1.1 ENVIRONMENTAL RISK ASSESSMENT

The safety and protection of people, equipment and the environment is a serious concern in Iron & Steel industries. Steel Plants have recognized the significance of Safe Working Environment and are progressively trying to prevent hazardous events, avoid production & manpower losses and other fallouts associated with industrial accidents by conducting risk assessment, onsite & off site management plan and adopting the safety measures. This also assists industries to enhance employee knowledge of operations, improve technical procedures, maintain accurate process safety information and increase overall facility productivity. This write up, accordingly, gives an outline of the associated environmental and other risk prone hazards, their assessment and remedial measures. It also describes an approach to emergency planning to be adopted by the Plant management.

1.2 OBJECTIVES

The objectives of environmental risk assessment are governed by the following, which excludes natural calamities:

i) Identifying the potential hazardous areas so that adequate design safety measures can be adopted to reduce the likelihood of accidental events.

ii) Identifying the stakeholders and evaluating their risk along with proposing adequate control techniques.

iii) Identifying the probable areas of environmental disaster which can be prevented by proper design of the installations and its controlled operation.

iv) Managing the emergency situation or a disastrous event, if any, during the plant operation.

Environmental risk assessment is a systematic approach for identification, evaluation, mitigation and control of hazards that could occur as a result of failures in process, procedures, or equipment. Increasing industrial accidents, loss of life & property, public scrutiny, statutory requirements and intense industrial processes, all contribute to a growing need to ensure that risk management is conducted and implemented.

Managing a disastrous event would require prompt action by the operators and plant emergency staff using all their existing resources like deployment of fire fighting equipment, operation of emergency shut off valves, water sprays etc.

Minimising the immediate consequences of a hazardous event include cordoning off, evacuation, medical assistance and providing correct information to the families of the affected persons and local public to avoid rumours and panic.

Lastly, an expert committee is required to probe the cause of such an event, even if it is a "near miss" situation, note the loss incurred/ would have been incurred, and suggest remedial measures for implementation so that in future such events or similar events do not recur.

1.3 ENVIRONMENTAL RISK EVALUATION

From environmental hazards point of view, risk analysis (RA) acts as a scrutinizing vehicle for establishing the priority in risk management that concerns human health and environmental quality in general. Though the proposed facilities are not manufacturing, storing or handling any potentially hazardous/toxic chemicals as scheduled in Manufacture, Storage and Import of Hazardous Chemicals (MSIHC) Rules, 1989 and its amendments thereof, the proposed facility would have installations, such as, storage and handling of coal, fuel oil, and fuel gases.

Raw materials & consumable chemicals, and processing of the same in various production units, along with relative risk potential analysis is made on the following three factors using a P/I (Probability/ Impact) analysis methodology:

i) likelihood of occurrence
ii) likelihood of detection
iii) severity of consequence

Each of these factors is graded and compiled to determine the risk potential. The factors governing the determination of relative risk potentials are presented in Table 1.

TABLE 1 - DETERMINATION OF RISK POTENTIAL

(A) Likelihood of occurrence		(B) Likelihood of detection		(C) Severity of consequence	
Criteria	**Rank**	**Criteria**	**Rank**	**Criteria**	**Rank**
Very High	5	Very High	1	None	2
High	4	High	2	Minor	4
Moderate	3	Moderate	3	Low	6
Low	2	Low	4	Moderate	8
Very Low	1	Very Low	5	High	10

RISK POTENTIAL (RP) = (A + B) x C

Based on the above stated criteria for assessing the risk, each probable event has been evaluated by addressing several questions on the probability of event occurrence in view of the in-built design features, detection response, operational practice and its likely consequence.

A summarised list of environmental risk potential for the likely events is presented in Table 2.

This assessment is based from the past experience in the operation of an integrated iron and steel plant and best practicable designs for the proposed Project. The present risk potential evaluation is primarily based on human errors or faulty operation or failure of the control systems.

