministry of Environment & Forests have notified the “Manufacture Storage & Import of Hazardous Chemicals Rules” in the year 2008 (In supersession of the *Hazardous* Wastes (Management and Handling *Rules*, *1989)* and subsequently modified, inserted and added different clauses in the said rule to make it more stringent. For effective implementation of the rule, Ministry of Environment & Forests has provided a set of guidelines. The guidelines, in addition to other aspects, set out the duties required to be performed by the occupier along with the procedure. The rule also lists out the industrial activities and chemicals, which are required to be considered as hazardous.

During the process of manufacture of steel and other associated materials hazardous wastes are generated which are stored and used within the plant process. In view of this, proposed activities are being scrutinized in line of the above referred “manufacture, storage and import of hazardous chemicals rules” and observations / findings are presented in this chapter.

The steel plant normally assesses and manages risk using recognized risk management tools and/ or internal procedures (e.g., standard operating procedures). Some of these tools are (i) basic risk management facilitation methods (flowcharts, check sheets etc.), (ii) failure mode effects analysis (FMEA), (iii) failure mode, effects and criticality analysis (FMECA), (iv) fault tree analysis (FTA), (v) hazard analysis and critical control points (HACCP), (vi) hazard operability analysis (HAZOP), (vi) preliminary hazard analysis (PHA), (vii) risk ranking and filtering, and (viii) supporting statistical tools.

1.1 HAZARD IDENTIFICATION AND RISK ASSESSMENT

Hazard is a source or situation that has the potential for harm in terms of human injury, ill health, damage to property or the environment, or a combination of these factors. It has got a short or a long term effect on the work environment with considerable human and economic costs. A hazard can have a potential to create an emergency like situation at the work place. Hazard is a potential cause to generate a disaster.

Hazards exist in every workplace in different forms and required to be identified, assessed and controlled regarding the work processes, plant or substances. They arise from (i) workplace environment, (ii) use of plant and equipment (iii) use of substances and materials, (iv) poor work and/or plant design, (v) inappropriate management systems and work procedures, and (vi) human behaviour.

Steel plant has many hazardous processes and operations which can cause considerable environmental, health and safety risk to the workforce. All the hazards cause potential risk to the work environment which include work force and work place and hence need proper assessment.

M/s BRGD Ingot Pvt. Ltd. is planning to install a 1,15,500 TPA capacity Sponge Iron Plant; 1,98,000 TPA capacity Induction Furnace (4x15 T) with matching LRF & CCM; 1,80,000 TPA capacity Rolling Mill; 1,20,000 TPA capacity Continuous Galvanising Line; and 12 MW (8 MW WHRB based & 4 MW AFBC based) Captive Power Plant utilizing the waste heat and char from the DRI plant in the existing steel plant at village: Palitpur, Mouza: Mirzapur, District: Burdwan in West Bengal. The Plant has lower risk potential than those industries dealing with toxic and flammable chemicals. Off-site people are not exposed to any dangers, hence the societal risk is insignificant.

1.1.1 APPROACH TO THE STUDY

Risk involves the occurrence or potential occurrence of some accidents consisting of an event or sequence of events. The risk assessment study covers the following:

1. Identification of potential hazard areas;
2. Identification of representative failure cases;
3. Assess the overall damage potential of the identified hazardous events and the impact zones from the accidental scenarios;
4. Assess the overall suitability of the site from hazard minimization and disaster mitigation point of view;
5. Furnish specific recommendations on the minimization of the worst accident possibilities; and
6. Preparation of broad Disaster Management Plan (DMP), on-site and off-site emergency plan, which includes occupational and health safety plan.

1.1.2 HAZARD IDENTIFICATION

The following two methods for hazard identification have been employed in the study:

1. Identification of major hazardous units based on manufacture, storage and import of hazardous chemicals rules, 2008 and storage units based on relative ranking technique, viz. fire-explosion and toxicity index (FE&TI).
2. Identification of hazardous units and segments of plants based on FMEA

1.2 CLASSIFICATION OF MAJOR HAZARDOUS SUBSTANCES

Hazardous substances may be classified into three main classes namely flammable substances, unstable substances and toxic substances. The ratings for a large number of chemicals based on flammability, reactivity and toxicity have been given in NFPA Codes 49 and 345 M. The major hazardous materials to be stored, transported, handled and utilized within the facility have been summarized in the Table-1.1. The fuel storage details and properties are given in Table-1.2 and Table-1.3 respectively.

TABLE-1.1
CATEGORY WISE SCHEDULE OF STORAGE TANKS

Materials	Hazardous Properties
HSD	U 1202. Dangerous Goods Class 3 – Flammable Liquid

TABLE-1.2
HAZARDOUS MATERIALS STORED, TRANSPORTED AND HANDLED

A	Material	No. of Tanks	Capacity (Storage Condition)
1	HSD	1	20 KL

TABLE-1.3
PROPERTIES OF FUELS USED IN THE PLANT

Chemical	Codes/Label	TLV	FBP	MP	FP	UEL	LEL
			^{0}C			%	
HSD	Flammable	-	371	-	54.4	6	0.7

TLV : Threshold Limit Value   FBP : Final Boiling Point
MP : Melting Point   FP : Flash Point
UEL : Upper Explosive Limit   LEL : Lower Explosive Limit

1.2.1 IDENTIFICATION OF MAJOR HAZARD INSTALLATIONS BASED ON GOI RULES, 2008

Following accidents in the chemical industry in India over a few decades, a specific legislation covering major hazard activities has been enforced by Govt. of India in 2008 (In suppression of 1989) in conjunction with Environment Protection Act, 1986. This is referred here as GOI Rules 2008. For the purpose of identifying major hazard installations, the rules employ certain criteria based on toxic, flammable and explosive properties of chemicals.

