

## **Risk Assessment**

The complete mining operation will be carried out under the management control and direction of a qualified mine manager holding a First Class Manager's Certificate of competency to manage a metalliferous mine granted by the DGMS, Dhanbad. The DGMS have been regularly issuing standing orders, model standing orders and circulars to be followed by the mine management in case of disaster, if any. Moreover, mining staff will be sent to refresher courses from time to time to keep them alert. However, following natural/industrial hazards may occur during normal operation.

- Accident due to explosives;
- Accident due to heavy mining equipment; and
- Sabotage in case of magazine.

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

- All safety precautions and provisions of Mine Act, 1952, Metalliferous Mines Regulation, 1961 and Mines Rules, 1955 will be strictly followed during all mining operations;
- Entry of unauthorized persons will be prohibited;
- Fire fighting and first-aid provisions in the mine office complex and mining area;
- Provisions of all the safety appliances such as safety boot, helmets, goggles etc will be made available to the employees and regular check for their use;
- Training and refresher courses for all the employees working in hazardous premises; Under Mines vocational training rules all employees of mines shall have to undergo the training at a regular interval;
- Working of mine, as per approved plans and regularly updating the mine plans;
- Cleaning of mine faces shall be regularly done in order to avoid any overhang or undercut;
- Handling of explosives, charging and firing shall be carried out by competent persons only under the supervision of an Assistant Mine Manager;
- Provision of magazine at a safe place with fencing and earthen mound and necessary round the clock security arrangement;
- Regular maintenance and testing of all mining equipment as per manufacturer's guidelines;
- Suppression of dust on the haulage roads by regular deployment of water sprinklers;
- Adequate safety equipment will be provided at explosive magazine; and
- Increasing the awareness of safety and disaster through competitions, posters and other similar drives.

For any type of above disaster, a rescue team will be formed by training the mining staff with specialized training.

## Possible Hazards in Open Cast Mine

There are various factors, which can cause disaster in the mines. These hazards are as follows:

- Blasting;
- Waste Rock Dumps;
- Heavy Machinery; and
- Explosives storage.

In addition to the above general types of hazards, one specific type of hazard associated to the Deposits-14/11C is breaching of tailing dam constructed to treat the slimes generated, in the event of floods or earthquakes. The mining activity has several disaster prone areas. The identification of various hazards in open cast mining is depicted in **Figure-1**.

### *Blasting*

Most of the accidents from blasting occur due to the projectiles, as they may some times go even beyond the stipulated danger zone of 500 m, mainly due to overcharging of the shot holes as a result of certain special features of the local ground. Flying rocks are encountered during initial and final blasting operations in a particular bench. Vibrations also lead to displacement of adjoining areas. Dust and noise are also problems commonly encountered during blasting operations.

### *Waste Rock Dumps*

The waste rock dumps may cause landslides. High rock dumps created at the quarry edge may cause sliding of the dump or may cause failure of the pit slope due to excessive loading, thereby causing loss of life and property. Siltation of surface water may also cause run-off from waste rock dumps.

### *Heavy Machinery*

Most of the accidents during transport of dumpers, trucks, excavators, ripper dozers and other heavy vehicles are often attributable to mechanical failures and human errors.

