
RISK ASSESSMENT & MANAGEMENT

1 INTRODUCTION

Keeping in view the three basic principles i.e. prevention, preparedness (both pro-active and reactive) and mitigation of effect through rescue, recovery, relief and rehabilitation; a comprehensive blue print for risk assessment and management has been drawn-up for the project incorporating the following:

- Identification and assessment of risks.
- Recommendation of measures to prevent damage to life and property against such risks.

The following disasters / accidents may occur during normal operations of the mine.

- Slope failure.
- Dangers due to handling and use of explosives and accidents due to fly-rocks and air-blasts following a faulty heavy blast.
- Hazards associated with use of electricity.
- Accidents due to unruly operation of HEMM.
- Dust hazards.
- Fire hazards due to spontaneous heating of coal in stock piles and exposed benches.
- Fire hazards in stores & workshops where inflammable & highly inflammable materials are stored or used.
- Danger of inundation from surface and/or ground water.

2 SLOPE FAILURE IN MINE PIT

Slope failures are affected by the following factors:

- Slope geometry
- Geological Structure
- Lithology
- Ground Water

-
- Mining method & equipment
 - Dynamic forces.
 - Shear strength of road and cohesion
 - Angle of friction

The exposed ends of the coal seams and OB will be left with a safe slope to avoid slope failure and collapse of benches. Similarly, at the end of mining operation, safe terminal slope will be provided to avoid pit failure.

3 HAZARD AND RISK ASSESSMENT OF OB DUMPS

Hazard of OB dump failure is mainly governed by following factors :

1. Height of benches.
2. Slope of benches.
3. Nature of material.
4. Slope of foundation rock.
5. Nature of foundation rock.
6. Drainage of foundation.
7. Depth of ground water table.

4 PRECAUTION TO BE TAKEN TO REDUCE RISK OF OB DUMP FAILURE

1. OB benches will be made of <30m ht in each tier.
2. The angle of repose of each dump tier should be around 37° and overall dump slope should be less than 26°.
3. Soil should be scrapped separately, so that it is not mixed with OB rock.
4. The slope of ground will be kept mild so that it will not have any adverse effect.
5. The soil from the foundation ground should be scrapped before starting of OB dumping.
6. Garland drain to be made around OB dump area to avoid water flow during monsoon below the OB dump.
7. Ground water table is generally 3-5m below ground level hence may have no adverse impact.

8. Leveling, grading and drainage arrangement at the toe of OB dumps and at each dump tier should be done with much care and should be monitored regularly.
9. Technical & Biological reclamation will be done.
10. A scientific study regarding slope stability and monitoring team should be formed to assess the dump stability throughout the life of the mine.
11. A proper fencing with suitable material should be provided around dump toe to prevent failure or unauthorized access towards dump toe.
12. Precautions shall be taken to prevent spontaneous heating and fire in the carb shale when dumped along with overburden rock.
13. The backfilled area shall be kept benched and the distance of active mine workings (faces) from the toe of the bottom most backfilled face (bench) shall not be less than 60m.

5 BLASTING AND VIBRATION STUDY

For proper blasting and minimizing the adverse side effects due to blasting viz. noise, ground vibration, back-breaks, air blast and fly rocks etc., the optimal blast design parameters will be suggested during the mine operation after conducting a study for determining the blasting parameters. The following precautions have been suggested to avoid dangerous situations:

- The blasting operation shall be under the overall supervision of competent person like Sr. Manager having First/Second Class Mine Managers Certificate of competency.
- Making of holes, charging and stemming the holes may be made under the supervision of a competent person.
- Care may be taken to see that there is no overcharging or undercharging of the holes, the connections and arrangements of delay detonators are in order.
- Before a shot is fired the shot firer is required to ensure that all persons within a radius of 500m from the place of firing (referred to as blasting

danger zone) have taken proper shelter, apart from giving sufficient warning by efficient signals over the entire danger zone.

- Blasting shall be carried out in conformity with the stipulation given by DGMS, existing laws with closer control of blasting parameters including blasting results like desired fragmentation, vibration, etc.
- Blasting will be done in day time only.

➤ **Blast Induced Ground Vibration**

When blasting is done in the opencast mines ground vibrations are generated outward from the blast areas which cause damage to surrounding surface structures. The vibrations radiating from blast holes while passing through surface structures induce vibrations on the structures causing resonance. The component of ground motion can effect the structures through compression and tension and also through vertical and horizontal shearing effects. Blast induced ground vibration creates socio economic problems for the mine management as well as the people residing in the vicinity of these mines. As only 20-30% of energy of commercial explosives used in mines is utilized for fragmenting the rock, the rest of the energy is transmitted through the earth in the form of ground vibrations resulting in damage to the surrounding structures.

Peak particle velocity (ppv) has so far been considered as the best criteria for evaluating blast vibrations in terms of its potential to cause damage.