A systematic analysis of the fuels/chemicals and their quantities of storage has been carried out, to determine threshold quantities as notified by GOI Rules, 2008 and the applicable rules are identified. Applicability of storage rules are summarized in Table-1.4.

TABLE-1.4
APPLICABILITY OF GOI RULES TO FUEL STORAGE

Sr. No.	Chemical/Fuel	Listed in Schedule	Total Quantity	Threshold Quantity (T) for Application of Rules	
				5,7-9,13-15	10-12
1	HSD	3(PART II)	1 x 20 KL	25 MT	200 MT

1.3 HAZARD ASSESSMENT AND EVALUATION

1.3.1 METHODOLOGY

An assessment of the conceptual design is conducted for the purpose of identifying and examining hazards related to feed stock materials, major process components, utility and support systems, environmental factors, proposed operations, facilities, and safeguards.

In the steel plant of M/s BRGD Ingot Pvt. Limited, large amounts of material are processed, transported and conveyed by massive equipment. The major chemicals handled / stored by the plant includes HSD, LDO etc. Due to massive equipment and movement of large masses of materials, workers are exposed to the heat of molten metal and slag at temperatures up to 1,800°C, toxic or corrosive substances, respirable air-borne contaminants and noise.

Burns may occur at many points in the steel-making process: at the front of the furnace during tapping from molten metal or slag; from spills, spatters or eruptions of hot metal from ladles or vessels during processing, teeming (pouring) or transporting; and from contact with hot metal as it is being formed into a final product.

Water entrapped by molten metal or slag may generate explosive forces that launch hot metal or material over a wide area. Inserting a damp implement into molten metal may also cause violent eruptions.

Mechanical transport exposes workers to potential struck-by and caught- between hazards. Overhead travelling cranes are found in almost all areas of steel works. Most large works also rely heavily on the use of fixed-rail equipment and large industrial tractors for transporting materials.

Large quantities of greases, oils and lubricants are used and if spilled can easily become a slipping hazard on walking or working surfaces.

Sharp engines or burrs on steel products or metal bands pose laceration and puncture hazards to workers involved in finishing, shipping and scrap-handling operations.

Foreign-body eye hazards are prevalent in most areas, especially in raw material handling and steel finishing, where grinding, welding and burning are conducted.

Splashing of molten metal and solid waste

Sudden breaks out of molten metal and slag may take place during furnace operation. The break out may take place from weak portions of hearth. The spillage of hot metal or slag can cause severe burn injuries and fires. Explosions may also occur due to hot metal or slag falling in a pool of water resulting in injuries and fire due to flying hot splinters and splashing of hot metal or slag. The spillage of hot metal can also be due to hearth breakage, mould breakage and during transportation. The accidents can occur due to failure of water-cooled panels, puncture in water-cooled lances, leakage of water from the walls of mould. Through regular checks and proper upkeep of furnace refractory and cooling panels, such incidents can be avoided.

The consequences will result in death (extreme case), severe burn and mechanical injury and will be limited to working personnel near the site of incident.

Dust and fumes

Dust and fumes are generated at many points in the existing steel plant. Dust and fumes are found in the preparation processes, especially sintering, in front of the induction furnaces etc.

Exposure to silica is a risk to workers engaged in lining, relining and repairing induction furnaces and vessels with refractory materials. Ladles are lined with fire-brick or bonded crushed silica and this lining requires frequent repair. The silica contained in refractory materials is partly in the form of silicates, which do not cause silicosis but rather pneumoconiosis. Workers are rarely exposed to heavy clouds of dust.

Alloy additions to furnaces making special steels sometimes bring potential exposure risks from chromium, manganese, lead and cadmium.

Rolling Mill

Severe injuries may be sustained in hot rolling, if workers attempt to cross roller conveyors at unauthorized points. Looping and lashing may cause extensive injuries and burns, even severing of lower limbs. The use of large quantities of oils, rust inhibitors and so on, which are generally applied by spraying, is another hazard commonly encountered in rolling mills. Despite the protective measures taken to confine the sprayed products, they often collect on the floor and on communication ways, where they may cause slips and falls.

Even in automated works, accidents occur in conversion work while changing heavy rollers in the stands.

Tongs used to grip hot material may knock together; the square spanners used to move heavy rolled sections by hand may cause serious injuries to the head or upper torso by backlash. Many accidents may be caused by faulty lifting and handling and by defects in cranes and lifting tackle. Many accidents are caused through falls and stumbles or badly maintained floors, by badly stacked material, by protruding billet ends and cribbing rolls and so on.

In hot rolling, burns and eye injuries may be caused by flying mill scale; splash guards can effectively reduce the ejection of scale and hot water. Eye injuries may be caused by dust particles or by whipping of cable slings; eyes may also be affected by glare.

Considerable noise develops in the entire rolling zone from the gearbox of the rolls and straightening machines, from pressure water pumps, from shears and saws, from throwing finished products into a pit and from stopping movements of the material with metal plates.

