

## **RISK ASSESSMENT AND DISASTER MANAGEMENT PLAN**

### **1. Risk Analysis and Control Measures:**

Risk assessment is a process whereby risks are analyzed, assessed and risk management priorities are evaluated. It is defined as the characterization of the potential adverse effect to human health & environment due to environmental hazards.

Objectives of risk assessment are:

- Identifying hazardous activities
- Assessment of risk level and severity in different operations
- Identification of control measures
- Setting monitoring process
- Reduce the impact of mishaps of all kinds
- Reduce the inherent potential for major accidents

### **Methodology of Risk assessment:-**

- Collection of information & identification of hazard
- Classify their severity and probability of occurrence
- Identification of exposed risks
- Assess the risk and risk rating based on
  - Probability
  - Exposure
  - Consequence
  - Prioritization of the risks
  - Implementation of control measures
  - Monitoring risk assessment
  - Evaluation and correction

Factors of risks involved due to human induced activities in connection with mining & Beneficiation plant operations are

- 1) Slope stability of mine benches and dumps
- 2) Drilling
- 3) Storage & handling of explosives
- 4) Blasting
- 5) Excavation of waste & ore and
- 6) Transportation of waste & ore
- 7) Failure of Tailing dam

Other risk factors due to natural activities are

- 1) Fire due to electricity and Oil
- 2) Water inundation and
- 3) Natural calamities.

For the various risks, likely to arise, as above, detailed analysis of causes and control measures is given in below table:

S. No	Factors	Causes of risks	Control measures
1	Slope stability of mine face and dumping benches	<p>a) Sliding of benches (both mine face &amp; dump slopes) due to its unconsolidated nature.</p> <p>b) Vibration due to movement of vehicles in the benches.</p>	<p>By maintaining proper bench slopes for both the mine benches and the dump slope this risk can be tackled.</p> <p>The slope of the mine benches during operation, in the ultimate stage and the dump slope will be as suggested in the scientific study carried out by CMFRI. Its details are as follows:</p> <p><b>Mine Face:</b></p> <ul style="list-style-type: none"> <li>- Bench Height - 10m</li> <li>- Working Bench width - &gt; 20m</li> <li>- Ultimate Bench width - 12 m</li> <li>- Individual bench slope - 80°</li> <li>- The inactive external dump slopes will be terraced and proper vegetation will be laid which will cause binding of the soil preventing any slope failure. Retaining walls will be built all-around the external dumps which will have weep holes for passage of storm water to join garland drains around the periphery at the toe of the dump.</li> </ul>
2	Drilling	<p>a) Due to high pressure of compressed air, hoses may burst</p> <p>b) Jack hammer rod may break due to improper maintenance of the rod</p>	<ul style="list-style-type: none"> <li>- Periodical preventive maintenance and replacement of worn out accessories in the compressor and drill equipment.</li> <li>- As per manufacturers recommendation rod to be replaced and bits will be changed</li> </ul>
3	Storage & handling of explosives	<p>a) Improper storage of explosives</p> <p>b) Improper charging of explosives</p>	<ul style="list-style-type: none"> <li>- Adequate safety zone will be provided as per statutory requirements while locating the magazine and will be constructed as per plans approved by Dept of Explosives.</li> <li>- The following will be considered in the design of the magazine:</li> </ul>