TABLE 2 - ENVIRONMENTAL RISK POTENTIAL EVALUATION

Sl. No.	Event	Rank: Likelihood of occurrence	Likelihood of detection	Severity of consequence	Risk potential
i)	Fuel gas leaks from the pipe line/valves	High (4)	Low (4)	High (10)	80
ii)	Propane storage and handling	Moderate (3)	Low (4)	High (10)	70
iii)	Unsafe disposal of oily wastes of Rolling Mills	Moderate (3)	Low (4)	Moderate (8)	56
iv)	Occurrence of static electricity/electric spark in the Mill Cellar Room	Very low (1)	Very low (5)	High (10)	60
v)	Leakage of acids/ alkalis	Low (2)	Very low (5)	Moderate (8)	56
vi)	Uncontrolled dust emissions/failure of emission control system	High (4)	Moderate (3)	Moderate (8)	56
vii)	Failure of Gas Cleaning Plant/Fume Extraction System	Moderate (3)	High (2)	High (10)	50
viii)	Wet scrubbers running dry	Low (2)	Moderate (3)	High (10)	50
ix)	Oil wastes/oil sludge handling	Low (2)	High (2)	Moderate (8)	32
x)	Fire at the coal stockyard	Very low (1)	High (2)	High (10)	30
xi)	Collapsing of Gas Holders	Very low (1)	High (2)	High (10)	30
xii)	Splashing of molten metal and slag	Low (2)	Very High (1)	High (10)	30
xiii)	Release of untreated wastewater	Low (2)	Very high (1)	High (10)	30
xiv)	Collapsing of acid/ alkali storage tanks	Very low (1)	High (2)	High (10)	30

From the Table 2, it appears that some events carry risk potential above 50. These would be considered as hazardous events, where effective safe-design for operation and maintenance is highly essential to reduce the risk.

As risk from fuel leaks is maximum, and has the maximum severity of consequence, consequence modeling for catastrophic failure of Gas holders has been carried out using DNV Phast Lite 7.1 to quantify the extent of the impact from this event.

For BF and LD gas holders, toxic exposure from failure of gas holders has been considered due to relatively high concentration of Carbon monoxide gas in BF and LD gas. For Coke oven gas holder, heat radiation from ignition of leaked gas has been considered due to its relatively high concentration of H_2 and CH_4.

Fig. 1 shows the maximum concentration footprint of leaked gas from catastrophic rupture of the BF gas holder. The concentration of interest (151.5 ppm) corresponding to the STEL value of BF gas extends up to a maximum distance of around 105 m downwind.

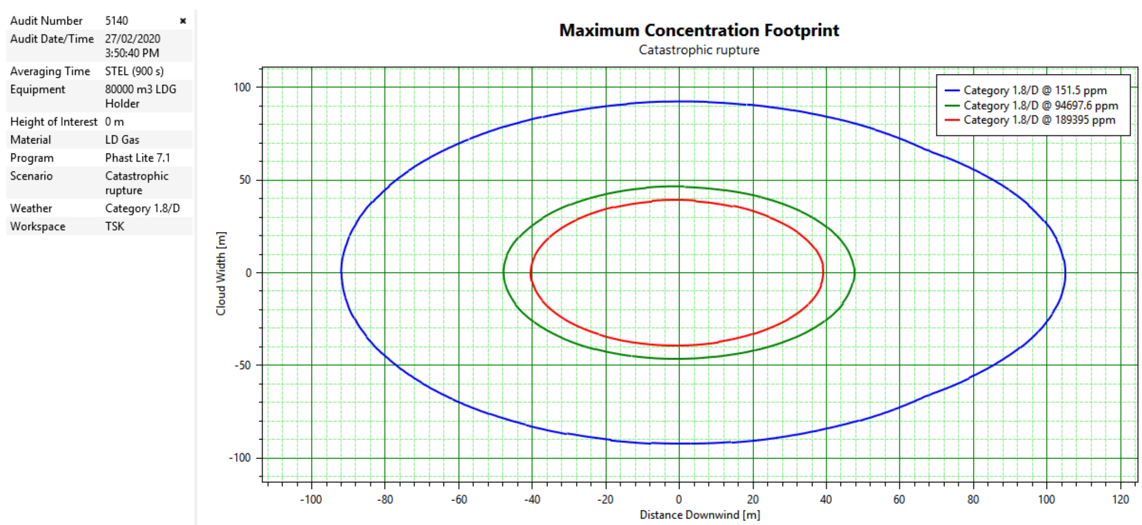

FIG. 1 - MAXIMUM CONCENTRATION FOOTPRINT FOR BF GAS HOLDER

Fig. 2 shows the maximum concentration footprint of leaked gas from catastrophic rupture of the LD gas holder. The concentration of interest (555 ppm) corresponding to the STEL value of LD gas extends up to a maximum distance of around 155 m downwind.