### *Storage of Explosives*

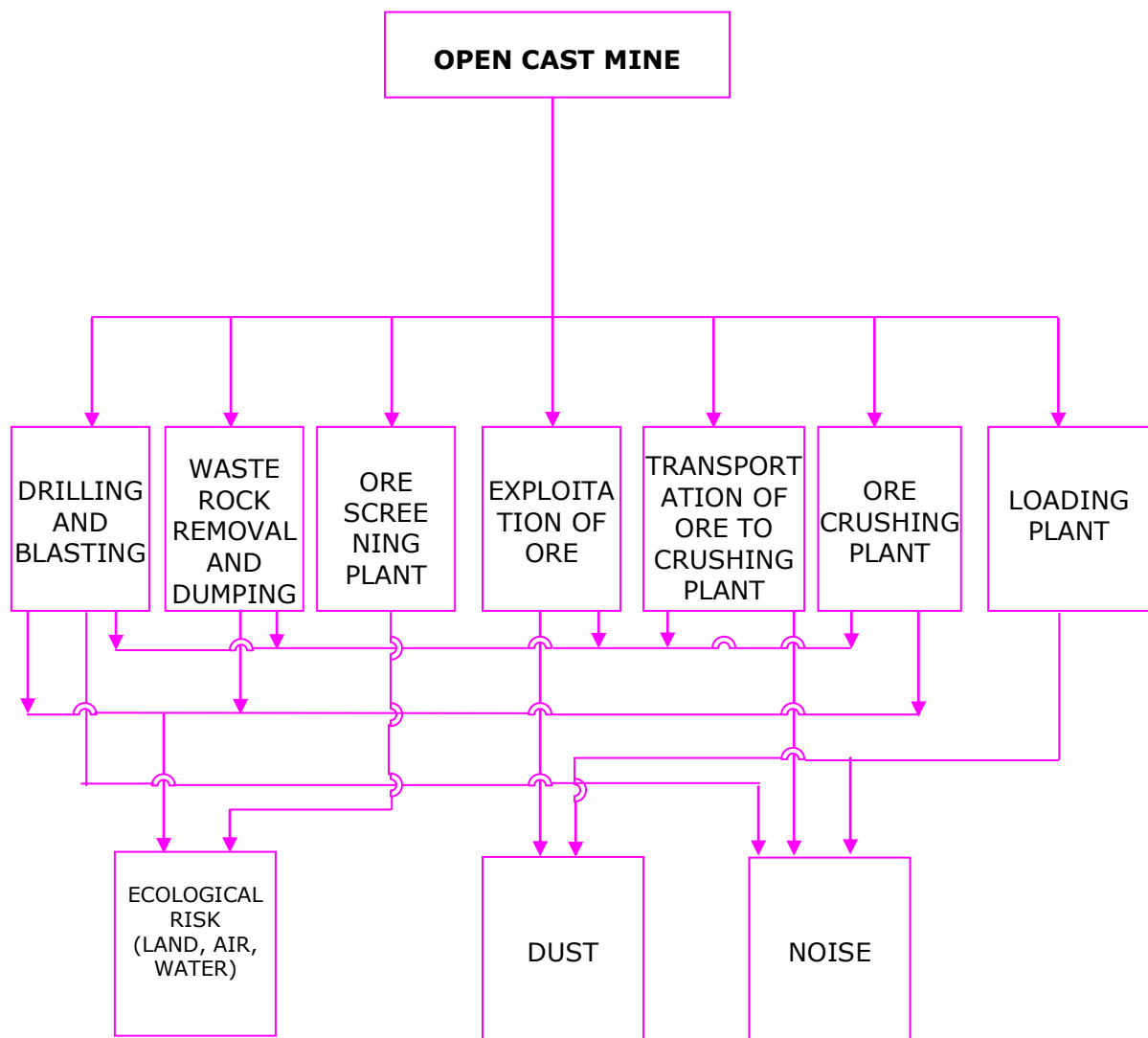
In Deposits-14/11C, the blasting operations are carried out once or twice in a week. The main hazard associated with the storage, transport and handling of explosives is fire and explosion. The Rules as per the Indian Explosive Act and Rules 1883 shall be followed strictly for handling of explosives.

The storage, transportation and use of explosives shall be carried out with complete safety, in accordance with rules and regulations. The magazine is kept guarded round the clock by security personnel. The entire magazine area is fenced by high chain link with barbed wire at top. Security watchtower and morchas are provided for surveillance of the area around magazines. The storage and maintaining of stock records of magazine is done by an authorized magazine in-charge under the guidance of blasting engineer. The magazines are kept under lock and key and are guarded by security personnel.

Suitable explosive vans duly licensed by the controller of explosives are utilized for daily transportation of explosives between magazine and blasting site both for

bringing and returning the explosives. Necessary foolproof arrangements are made for transportation/bringing of detonators in separate vehicles to the blasting site. It is ensured that high explosives and detonators/detonating fuse are not transported in the same compartment of explosive van in order to avoid any possible accidents.