Cleaning of the finished products with high-speed percussion tools may lead to arthritic changes of the elbows, shoulders, collarbone, distal ulna and radius joint, as well as lesions of the navicular and lunatum bone.

Joint defects in the hand and arm system may be sustained by rolling mill workers, owing to the recoiling and rebounding effect of the material introduced into the gap between the rolls. When lead-alloyed steel is rolled or cutting-off discs containing lead are used, toxic particles may be inhaled. Lead may also be inhaled by flame scarfers and gas cutters, who may at the same time be exposed to nitrogen oxides (NO_x), chromium, nickel and iron oxide.

Large amounts of degreasing agents are used for the finishing operations. These agents evaporate and may be inhaled; their action is not only toxic, but also causes deterioration of the skin, which may be degreased when solvents are not handled properly. The Brief about nature of various Hazards in BRGD is given in Table1.5

Table-1.5 : Brief of Nature of Hazard in BRGD

NATURE OF HAZARD	SOURCES
Fire Hazard	Release/leakage of Oxygen, and Hot Liquid metal. Fire in HSD storage.
Cold Burns	Exposure to liquid oxygen, liquid nitrogen and liquid argon.
Fire/Explosions due to Spillage of Liquid Metal	Spillage/Transfer of liquid metal, liquid steel and hot slag.
Heat Radiations due to Hot Metal Handling	Spillage of liquid metal, liquid steel and hot slag
Accidents due to Material Handling	Connected with all Material Handling Equipment

Equipment	

1.3.2 PRELIMINARY HAZARD ANALYSIS (PHA)

A preliminary hazard analysis is carried out initially to identify the major hazards associated with storages and the processes of the plant. 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. Preliminary hazard analysis for fuel storage area and whole plant is given in **Table-1.6** and **Table-1.7**.

TABLE-1.6
PRELIMINARY HAZARD ANALYSIS FOR STORAGE AREAS

Unit	Capacity	Hazard Identified
HSD	20 KL	Pool fire

TABLE-1.7
PRELIMINARY HAZARD ANALYSIS FOR THE WHOLE PLANT IN GENERAL

PHA Category	Description of Plausible Hazard	Recommendation	Provision
Environmental factors	If there is any leakage and eventuality of source of ignition.	--	All electrical fittings and cables are provided as per the specified standards. All motor starters are flame proof.
	Highly inflammable nature of the liquid fuels may cause fire hazard in the storage facility	A well designed fire protection including foam, dry powder, and CO_2 extinguisher should be provided.	Fire extinguisher of small size and big size are provided at all potential fire hazard places. In addition to the above, BRGD has own firefighting equipment.

1.3.3 FIRE EXPLOSION AND TOXICITY INDEX (FE&TI) FOR STORAGE UNIT

Dow's Fire and Explosion Index (F and E) is a product of Material Factor (MF) and hazard factor (F3) while MF represents the flammability and reactivity of the substances, the hazard factor (F3), is itself a product of General Process Hazards (GPH) and Special Process Hazards (SPH). The application of FE & TI would help to make a quick assessment of the nature and quantification of the hazard in these areas. However, this does not provide precise information.

The degree of hazard potential is identified based on the numerical value of F&EI as per the criteria given below:

F&EI Range	**Degree of Hazard**
0-60	Light
61-96	Moderate
97-127	Intermediate
128-158	Heavy
159-up	Severe

By comparing the indices F&EI and TI, the unit in question is classified into one of the following three categories established for the purpose **(Table- 1.8).**

TABLE-1.8
FIRE EXPLOSION AND TOXICITY INDEX

Category	Fire and Explosion Index (F&EI)	Toxicity Index (TI)
I	F&EI < 65	TI < 6
II	65 < or = F&EI < 95	6 < or = TI < 10
III	F&EI > or = 95	TI > or = 10

F&EI Index Range	Degree of Hazards
1 – 60	Light
61 – 96	Moderate
97 – 127	Intermediate
128 – 158	Heavy
159 – up	Severe

Certain basic minimum preventive and protective measures are recommended for the three hazard categories.

1.3.3.1 RESULTS OF FE AND TI FOR STORAGE UNIT

Based on the GOI Rules 2008, the hazardous fuel used by the proposed project is identified. Fire and explosion are the likely hazards, which may occur due to the fuel storage. Hence, fire and explosion index has been calculated for in plant storage.

The Health (N_h), Flammability (N_f), Reactivity (N_r), and MF (Material Factor) for all the materials under consideration was derived from NFPA (National Fire Protection Association) codes. The GPH (General Process Hazard Factor) and SPH (Specific Process Hazard Factor) was calculated accordingly. Based on F&EI (Fire and Explosion Index), the HSD will come in light degree of hazard and nil toxicity. Thus, Risk Assessment and Hazard analysis has been carried out due to fire hazard for HSD tanks by carrying out MCA (Maximum Credible Accident) analysis for the same. Estimates of FE&TI are given in Table-1.9.

TABLE-1.9
FIRE EXPLOSION AND TOXICITY INDEX

Fuel	Total Capacity	NFPA Classification				GPH	SPH	F&EI	F & E Category	**TI	Toxicity Category
		N_h	N_f	N_r	MF						
HSD	1 x 20 KL	0	2	0	10	2	2.2	43.2	Light	NIL	-

Results of FE&TI analysis show that the storage of HSD falls into Light category of fire and explosion index.

Damage distance computations for MCA (Maximum Credible Accident) analysis

The major hazards scenarios identified for the possibility of occurrence are mainly concerned with HSD tanks.