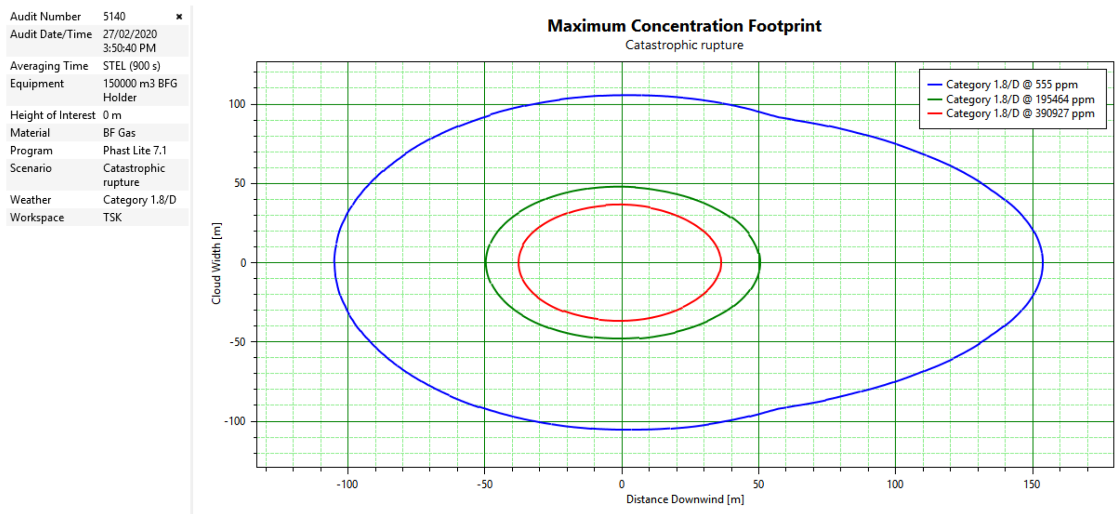

FIG. 2 - MAXIMUM CONCENTRATION FOOTPRINT FOR LD GAS HOLDER

Fig. 3 shows the intensity radius for fireball arising due to catastrophic rupture of the CO gas holder. Two radiation levels of interest have been plotted and as observed, the 4 kW/m^2 (pain threshold) radiation level extends up to about 200 m distance and the 12.5 kW/m^2 (first degree burns) radiation level extends up to about 100 m distance.