During monsoon season and cloudy weather, no charging of explosives in the field are carried out. Necessary precautions such as keeping the detonating fuse properly covered with drill cuttings/stemming material are taken during onset of rains/stormy weather in order to prevent any possible premature firing due to lighting.



**FIGURE-1**  
**IDENTIFICATION OF HAZARDS IN OPEN CAST MINE**

- **Type of Explosives**

Types of explosives currently in use at Bailadila Iron Ore Complex are given below:

1. Nitroglycerin base explosive viz. Open Cast Gelignite (OCG) supplied by Indian Explosives Ltd;
2. SME (Site Mixed Emulsion Explosive) supplied by M/s. ORICCA, M/s. NFCL & M/s. KEL Tech.

- **Storage of Explosives:**

NMDC have four explosives magazines for storage and use of explosives in mines of BIOM, Kirandul Complex. These explosives magazines are common for all three pits viz. Pit-1 (Dep.-14), Pit-2 (Dep.-11C) and Pit-3 (Dep.-11B) are given in **Table-1**.

**TABLE-1**  
**COMBINED CAPACITY OF MAGAZINE**

<b>Name of Explosive / Accessory</b>	<b>Capacity</b>
Nitrate Mixture	13500 Kg
Safety Fuse	2000 m
Detonating Fuse	80000 m
Detonators	20000 no.
Cast Booster	3500 Kg

*Fuel Storage*

The Main Central Stores Depot is located within the Service Centre Complex. Fuel is stored at both Kirandul and Hilltop Depots and Central Stores.

*Water Logging*

Water logging in the mine site can be avoided by adopting following measures:

- Position of water body should be correctly known;
- Water from the surface water bodies should not be allowed to enter in the mines;
- Draining of mine water by suitable capacity pumps; and
- Surface water bodies should be correctly marked together with their highest flood level on the mines.

*Failure of Tailing Dam*

The mined out ore of the deposit is being processed in the screening plants by wet process after crushing during monsoon season only as per requirement. The sized ore is separated in the screening plant and the tailings from the outlet of the discharge are transported in the form of slurry into the tailing dam where the slime gets settled and the overflow, which is free from tailings, is discharged into nalla i.e Koyar nadi.

The main hazard due to tailing dam giving away (due to floods or earthquakes), is inundation in the downstream areas. Heavy loss of vegetation, soil erosion or

death of inhabitants and loss of property may occur if proper measures are not taken. The villages/settlements at the downstream may get affected if the tailing dam failure takes place. There is very less agricultural area at the downstream of the tailing dam.

In order to handle the emergencies, safe passage channels are constructed to divert the water safely. Alternatively, all efforts are made to evacuate the people in the probable affected areas in case of emergency.

However, the chances of inundation due to tailing dam failure is remote occurrence because the construction of tailing dam is of heterogeneous type, which provides safety against overturning and slicing on the preatic line. As it is, there is no danger from immediate and subsequent flooding of the mine, as the mine is of hilly terrain type. As a matter of precaution proper and substantial drainage system is maintained all the time in order to divert the water in the check pond properly.

### Safety Measures

NMDC ensures implementation of all the possible safety measures in the course of its endeavour to mine iron ore from the Bailadila area. This is in line with the company's policy that all the efforts made towards enhancement of safety pays rich dividends in terms of higher productivity and reduction of losses.

A brief description of the measures taken-up by NMDC during the process of quarrying are mentioned below:

#### *Mine Layout*

The Deposit-14/11C is of hilly type. To overcome the problem due to complex geological structure of the deposit and to ensure safe and stable working benches, following measures are taken:

- The deposit is opened up from the top of the hill, to enable slicing method of open cast working pattern to be followed. This ensures that there are no left over benches above the working benches, which can cause unstable workings;
- The benches are kept sufficiently wide for greater stability as well as for easy movement of the Heavy Earth Moving Machinery; and
- The height of the benches is kept commensurate with the digging height of the excavators. This facilitates easier operation of the loading machines at the face and the benches remain stable as well.