Depending on the type of structures and dominant excitation frequency, Peak Particle Velocity (PPV) on the ground adjacent to the structures shall not exceed the given values under different frequencies as per DGMS. (Tech circular 7/1997).

Table 1: Permissible Peak Particle Velocity (ppv) in mm/s

	Type of Structures	Dominant Excitation Frequency, Hz		
		<8 Hz	8-25 Hz	>25 Hz
A	Buildings/Structures not belonging to the owner			
	i) Domestic Houses/structures (Kucha, Brick & Cement)	5	10	15
	ii) Industrial Buildings RCC & Framed Structures)	10	20	25

	iii) Objects of Historical importance	2	5	10
B	Buildings belonging to the owner with limited span of life			
	i) Domestic Houses/structures (Kucha, Brick & Cement)	10	15	25
	ii) Industrial Buildings RCC & Framed Structures)	15	25	50

Where any permanent building or structure of permanent nature not belonging to mine owner lie within the danger zone, the aggregate maximum charge per delay and per round shall not exceed the amount fixed by DGMS on the basis of a scientific study.

6 EXPLOSIVE HANDLING

The present day technology of blasting with site mixed slurry (SMS) explosive shall be used with milli second delay detonators that are initiated by shock tube initiation system. SMS is stored by the supplier as per GOI Notification. Further, transport and charging are also done by the supplier on the spot. Only priming will be done by the project authority. For storage of explosives meant for priming, detonating fuse and detonators, one service magazine has been provided.

7 SAFETY RULES

Mining operations follow statutory mine safety rules administered by the Directorate General of Mine Safety (DGMS), Chief Controller of Explosives and others. Planning and design of electrical installations will take into account the existing electricity rules to obviate the hazards due to use of electricity.

For creating safety awareness and imparting education on safe practices, the following steps shall be taken:

- Holding annual safety weeks.
- Imparting basic and refresher training to new and old employees respectively as per Vocational Training Rules.

8 MINE INUNDATION

Due care should be taken during mining to prevent water ingress operations from the higher ground local rivers/reservoir. Provisions of coal Mine Regulations shall be followed. There are three sources of water in the mine:

i) Surface run off from the surrounding area and nalla flowing over the property:

Major threat of Inundation is from Basundhara river/nala & Chaturdhara nala, which flows along the northern boundary of the block and Chattajhor nala towards eastern boundary of the block. Embankment with a height of three meter above the HFL has been proposed against Basundhara river. The HFL should again be ascertained & precautions taken before taking up the mining activities. Detailed design of the embankment should be done by experienced agency and the same should be constructed during initial years.

ii) Direct Precipitation:

Rain Water

- a) Garland drains along the periphery of excavated area of the mine shall be provided to stop rainwater from surface entering into the mine. Garland drains shall be kept clean without any obstruction and shall be inspected regularly during the monsoon.
- b) All Rainwater in the catchment area of the opencast mine shall be channelized to gravitate into the main sump constructed in the dip most part of the mine. Adequate pumping arrangement shall be kept to pump out water from the sump to the surface.

iii) Seepage from Strata:

There is no danger of inundation due to make of water in the mine while mining coal. The water will gravitate into the sump and will be pumped out.

9 FIRE AND SPONTANEOUS HEATING

The most vulnerable points for fire in an opencast mine is in the Coal stock, old coal benches with loose coal, HEMMs, OB dumps with carbonaceous shales etc. The common accidents due to fire may take place while working or deploying shovels in a fiery seam where there are chances of fall of sides forming thick cloud of hot dust and injuring the personnel nearby. Accident due to fire may take place while dealing with fire in coal stocks, old coal bench with fire etc. The following precautions may be taken to deal with fire in OCPs.

- i) In order to prevent accidents due to fire every mine should have a proper firefighting organization under the control of Manager of the mine or the Safety officer. Firefighting stations should be established near the entrance of the mine with adequate firefighting equipment.
- ii) Adequate number of persons should be trained in firefighting who should be familiar with all firefighting equipment.
- iii) The coal stocks should be regularly liquidated or else it should be properly dozed and made dome shaped to prevent entry of air and prevent spontaneous heating.
- iv) Pipe lines should be laid around the coal stock to deal with fire in case of emergency.
- v) In the quarry, the coal benches should be properly dressed and no loose coals to be left which facilitate spontaneous heating.
- vi) Before deploying any equipment in a fiery coal bench, it should be isolated, dealt with fire and then allow machines to operate.

FIRE IN PROJECT STORES & WORKSHOPS

Sufficient provision will be made for the prevention & control of fire in the project store, both E&M & HEMM workshops & sub-stations by way of installing fire extinguishers of right type & size. Timely inspection & refilling of fire extinguishers will be done.