S. No	Factors	Causes of risks	Control measures
			<ul style="list-style-type: none"> <li>• All dry vegetation within a 15 m radius will be cleared.</li> <li>• Lightning arrestor will be installed on the magazine roofs.</li> <li>• A 50m safety zone around the magazine will be created.</li> <li>• In summer, the temperature inside the magazine will be monitored to guard against spontaneous fire.</li> <li>• The manufacturing dates of all explosives stored in the magazine will be carefully recorded so that no explosive whose shelf life expired will kept in stock.</li> </ul> <p>- All workers will be informed that in case of any fire, whoever notices the fire will sound the alarm and inform the shift-in-charge. The shift-in-charge will inform security personnel and arrange to evacuate all personnel, except those who are required for fire-fighting, from the area. The fire brigade shall be summoned to deal with the emergency. Concerned district officials will also be informed. The hospital will also be informed.</p>
4	Blasting	a) Fly rock, ground vibration and noise etc.,	<p>- Burden and spacing will be kept optimum as per the recommendation of CMFRI..</p> <p>- All precautions as prescribed by DGMS, will be taken to control fly rock.</p> <p>- Delay detonators will be used.</p> <p>- By carrying out controlled blasting, restricting the maximum charge per delay and by optimum blast hole pattern, vibrations will be controlled within the permissible limit and blast can be conducted safely.</p>
5	Excavation of waste & Ore	<p>a)Hauling and loading equipment are in such proximity while excavation</p> <p>b)Swinging of bucket over the body of tipper</p> <p>c)Driving of unauthorized person</p>	<p>- Operator shall not operate the machine when person &amp; vehicles are in such proximity.</p> <p>- Shall not swing the bucket over the cab and operator leaves the machine after ensuring the bucket is on ground.</p> <p>- Shall not allow any unauthorized person to</p>

S. No	Factors	Causes of risks	Control measures
			operate the machine by effective supervision
6	Transportation of Waste and ore	a) Operating the vehicle “nose to tail” b) Overloading of material c) While reversal & overtaking of vehicle d) Operator of truck leaving his cabin when it is loaded.	<ul style="list-style-type: none"> <li>- It will be ensured that all these causes will be nullified by giving training to the operators.</li> <li>- No overloading.</li> <li>- Audio visual reverse horn will be provided.</li> <li>- Proper training will be given.</li> </ul>
7	Fire due to electricity and Oil	a) Due to the short circuit of cables & other electrical parts b) Due to spillage of inflammable liquid like HSD, oil etc and consequent fire	<ul style="list-style-type: none"> <li>- Commutator &amp; electrical parts shall be cleaned frequently with the help of dry air blower.</li> <li>- All fastening parts and places will be tightened.</li> <li>- The quantity of the maximum fuel oil which can spill is not much and can be easily controlled. Sufficient nos. of portable fire-extinguishers will be provided in</li> <li>- Office buildings, stores, laboratories and especially at strategic locations near the fuel, store, fuel filling area etc to take care of any eventuality. The distribution and selection of extinguishers will be done in accordance with the requirements of Bureau of Indian Standards (BIS): 2190-92.</li> </ul>
8	Water inundation	a) Inrush of storm water due to heavy rain b) Unusual seepage of water c) Sudden collapse of peripheral bund due to torrential pour	<ul style="list-style-type: none"> <li>- Proper drainage arrangements will be made to divert water from entering into the mine pit.</li> <li>- Adequate pumping capacity considering the heavy monsoon rainfall will be provided.</li> <li>- Guard will keep a continuous watch on water level in the mine sump especially during monsoon to know the water level in the sump and inform to the mine official.</li> <li>- Work shall not be resumed except with the prior permission of the Manager unless all the working places thoroughly examined by a competent person.</li> </ul>
9	Natural calamities	Unexpected happenings	<ul style="list-style-type: none"> <li>- Proper management team with necessary equipments will be in place to deal with the</li> </ul>

S. No	Factors	Causes of risks	Control measures
			situation

## 2. Hazard from the Tailings Dam:

On beneficiation of iron ore at the Beneficiation plant, considerable quantity of fine solids shall be liberated in the form of slurry i.e. tailing. About 681546.5cum tailings to be generated from the beneficiation plant during plan period will be disposed in the tailings pond over an area of 4.92Ha on the south east side of the lease area.

The tailing water shall be disposed by pumping into the tailing pond so as to allow settling of fine solids. The clarified water is taken back for recirculation to plant. Before pumping of tailing, the slurry generated at Beneficiation plant shall be concentrated in thickeners. The clarified overflow water of thickeners shall be reclaimed and re-used in process. The underflow which i.e. the tailings shall be pumped to the tailing pond.