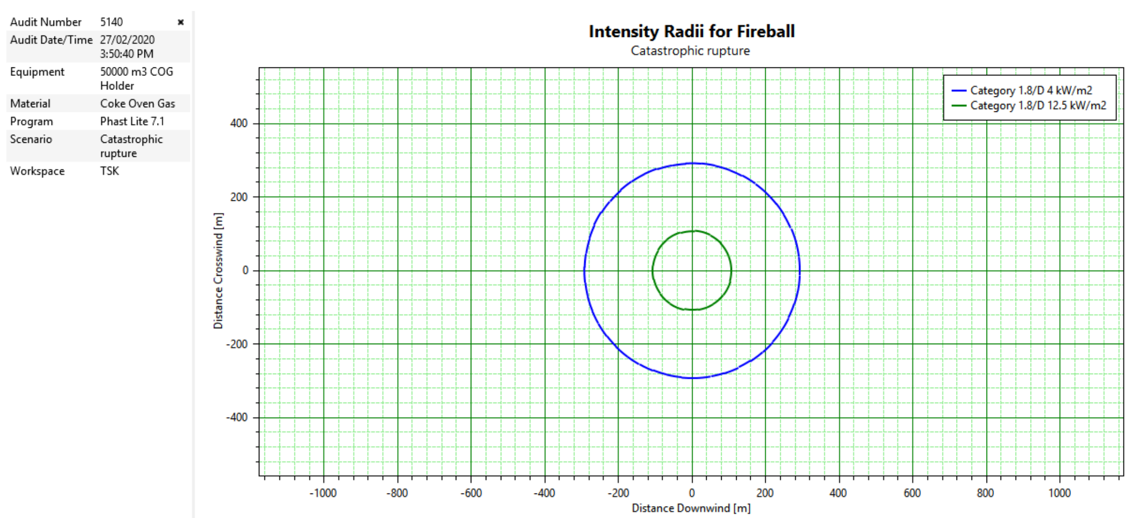

FIG. 3 - FIREBALL INTENSITY RADIUS FOR CO GAS HOLDER

The consequence of a major hazardous event as described above would be mitigated by implementation of a well designed on-site emergency management plan as elaborated in the following section. Moreover, a HAZOP Study for the selected units/areas needs to be undertaken at the 'design-freeze' stage, when P&I diagrams, shop layout drawings, control logic diagrams, technical specifications etc are made ready. For these areas, 'Fault Tree Analysis' of the failure of equipment/valve component or due to human error can be carried out to assess more realistically the risk involved and draw up final management measures. It is also suggested to conduct HAZOP Study for the fuel gas distribution network to incorporate last minute corrections in the design of the system from fail-safe angle, prior to commissioning.

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1.4 ON-SITE EMERGENCY PLAN

Emergency planning is an integral part of the environment and safety management of an organisation. Emergency may arise due to manmade reasons resulting in heavy leakage, fire, explosion, failure of critical control system, design deficiency, unsafe acts, etc, and natural causes like earthquake, flood, cyclone, excessive rain, etc. It is crucial for effective management of an accident to minimize the losses to the people and property, both in and around the facility, termed as on-site and off-site emergency plan.

The vital aspect in emergency management is to prevent accidents and losses by technical and organizational measures. Emergency planning demonstrates the organizational commitment to the safety of employees and adds to the organization's safety awareness.

The objective of the on-site emergency plan is to make maximum use of the combined resources of the factory and the outside services to:

i) Initially contain and ultimately bring the incident under control
ii) Minimize damage to property and environment
iii) Effective rescue and treatment of casualties
iv) Safeguard personnel in the premises (Provision of safe assembly points and escape route)
v) Provide information to relatives
vi) Identify any casualty
vii) Provide authoritative information to news/media
viii) Secure safe rehabilitation of affected areas
ix) Preserve relevant records and equipment for subsequent inquiry into the cause and circumstances of emergency

The on-site emergency plan relates to a laid-down procedure after taking care of all precautionary measures at the time of design-freezing and plant trial testing. The Operations General Manager is responsible to implement this procedure manual. Implementation involves the following:

i) The Safety department has separate group manned by only those persons, who are capable of keeping themselves unperturbed and cool during emergency.

ii) The command area of the assigned person is as follows-

   a) These key personnel of Safety department work as 'Works Incident Controller' for respective areas and one man as 'Works Main Controller'.

   b) These key personnel are trained with various simulated cases, if necessary, and how the problems need to be tackled.

   c) The Safety department is equipped with communication and public alarm system

iii) The responsibilities are as follows

a) Assessment of the size and nature of the events foreseen, its probability of occurrence and if happens, the advanced action plan.

b) Liaison with the outside local authorities including the emergency services.

c) Rehearsing emergency procedures.

The most important task of these key personnel of Safety department is their quick assessment of the event and organising the resources within shortest possible time so that the event is taken under control immediately.

Emergency planning rehearsals and exercises are also monitored by the experienced persons from other factories or Factory Inspectorate, who can help in updating the emergency plan procedure.

1.5 ACCIDENT STATISTICS

The section of Safety department dealing with Emergency also record the events of both minor and major accidents, listing all the details such as place, date & time, duration, probable cause, extent of damage, personnel affected, man-hours lost, medical assistance provided etc so as to analyse these data for drawing up necessary corrective measures.