#### *Measures Suggested to Avoid Accidents due to Blasting*

To ensure safe blasting, the following steps are followed:

- The use of Non Electric System of Initiation of the Blast Holes by using Excel detonators and connectors. It ensures bottom hole initiation of the explosive charge, thereby reducing the ground vibration and fly rock problem;
- Use of ground vibration and air blast monitoring instruments to monitor the blasts. The instrument reveals efficiency of the blasting activity;

- Complete evacuation of the area falling within 300-m of the blast site by sounding siren and by sending guards to avoid any exposure of the human beings and other animals to the danger associated with blasting;
- All the blasts are carefully planned and executed by experienced blasters under proper supervision of qualified and experienced mining engineers to ensure effective utilization of the explosive material towards breaking of the rock;
- The explosive material is stored properly in an approved magazine, which is guarded by CISF personnel round the clock;
- No secondary blasting is carried out. All the big boulders are broken using a Hydraulic Rock Breaker, thereby eliminating the risk of flying fragments associated with secondary blasting.
- The blasting operation shall be strictly conducted as per the guideline given in metalliferous mines regulation, 1961;
- All employee and equipment shall be cleared from the blast area and removed to a safe location prior to any scheduled blasting;
- To prevent unauthorized entry, guards shall be posted at all access points leading to the blast area; and
- Audible signals such as sirens, whistles, etc. shall be used to warn employees, visitors and neighbours about the scheduled blasting event.

#### *Ripping and Dozing*

The existing Dozers of the NMDC are utilized, especially to excavate mineral from the areas having close proximity to structures, likely to be affected by blasting. This machine completely minimizes the blasting activity, thereby ensuring safety at the critical locations.

#### *Transport of Mineral*

To ensure safe working of the rear dump trucks, which transport the mineral from the quarry to the crusher, following measures are taken-up:

- The haul roads are kept sufficiently wide to ensure free and easy movement;
- The curves on the roads are given proper super elevation;
- Drains along the roads are designed to carry away rainwater without causing damage to the road;
- The valley side of the road is clearly demarcated either by erecting stone walls or by fixation of drums;
- Proper illumination of the roads has been done to facilitate work in the night hours.
- All transportation within the main working area should be carried out under the direct supervision and control of the management;

- The vehicles must be maintained in good repairs and checked thoroughly at least once a week by a competent person authorized for this purpose by the management;
- Broad signs should be provided at each and every turning point specially for the guidance of the drivers at night; and
- To avoid dangers while reversing the trackless vehicles, especially at the embankment and tripping points, all areas for reversing of lorries should, as far as possible, be made man free, and there should be a light and sound device to indicate reversing of trucks.

#### *Other Features*

Automatic Fire Fighting Systems are provided for the critical equipment like Excavators, Loaders etc. All the Heavy Earth Moving Equipments are maintained in the efficient working order by a team of well experienced and qualified personnel at the mine site. Personal checking of the following features is being carried out on daily basis.

- Brakes;
- Horns and auto reverse horns; and
- Lights.

All the staff are provided with essential personal protective equipment like safety shoes, helmets, hand gloves, goggles, apron, guards, ear muffs etc. Regular training is being imparted to the related staff of the mines for safe and proper operation and maintenance of the machines.

#### *Measures to Prevent the Danger of Overburden*

To prevent the failure of overburden slopes, especially during the rainy season, the following precautions shall be taken:

1. Proper terracing of the dump slopes, with a maximum bench height of 30m; and
  2. In flat areas where the dumping operations have come to an end, the slope angle should be flattened by about 5° lower than the angle of repose which varies from site to site but not less than 25°.
- Planting vegetation as early as possible over the overburden dump slopes;
  - Provide drainage channels along the overburden dump toe for additional protection, in such a way that a distance of 15 m should be maintained left between the overburden dump and the bench; and
  - If a mine is abandoned, the bench and overburden dump should be separated from each other by digging a trench of 6 to 10 m width.