Any breach or break in the dam may result in flow of slurry / water the downstream side creating hazards in the form of damage to property / environment or loss of human life/ injury.

The potential hazard due to the proposed tailing dam are mainly:

- Uncontrolled releases or seepage from the dam.
- Embankment failure.

## 3. Uncontrolled releases or seepage from the dam:

Due to uncontrolled seepage or release of water from the dam there may be impact on the downstream surface water quality affecting the men, livestock and environment exposed to it.

In case of this project, Tailing pond is planned to accommodate just for 2 years of tailings (i.e 4<sup>th</sup> & 5<sup>th</sup> year) till the mine void is created where future tailings from the plant will be accommodated. The tailing pond is designed with adequate volume to take care of the tailing to be generated in this period and also the expected direct rainfall during monsoon. As such no release is expected. On the rise side of the tailing pond diversion ditches / garland drains have been planned to arrest flow of storm water into the tailing pond and as such no additional rain water will be collected during the monsoon period.

Tailing pond will also be provided with decant well inside the pond and connecting it to a water pumping system outside the bund / wall by a buried pipeline. Water pumping system will be provided for pumping the clear water back to the beneficiation plant and It is proposed to recycle about 80% water.

A spill way channel will be created to take care off any over flow of water in case of any eventualities. At the end of the channel an additional embankment will also be created to restrict the flow of water outside the lease area.

By all these measures it will be ensured that there are no uncontrolled release or seepage from the dam.

#### **4. Embankment failure:**

Various causes for embankment failure are as follows:

- A) Seepage failure
- B) Structural failure
- C) Hydraulic failure

##### **A) Seepage Failure:**

Uncontrolled seepage of water through the embankment can lead to seepage erosion resulting in failure. Seepage erosion will be mainly due to poor compaction and presence of fine sand or silt in the embankment. Embankment construction will be made with coarse material only and will be properly compacted to prevent any seepage. Stone pitching or Turfing will be made in the outer periphery if necessary. Besides, continuous monitoring will be carried out and ensured that even small seepage if any is plugged and there are no seepage in the embankment.

##### **B) Structural Failure:**

Design and construction of embankment is critical to prevent from any failure. It is proposed to have the tailing pond on the south eastern side of the lease area where the natural slope of the area from west to east is supporting the construction of tailing pond. As far geology of the site area is concerned the proposed tailing dam will be on lateritic zone. Laterite is a hard rock which is suitable for the construction of tailing pond.

Scientific design through expert agencies considering the tailings strength parameters, its density, hydrological and hydrogeological data tailings chemistry, side slope geometry, etc., will be carried out. Construction of the embankment will also be done through reputed agencies. All necessary tests will be carried out and ensured that there will be no structural failure due to embankment.

##### **C) Hydraulic Failure:**

Erosion of surface of embankment due to continuous flow of water over the embankment surface may lead to hydraulic failure. This is caused due to inadequate spillway capacity, clogging of spillways, obstruction in the spillway channel, insufficient freeboard or settlement of embankment after construction etc.

The tailing dam is designed with adequate spill way and free board to prevent hydraulic failure.

By ensuring all the above said measures during design, construction of the pond and proper follow up during the operation of the project the risk due to tailing dam will be obviated. Ultimately the tailing dam will be reclaimed with plantation.

In case of the dumping of tailing in the mined out pit from 6<sup>th</sup> years onwards, no major risk is expected, since adequate mined out void is available and selected to accommodate the quantity. Besides, this pit is also provided with garland drain and other safety measures to prevent any overflow of material. In the post mining stage, even this pit will be totally fenced to prevent entry of men and material and reclaimed with plantation.

#### **5. 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 should be widely circulated and personnel training through rehearsals / drills.

The Disaster Management Plan will reflect the probable consequential severalties 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 currently available and reliable information, incident data from internal and external sources and if necessary the reports of the outside agencies.