A storage tank of HSD with a capacity of 20 KL, Molecular Weight 135 kg/ kg mol, Boiling Point 350 ^{0}C, density 900 kg/m^3 is considered. Tank fire would occur if the radiation intensity is high on the peripheral surface of tanks leading to increase in internal tank pressure. Pool fire would occur when fuel oil collected in the dyke due to leakage gets ignited. As the tanks are provided within the dyke the fire will be confined within the dyke wall.

SOURCE STRENGTH:
Burning Puddle / Pool Fire
Puddle Diameter: 2.5 meters
Puddle Volume: 5 cubic meters
Flame Length: 8 meters
Burn Duration: ALOHA limited the duration to 1 hour
Burn Rate: 25.3 kilograms/min
Total Amount Burned: 1,516 kilograms

THREAT ZONE:

Sr. No.	Incident Radiation (kW/m^2)	Type of Damage Intensity	
		Damage to Equipment	Damage to People
1	37.5	Damage to process equipment	100% lethality in 1 min. 1% lethality in 10 sec
2	12.5	Minimum energy to ignite with a flame; melts plastic tubing	1% lethality in 1 min.
3	4.5		Causes pain if duration is longer than 20 sec, however blistering is un-likely (First degree burns)
4	2		Causes no discomfort on long exposures

Source: Techniques for Assessing Industrial Hazards by World Bank

The maximum capacity of storage of HSD is 20 KL. The most credible failure is the rupture/hole of the storage tank. As a worst case, it is assumed that the entire contents leak out into the dyke forming a pool, which may catch fire on finding a source of ignition. The radiation intensities for rupture of HSD storage tank is given in Table-1.10

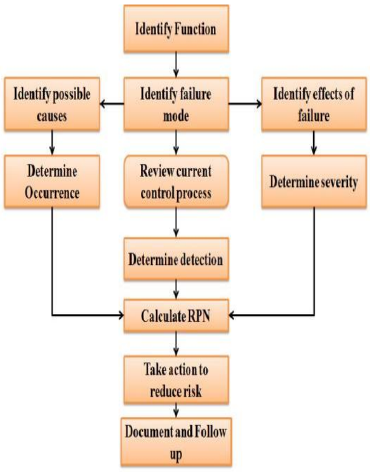
TABLE-1.10
THERMAL RADIATION DUE TO FAILURE OF HSD AND LDO TANKS

Scenario	**Thermal radiation kW/m2 distance in m**			
	37.5	**12.5**	**4.5**	**2**
Failure of HSD Storages tank	4.7	10.7	18.8	34.5

1.3.4 FAILURE MODE EFFECT ANALYSIS FOR PROCESS UNITS

Failure mode effects analysis (FMEA) is one of the most important and widely used tools for reliability analysis. FMEA identifies corrective actions required to reduce failures to assure the highest possible yield safety and reliability. Even though it is widely used reliability technique it has some limitation in prioritizing the failure modes and output may be large for even simple systems, may not easily deal with time sequence, environmental and maintenance aspects.

Figure – 1.2: Steps in FMEA



1.3.4.1 RISK PRIORITY NUMBER

Risk priority number methodology is a technique for analysing the risk associated with potential failures during a FMEA analyses. To calculate risk priority number severity, occurrence, and detection are the three factors need to determine.

$$RPN = Severity \times Occurrence \times Detection$$

1.3.4.2 SEVERITY (S)

Severity is the seriousness of the effect of potential failure modes. Severity rating with the higher number represents the higher seriousness or risk which could cause death.

Table-1.11: Example table of Severity

Rating	Detection	Detection by design control
10	Absolute uncertainty	Design control cannot detect failure mode
9	Very remote	Very remote chance the design control detect failure mode
8	Remote	Remote chance the design control detect failure mode
7	Very low	Very low chance the design control detect failure mode
6	low	Low chance the design control detect failure mode
5	Moderate	Moderate chance the design control detect failure mode
4	Moderately high	Moderately high chance the design control detect failure mode
3	High	High chance the design control detect failure mode
2	Very high	Very high chance the design control detect failure mode
1	Almost certain	Design will control detect failure mode

1.3.4.4 OCCURRENCE (O)

Occurrence ratings for FMEA are based upon the likelihood that a cause may occur based upon past failures and performance of similar system in similar activity. Occurrence values should have data to provide justification.

Table –1. 12: Example table of Occurrence

Rating	Classification	Example
10 9	Very high	Inevitable failures
8 7	High	Repeated failures
6 5	Moderate	Occasional failures
4 3	Low remote	Few failures
2 1	Remote	Failures unlikely

1.3.4.5 DETECTION (D)

Detection is an assessment of the likelihood that the current controls will detect the cause of failure mode.

Table – 1.13: Example table of Detection

Ranking	Effect	Severity effect
10	Hazardous without warning	Very high severity without warning
9	Hazardous with warning	Very high severity with warning
8	Very high	Destructive failure without safety
7	High	System inoperable Equipment damage
6	Moderate	System inoperable with Minor damage
5	low	System inoperable without damage
4	Very low	Degradation of performance
3	Minor	System operable with Some degradation in performance
2	Very minor	System operable with minimal interference
1	None	No effect

1.3.4.6 FMEA IMPLEMENTATION

Failure mode effect analysis is executed by a multidisciplinary team of experts in induction furnace operation with the help of process flow chart. Criteria of ranking of severity, occurrence and detection are selected suitably by analyzing the past failure records of the furnace. Using values of severity, occurrence and detection number risk priority number is calculated.