Where ever Fire extinguishers will be provided like Operator cabin, stores, Workshops, Magazines etc. sufficient number of persons like operators, helpers should know the use of fire extinguishers.

Systematic layout of both stores & workshops will be made so that inflammable & highly inflammable materials do not come in contact with any spark or flame. Adequate number of cautions in the form of hoardings will be displayed near such places. While calculating total water demand for the project, provision for fire fighting has also been made.

10 HAUL ROAD MAINTENANCE

For proper haul road maintenance, following aspects will be considered and implemented:

- i) Proper design and maintenance of the haul roads
- ii) Formulation, approval and enforcement of traffic rules regarding :
 - a) Speed limit
 - b) Parking and standing
 - c) Overtaking
- iii) One way traffic, otherwise width should not be less than 3 times the width of the largest vehicle.
- iv) Gradient should not be greater than 1 in 16.
- v) Berm should not less than 1 m in width.
- vi) Separate machines and personnel for maintenance of haul road.

During rainy season soil erosion will take place and it will deteriorate the haul road corridor and therefore.

- i) Proper drainage arrangement shall be made along the haul road.
- ii) Cross slopes (1 in 50 to 1 in 25) shall be provided on the haul road so that water flows into the drain.
- iii) Water barrier, cross drains, relief drains etc. should be constructed and maintained properly.
- iv) Culverts shall be designed, installed and maintained to withstand the vertical soil pressure, weight of the vehicles plying over the road etc.

11 ILLUMINATION AND COMMUNICATION

Sufficient lighting as per standards will be provided at all the required places, i.e. working faces, OB dump area, haul road, coal transfer points, loading points, CHP, workshop, etc., to avoid accidents and to create efficient working conditions.

Provisions for efficient communication systems (both internal and external) to allow communication link amongst various work centers to help avoid accidents and handle emergencies will be made. The following standard of illumination as per DGMS may be followed for better illumination in the mine.

Table 2: Standards of lighting in Opencast Coal Mines

Sl. No.	Place / Area to be illuminated	Manner in which it is to be illuminated	Minimum standard of illumination (LUX)	Plane/Level in which the illumination is to be provided.
1.	General working areas as determined by the Manager in writing		0.2	At the level of the surface to be illuminated
2.	Work place at Heavy Machinery	So as to cover the depth and height through which the machinery operates	5.0 10.0	Horizontal Vertical
3.	Area where drilling rig works	So as to illuminate the full height of the rig	10.0	Vertical
4.	Area where Bulldozer or other tractor mounted machine works	--	10.0	At level of the Crawler tracks
5.	Places where manual work is done	To be provided at level of the surface on which such work is done	5.0 10.	Horizontal Vertical
6.	Places where loading, unloading or transfer, loading of dumpers, trucks or train is carried on	--	3.0	Horizontal
7.	Operators' Cabins of machines or mechanisms	To be provided upto a height of 0.8 metres from floor level	30.0	Horizontal
8.	At hand picking points along a conveyor belt	To be provided upto a distance of not less than 1.15 metres from the picker	50.0	On the surface of the conveyor belt
9.	Truck haulage roads	To be provided at level of the road	0.5 to 3.0	Horizontal
10.	Rail haulage track in the pit	To be provided at level of the rail heads	0.5	Horizontal

Sl. No.	Place / Area to be illuminated	Manner in which it is to be illuminated	Minimum standard of illumination (LUX)	Plane/Level in which the illumination is to be provided.
11.	Roadways and foot paths from bench to bench	--	3.0	Horizontal
12.	Permanent paths for use of persons employed etc.	--	1.0	Horizontal

12 OTHER MISCELLANEOUS MEASURES

Following facilities will be there in the project:

- Provision of well-equipped workshops for maintaining HEMMs and other equipment properly for avoiding their failures as well as the risk of accidents.
- Provision of stores for spare parts for quick maintenance.

13 TRAINING

Coal industry has set up a number of training institutes for imparting training to its employees. These trainings are meant to raise awareness amongst workers for performing their duties properly with safety.

Further, the personnel directly responsible for handling emergencies are given training for making them better equipped for discharging the responsibilities. Mock drills for checking the risk management preparedness will be carried out regularly.

14 MEDICAL AID

For guarding against occupational and community health hazards, the following measures will be taken:

- Steps to control respirable dust, improve workplace environment and reduce noise nuisance.
- Periodic Medical Examination (PME) of workers.
- Availability of improved medical facilities.

The coal company has a number of healthcare centres including a well equipped Regional Hospital and a specialised “referral” hospital in the coalfield area. Provisions of healthcare facilities have been provided in the project report. Healthcare facilities have been provided in the neighbouring projects. The above facilities will cater to the need of employees of this project. The local people can also avail these healthcare facilities.

15 CONCLUSION

With adoption of above preventive measures, the operation of this opencast mine will be safe as well as environment friendly.