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

In order to take care of hazard / disasters the following control measures will be adopted:

- All safety precautions and provisions of Metalliferrous Mines Regulations of 1961 will strictly followed during all mining operations.
- Observance of all safety precautions for blasting and storage of explosives as per MMR 1961.
- Checking and regular maintenance of garland drains and earthen bunds to avoid any inflow of surface water in the mine pit.
- Providing Firefighting and first-aid provisions in the mines office complex and mining & allied area.
- Provision of high capacity standby pumps with generator sets with sufficient quantity of diesel for emergency pumping especially during monsoon.

- Provisions of all the safety appliances such as safety boot, helmets, goggles, dust masks, ear plugs and ear muffs etc. will be available to the employees for their use.
- Providing training and refresher courses for all the employees work in hazardous premises
- Working of mine, as per approved plans and regularly updating the mine plans.
- Cleaning of mine faces will be done regularly.
- Handling of explosives, charging and blasting will be carried out only by qualified persons.
- A blasting SIREN will be used at the time of blasting for audio signal.
- Before blasting and after blasting, red and green flags will be displayed as visual signals. Checking of blasting area for any un blasted hole or material.
- Warning notice boards indicating the time of blasting and NOT TO TRESPASS are displayed prominently.
- An approved explosive van will be available for transporting explosives to the blasting site.
- Provision of magazine at a safe place when fencing and necessary security arrangement will be implemented.
- Regular maintenance and testing of all mining equipment as per manufacturers guidelines.
- Suppression of dust on the haulage roads with frequent water sprinkling, etc.
- Increasing the awareness of safety and disaster through competitions, posters and annual safety weeks and environmental weeks, encouraged through suitable rewards and other similar drives.
- Regular inspection of basin, embankment, dam periphery, decant facility, tailing delivery system, drainage outlets etc.
- Making available all the emergency equipments like Ambulances, communication equipment, auxiliary lighting, fire extinguishers, fire tenders etc.
- Entry of unauthorized persons will be prohibited.

The management will be able to deal with the situations efficiently keeping in view of the likely sources of dangers in the mine, beneficiation plant and the tailing dam.

**a. Structure of Disaster Management Plan:**

The structure of the DMP is described below.

**b. Outline of Disaster Management Plan:**

The purpose of disaster management plan is to restore the normalcy for early resumption of mining operation due to an unexpected, sudden occurrence resulting to abnormalities in the course of mining activity leading to a serious danger to workers or any machinery or the environment.

**7.6.2.3 System of Communication:**

An internal communication system will provided for the department head and to their line of command with wireless & mobile communication system. Telephone nos. and addresses of adjoining mines, rescue station, police station, fire service station, local hospital, electricity supply agency and standing consultative committee members will be maintained.

**c. Consultative Committee:**

A standing consultative committee will be formed under the head of Project Head. The members consist of Environmental Incharge / safety officer / Occupational Health In charge and other officials. This team prepares and executes the emergency plan.

**d. Facilities and Accommodation:**

The facilities for primary health care, rescue room and for various working groups will be provided. Regular checking of these facilities shall be under taken by the concerned persons.

**6. First Aid and Medical Facilities:**

The mine management will be having first aid / primary health facility for use in case of emergency situation. All casualties would be registered and will be given first aid. The centre will have facilities for first aid and minor treatment resuscitation, ambulance and transport. It will have proper telephone/ cell phone communication with hospitals, where the complicated cases are to be referred. Regular checking of these facilities shall be under taken by the in-charge of the first aid room.

**7. Emergency Plan:**

The emergency plans to be adopted to deal with any emergency situation are described below:

**Organization Plan:**

Organization plan includes a clear statement on the line of command and the responsibilities of each person involved in case of emergency situation.

**Equipment Plan:**

Equipment plan includes clearly stipulating make and type of machinery, capacity of machinery, location of operations and field of operations. Emergency plan includes Emergency Preparedness Plan and the standing orders will be prepared and displayed at all conspicuous places.