TABLE – 1.14

RPN for Sponge Iron Plant (1X350 TPD Kiln), Induction Furnaces (4x15 T), Rolling Mill along with 12 MW capacity Captive Power Plant & their Propose Control Measures

Components / Process	Failure Mode	Failure Effect	Failure Cause	Existing Control	S	O	D	RPN	Additional Control
DRI									
Conveyor feed belt to DRI	Friction	Corrosion	Improper Maintenance	Belt Sway Switch	8	2	2	32	Lubricating the rotating parts regularly
Reducing Gas injection	Pipeline rupture	Process Failure in DRI Kiln	Over Pressure	Line Inspection	7	3	3	42	Regular inspection and Periodic maintenance
Cooler Discharged Gas	Pipeline rupture	Failure in After Burning Chamber	Excess Pressure	Line Inspection	5	3	2	30	Regular inspection and Periodic maintenance
Mag Pulley	Mechanical Failure	Waste Conveying System Failure	Improper Monitoring	Inspection	5	3	3	45	Periodic Maintenance

Conveyor Belt to storage Bins	Friction	Waste Storage System Failure	Improper Maintenance	Belt Sway Switch	4	2	2	16	Lubricating the rotating parts regularly
INDUCTION FURNACE									
Flow monitoring switch	Failure to operate	Rupture in Current Flow	Switch broken	Reliable Supplier	7	2	3	42	Regular Inspection
DC Choke	Failure to operate	Rise of current to dangerous level	Electric Failure	Reliable Supplier	7	3	3	63	Regular Inspection
DM Water circulating unit	Failure to circulate de ionized water	Excessive Heat generation in solid state power supply unit	Electric Failure	Inspection	4	3	3	24	Regular inspection and Periodic maintenance
Direction Control Valve	Failure to operate	furnace tilting control failure	Corrosion	Reliable Supplier	7	2	3	42	Periodic Maintenance
Furnace lamination packet	Electric / magnetic failure	Failure to provide a return path to the flux	Overheating of the structure	Inspection	7	3	2	42	Regular inspection and Periodic maintenance
Flow regulating valves in furnace	Failed to Operate	Excessive Temperatur e	Improper Maintenance	Indicator	6	3	4	72	Periodic Maintenance
Ladle Refining Furnace									
Hot metal ladle transfer car	Friction	Fire	Improper Maintenance	Belt Sway Switch	8	2	2	32	Lubricating the rotating parts regularly
Continuous Casting Machine									
Ladle car	Friction	Fire	Improper Maintenance	Belt Sway Switch	8	2	2	32	Lubricating the rotating parts regularly
Stopper	Mechanical Failure	Fire & Explosion	Improper Maintenance	Indicator	7	2	2	28	Regular Inspection
Tundish	Failed to Operate	Spillage of Hot liquid metal	Mechanical Failure	Line inspection	7	2	2	28	Regular inspection and Periodic maintenance
Rolling Mill (Hot)									
Conveyor rollers to feed	Friction	Fire	Improper Maintenance	Belt Sway Switch	8	2	2	32	Lubricating the rotating parts regularly
Water cooling pump	Pump failure	Explosion	No power supply	Redundant power supply	10	3	2	60	Check the fuel level of diesel generator
Rolling Mill (Cold)									
Hot water sprayer in galvanizing	pin Holes	Gas temperatur e increase	Spraying hot water excessively	Monitors	7	3	2	42	Check the level for every 5 minutes
Hot pickle bath	pin Holes	Spillage	Spraying hot pickle	Monitors	7	3	2	42	Check the level for

			excessively							every 5 minutes
WHRB & AFBC based CPP										
Air Supply Fluidized Bed	Flow Air Fuel Ratio	Operation Failure	Air Flow Below 30 %	Line inspection	5	3	4	60	Provide detectors with alarm system
WHRB Boiler	Corrosion Effect	Cooling of tube increases temperature	Creep Failure	Line inspection	4	4	4	64	Regular inspection
WHRB Boiler	Tube Alignment & Setting	Deformation of vibration Arrestor	Vibration increases	Inspection	6	2	4	48	Periodic Maintenance
AFBC Boiler	Incomplete Combustion	Air Fuel Losses	Insufficient air supply to Furnace	Line inspection	5	2	5	50	Regular inspection
Turbine / Steam Generator	Temp of Super Heater & Reheater	Failure of turbine blades	Changing the plant load	Line inspection	5	2	6	60	Periodic Maintenance
water Tank	Water Level of Drum	Excess Steam Pressure	Failure of Indicators	Monitor	6	3	2	36	Regular inspection

1.3.4.1 RESULT OF FEMA FOR PROCESS UNIT

The hot metal from Induction Furnace is transported by ladle furnace which carry moderate risk priority number. Moreover, proper marking with ROW of 3 m is already in place along with all safe guards to ensure the absence of water throughout the hot metal transfer route.