1.6 SAFETY INSPECTIONS

Monthly safety inspection of all departments is carried out by Safety department. Additionally, half-yearly Safety Audit is performed including all aspects of Occupational Health and Safety for all the areas

1.7 OFF-SITE EMERGENCY PLANNING

The off-site emergency plan is also an integral part of any major hazard control system. This particular plan relates to only those accidental events, which could affect people and the environment outside the plant boundary. Incidents, which would have very severe consequences, yet have a small probability of occurrence, would be in this category.

The implementing authority of the off-site plan is the local authority and not the plant authority. But Safety department has a written document on how to ask for off-site plan implementation in case the consequence of any event escalates to such an extent that it goes beyond the plant authority's jurisdiction. Probability of such occurrence is though remote, but still there remains a probability.

The Safety department therefore has laid down procedure covering the following:

i) Identification of local authorities like civil defense, police, district collectors, their names, addresses and communication links.

ii) Details of availability and location of heavy duty equipment like bull dozers, fire-fighting equipment etc.

iii) Details of specialist agencies, firms and people upon whom it may be necessary to call.

iv) Details of voluntary organisation.

v) Meteorological information.

vi) Humanitarian arrangements like transport, evacuation centres, first aid, ambulance, community kitchen etc.

vii) Public information through media, informing relatives, public address system etc.

1.8 TESTING OF EMERGENCY PLANNING

The plant authority test from time to time the efficacy of off-site emergency plan in conjunction with on-site emergency plan. One essential component of this mock drill is to see that whether procedures related to communication, mobilisation of equipment and overall co-ordination to face the crisis is in order or not.

1.9 DISASTER MANAGEMENT PLAN (DMP)

A disaster is a catastrophic event that causes serious injuries, loss of life & extensive damage to Plant & property. It is a situation which goes beyond the control of the available resource of any authority or organization. A number of factors could trigger accidents leading to a disaster, some of which are as follows: (a) Process and safety system failures - Technical errors - Human errors (b) Natural Calamities: earthquake, Tsunami etc.

The DMP is formulated with an aim of taking precautionary measures to control the hazard propagation and to take such action that the damage following a disaster is the minimum.

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

i) Effective rescue and medical treatment of casualties
ii) Safeguard other people
iii) Minimize damage to property and the environment
iv) Initially contain and ultimately bring the incident under control
v) Identify any dead
vi) Provide for the needs of relatives
vii) Provide authoritative information to the news media
viii) Secure the safe rehabilitation of affected area
ix) Preserve relevant records and equipment for the subsequent inquiry into the cause and circumstances of the emergency.

In effect, DMP helps to optimize operational efficiency to rescue rehabilitation and render medical help and to restore normalcy.

The following hazards for disaster management have been considered:

i) Fire
ii) Explosion and Toxic release
iii) Oil spillage/liquid metal spillage
iv) Electrocution
v) Accident

These hazards and the events that can lead to these hazards have already been discussed in the preceding sections.

Few elementary disaster management measures to prevent disaster due to the above mentioned hazards are as follows:

i) Design, manufacture, operation and maintenance of all plant machineries/structures as per applicable national and international standards as laid down by statutory authority,

ii) Intelligent formulation of layout to provide 'Assembly Point' and safe access way for personnel in case of an hazardous event/disaster, as can be inferred from Risk and Consequence modeling.

iii) Proper emergency (both on-site & off-site) preparedness plan, emergency response team, emergency communication, emergency responsibilities, emergency facilities, and emergency actions shall be developed.

iv) Proper Alarm system and training the personnel for appropriate response during disastrous situation.

v) Complete fire protection coverage for the entire plant as per regulatory stipulations.

vi) Creation and maintenance of Disaster Management cell with adequately trained personnel who can handle all sorts of emergency situation.

vii) Provision of funds for prevention of disaster, mitigation, capacity-building and preparedness.

At present, the plant already has a firm DMP in place to deal with disasters, if any. There have not been any incidents to date. However, the existing DMP would be subjected to subsequent improvements as and when required for safe and efficient operation of the plan.