Functions of the emergency consultative committee:

1. Visit various working areas of the mine (mine pits, crusher, beneficiation plant , tailing dam area, workshop, electrical premises, loading area etc.) regularly (at least once a month) and meet the workers to discuss matters regarding safety and invite their suggestions on the same.
2. The team shall meet once in six months to discuss the possible or probable causes/ instances leading to any disaster that may occur in and around the mines, plant and dam.
3. The team shall assess the required resources to deal with the situation that may be identified as above.
4. The team leader shall lay down a detailed procedure or oral information to each member to follow in case of any impending or possible or actual disaster.
5. The team shall conduct mock drill once in a year to understand the practical problems that may arise while implementing the Emergency Preparedness Action Plan including the response time and take necessary steps to make the system effective.
6. The team shall make necessary recommendations/suggestions to the Management for identifying / monitoring/ dealing with any possible or probable disaster.
7. The minutes of the meeting of team shall be prepared including the probable cause of incident, response time and corrective and preventive actions required to be taken to avoid the reoccurrences of the same and kept as record.
8. The team may draw an Action Plan and modify the same from time to time based on changed circumstances.
9. The Emergency Preparedness team shall come into action immediately in case of any disaster by establishing the control room at an appropriate place nearer to the affected area.
10. The team shall record the actual performance/procedure followed/short comings while dealing with any actual disaster which will be discussed at various levels to strengthen the plan and approach.

11. Mines Manager shall inspect all the places where disaster occurred, along with Emergency Preparedness Team to give further instructions.
12. Review all accidents (including minor ones) reported since the last visit and suggest measures to prevent recurrence of the same.
13. Enquire into all serious accidents that are referred for enquiry.
14. Discuss recommendations of Inspector of Mines on matters of safety and DGMS violations if any placed by the Mines Manager for information and necessary action.
15. Take active part in organizing and observing Mines Safety week.
16. Undertake publicity and propaganda work at the mine for creating safety consciousness amongst the workers.

#### **7.1 Executorial Procedures for Emergency Plan:**

The following procedural methodologies will be adopted for proper execution of emergency plan.

- On realizing anything serious occurrence happened anywhere in the mine or plant, immediate information has to be passed on to the nearest available official and the management to take prompt action.
- On being informed about the emergency it will be verified for its correctness by the official who will communicate with telephone or wireless facility in particular to the Manager and supervisors of other parts / operations of the project and managers of adjoining mine so that persons may be withdrawn.
- On receiving information of emergency intimation, it will be sent to the consultative committee, already formed by the Project Head /mines manager. The mines manager shall also inform about the disaster to the police, nearest office of mines safety, office of pollution control board, District Collector in charge of emergency plan of the district and other required statutory bodies of State and Central Government. Shift in-charge will ensure that all the materials and transport system to deal with emergency situation are made available at the site.
- First aid facilities and ambulance to be made ready for providing to the victims. The Doctor should be immediately called upon.

The name and address of person / management responsible for management of disaster/emergency plan is given below:

**Name: Sabyasachi Mohanty**

**Address: General Manager (Mining),**

**Essar Steel India Limited**

**Ore Club, Bhadrasahi, Barbil, District: Keonjhar ,**

**Odisha: 758035, Ph.No. 7381007215**

In case of likelihood of any possible risks or disasters, pertaining to the mine workings such as inundation consequences, etc., spreading to outside peripheral areas, an "Off-site Emergency Plan" has to be properly planned and documented in consultation with Collector, Sundargarh District and other concerned Government Officials. In case of any unfortunate happening of an emergency in off-site areas, prompt execution of various action plans as laid down in the offsite Emergency plan has to be carried out with the help of the concerned Government officials and local people.

A comprehensive elaborate HIRA (Hazard Identification and Risk Assessment) structure will be created by the company. A detail Hazard Identification and Risk Assessment study will be carried out internally based upon the guideline of OHSAS: 14001.