1.3.5 RISK REDUCTION OPPORTUNITIES

The following opportunities will be considered as a potential means of reducing identified risks during the detailed design phase:

- Safety organization is of prime importance in the iron and steel industry, where safety depends so much on workers' reaction to potential hazards. The first responsibility for management is to provide the safest possible physical conditions, Accident-prevention committees, workers' safety delegates, safety incentives, competitions, suggestion schemes, slogans and warning notices can all play an important part in safety programmes.
  - Provision for adequate water capacity to supply fire protection systems and critical process water;
  - Isolate people from load carrying/mechanical handling systems, vehicle traffic and storage and stacking locations;

- Installation of fit-for-purpose access ways and fall protection systems to facilitate safe access to fixed and mobile plant;
- Provision and integrity of process tanks, waste holding tanks and bunded areas as per relevant standards;
- Arrange display signs for material strictly prohibited inside any work premises like inflammable materials, firearms, weapons & ammunitions, etc.
- Developing 'Dos' & 'Don'ts' during various types of works like working at heights, etc.
- Ensure that emergency control mechanisms like switch, valve and emergency lamp are covered with shield, water & shock resistance cover during rain etc. and peddle switch for bigger rotating machinery mixer etc. There should be no temporary cable joints and open air working switch yard at enriched level.
- In addition to the yard fire hydrant system, each individual shop would be provided with fire and smoke detection alarm system. Fire detection system would be interlocked with automated water sprinklers.
- Security of facility to prevent unauthorized access to plant, introduction of prohibited items, and control of onsite traffic; and
- Development of emergency response management systems commensurate.

Overall, an integrated approach combining good engineering and maintenance practices, safe job procedures, worker training and use of personal protective equipment (PPE) is required to control hazards.

1.4 DISASTER MANAGEMENT PLAN

A disaster is a catastrophic situation in which suddenly, people are plunged into helplessness and suffering, as a result, need protection, clothing, shelter, medical and social care and other necessities of life. A disaster is an unforeseen combination of circumstances that causes serious body injuries loss of life or extensive damage to the plant facilities or total.

In the above sections, risk assessment has been made, based on the potential hazards, identified for the said project.

Disasters can be divided into two main groups. In the first, disasters resulting from natural phenomena like

1. Cyclone
2. Earthquake
3. Sabotage
4. Riot
5. Air Raid

The second group includes disastrous events occasioned by man, or man's impact upon the environment. Examples are industrial accidents, radiation accidents, factory fires, explosions and escape of toxic gases or chemical substances, spillage of hot molten liquid metal, river pollution, mining or other structural collapses, rail and road transport accidents and can reach catastrophic dimensions in terms of human loss.

The company has prepared its Disaster Management Plan to take care of all the emergency situations/ eventualities, as discussed above.

The Disaster Management Plan of the company is divided into two parts:

(i) Onsite Emergency Plan
In this plan, the company officers will be given pre-designated responsibilities for dealing with the emergency.

(ii) Offsite Emergency Plan
In this, different Govt. agencies will be conformed about the emergency for necessary help from them.

1.4.1 OBJECTIVE OF DISASTER MANAGEMENT PLAN

The disaster management plan is aimed to ensure 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 disaster management plan, it will be widely circulated and personnel training given through rehearsals/drills. The disaster management plan would reflect the probable, consequential severalties of the undesired event due to deteriorating conditions

To tackle the consequences of a major emergency inside the factory or immediate vicinity of the factory, a disaster management plan has to be formulated and this planned emergency document is called "Disaster Management Plan".

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

- Proper training should be provided to ensure safe operation of the crane for hot metal transfer. There should be proper communication and use of standard hand signals between crane drivers and slingers to prevent injuries from unexpected crane movement / spillage of hot metal

- Safe means of access to cranes to avoid falls and accidents on crane transverse ways.

- Regular maintenance shall be ensured for Mechanical parts of trolleys like Gearbox, Axial & Wheels to avoid any spillage of hot metal during transportation.

- Proper training should be imparted to the workers, which should include information about hazards, safe methods of work, avoidance of risks and the wearing of PPE.

- Furnace operators should be protected by enclosing the source of noise by providing sound proof shelters. Reducing exposure time may also prove effective. Hearing protectors (earmuffs or earplugs) are often required in high-noise areas.

- All dangerous parts of machinery and equipment, including lifts, conveyors, long travel shafts and gearing on overhead cranes, should be securely guarded.

- Proper ventilation should be provided throughout the plant wherever substantial quantity of dust, fumes and gas are generated, together with the highest standards of cleanliness and housekeeping.

- Gas equipment must be regularly inspected and well maintained so as to prevent any gas leakage. When work in a dangerous area is unavoidable, self-contained or supplied-air respirators should be worn. Breathing-air cylinders should always be kept in readiness,

- Heat protection should be provided between workers and radiant heat sources, such as furnaces or hot metal.

ON-SITE EMERGENCY PLAN

A) The disaster control procedure lays down the efforts to be made to prevent fatal accidents, physical harm or injury to personnel and damage to equipment facilities materials. It requires coordinated efforts of all employees to control and eliminate a disastrous situation.

B) All efforts to control a disaster will be coordinated among the various co-ordinators and all actions, taken will be as directed by the chief co-ordinator. The co-ordinating members will be responsible to keep him posted on the development and course of action will be followed by them (refer **Annexure-I)**.

1.4.2 EMERGENCIES

Emergencies at this factory may be of minor and major nature and both requires be handled properly with minimum damage or loss and/or injury.

I. Fire & Explosion

- General Fire.
- Electrical Fire.
- Fire on HSD

Table-1.15-Work instruction for the personnel for fire

Sr. No.	Element	Description	Responsibility
1	Detection of Fire	It fire out breakers at any place, it is to be reported to Area- in-charge	Concerned Line In charge/Staff
2	Switch off the sources of fire	Source of fire to be stopped.	Concerned Operational in charge.
3	Emergency Alarm	Emergency Alarm should be activated by nominated Security Guard like Shift Security Supervisor	Shift Security Supervisor/ Shift Security Officer.
4	Assembly	All employees to be assemble at the nearest assembly point.	Security Guard/ Member of Emergency control team
5	Head count & Call Fire Brigade	Head count to be done for all the personal matching with total entry.	Manager- HR & A
6	Remedy Action	Using in house Fire Extinguisher, Fire Brigade/ tanker available in plant to stop the fire	Unit Head
7	Call Fire brigade	Call to the nearest fire brigade if required	Manager- HR & A

II. Heavy Splashing/Spillage of Hot Molten Liquid Metal:

- Leakage source to be controlled.
- Clean all the burnt and metallic parts.

Work Instruction during transportation of Hot Metal is given in **Table 1.16** below:

Table-1.16

Sr. No.	Element	Description	Responsibility
1	Heavy Splashing / Spillage of Hot Molten Liquid Steel from Induction Furnace	• Removal of all the flammable materials from the nearby areas. • Use ABC type, DCP type of fire extinguisher to control the fire from molten metal. • Use fire hydrant water to extinguish fire from molten metal.	Concerned Line In charge/ Operational In charge of BRGD

III. For Storage and Handling of Cylinders

- Check the label on the cylinder and identify the content before using.
- All Compressed gas cylinder should be properly handled and stored. All filled cylinders must be stored upright and secured by chains or straps or kept on the trolley to prevent falling due to accidental contact, vibration, or earthquakes.
- Gas cylinder must be secured to prevent falling due to accidental contact, vibration, or earthquakes.
- If the cylinder value cannot be open by hand, the valve should never be forced and to be returned to the supplier.
- All cylinder storage areas outside or inside, shall be protected from extreme heat, cold and access from unauthorized personnel.
- Do not allow grease or oil to come in contact with oxygen cylinders, valves, regulator, gauges or fittings.
- Open the cylinder value slowly directed away from face.
- Report all suspected leaks immediately to the maintenance department.

IV. Cyclones/Storms/Lightening

As high speed wind can cause severe property damage, bodily injury, this plan is intended to mitigate the risk of potential damage due to wind storm.

DO's:

- Immediately close all the equipment's / instruments in safe operational mode.
- Gather at emergency assembly point.
- Stay away from storm-damaged areas.
- Be up to date with Weather Forecast.
- Listen to the radio for information and instruction if any further chances or not

DON'Ts:

- Avoid taking rest high rise building / trees / equipment's etc.
- Do not panic

1.4.3 FACILITIES, AVAILABLE WITH THE FACTORY

a) **Fire Fighting Facility -** The entire factory is protected with fire extinguishing system from outside and inside the shop floor. Fire Brigade/ tanker is available in plant to take care of any unforeseen circumstances.

b) **Material Handling -** Heavy duty cranes including mobile cranes, fork lifts, trucks, trolleys is used in the plant. The same could be used at time of emergency for handling the material.

c) **Personnel Protective Equipment -** Safety shoe, safety helmets, safety goggles, asbestos hand gloves, rubber hand gloves, acid proof aprons, earplugs, aprons, leg guards etc. is made available in the Central store of the plant. At the time of emergency, the same can be made easily available by safety coordinator.

d) **Communication Facility-** All the officers can be communicated by mobile phone & Walky Talky provided by authority. A siren is being installed at the gate to inform everybody inside and outside the territory in case of emergency as well as all clear, by activating the siren tone.

e) **Assembly Points-** Four locations one in Power Plant Area, second in DRI Plant area and remaining two in the SMS area is selected and marked as assembly point during emergency. People will assemble at any one of these four locations during any emergency like gas leakage, fire explosion etc.. The wind direction can be determined from the wind sack fitted on the top of Administrative Building. People will move either opposite of wind direction or perpendicular to the wind direction.

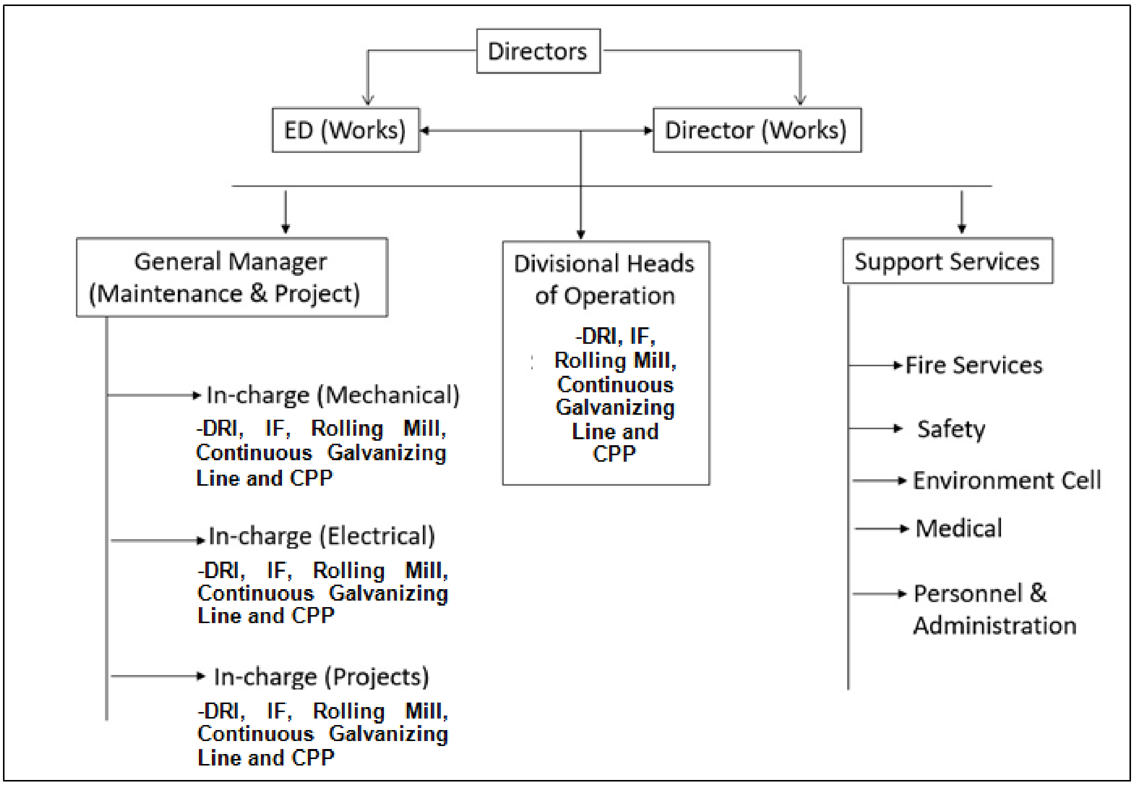
f) **Medical Facility -** The Plant has the required emergency medical facilities and health checkup for the workers is done regularly by the visiting Doctors. In case of major accident, persons are referred to nearest Hospital / Primary Health Centre.

1.4.4 KEY PERSONNEL AND RESPONSIBILITIES

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

1.4.5 ORGANIZATION

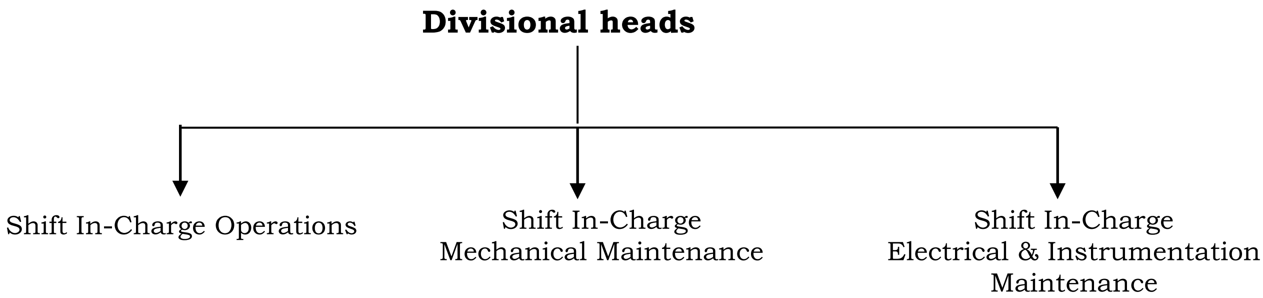
The Central Disaster Management Cell (DMC) is already set up under the direct charge of General Manager (Works). Organizational structure is as below:



Director/Executive Director (Works) is empowered to declare emergency and he is in charge of all operations in such situations. He is supported by GM (Maintenance & Projects), Divisional Heads of respective all Plants, Security and Fire Fighting, Administration, Medical Officer, In-charge Safety and In-charge Environment in handling such a situation.

Disaster Control Cell operates from the Administrative block during emergency.

There is shop level Disaster management cell in each division. Divisional heads are nominated as controllers for their respective divisions. They support central team as required. Organizational structure is as below:



1.4.6 OFF SITE EMERGENCY PLAN

Type of emergency facilities/ actions required from outside bodies:

a) **Firefighting facilities required**: The plant has its own fire fighting facilities but during emergency, fire brigade may be called.

b) **Police help** required during emergency for evacuation of the people, traffic control security arrangements etc. shall be available.

c) **Medical help required:** seriously injured personnel may be referred to the Hospital/Primary Health Centre depending upon the gravity and type of injuries.

d) **Humanitarian Arrangement:** Transport, evacuation centers, emergency feeding treatment of injured, first aid, ambulances, temporary mortuaries.

e) **Voluntary Organizations:** Details of organizers, telephone numbers, resources etc.

f) **Public Information:** Arrangements for Dealing with the media press office and informing relatives, etc.

List of Key persons of Off- Site Emergency Plan has been given in **Annexure-II**.

ANNEXURE-I

List of Key persons of on Site Emergency Plan

Sl. No.	Emergency Co-ordinator
1	Director
2	Executive Director & Director (Works)
3	General Manager (Maintenance & Projects)
4	Divisional Head of Operation (All Units)
5	Support Services (All Units)

ANNEXURE-II

List of Key persons of Off Site Emergency Plan

1.	Collector & Magistrate of District
2.	Additional District Magistrate
3.	Block development Officer
4.	Industrial Development Officer
3.	Fire & Disaster Office
4.	Controller of Explosive
5.	District Informatics Officer
6.	Superintendent of Police
7.	District Health Officer
8.	Assistant Labour Commissioner
9.	Factory Inspector