1.1 RISK ASSESSMENT

Human health and Environmental risk from developmental activities is mainly due to occurrence of some accident consisting of an event or sequence of events explosion, fire and toxic hazards. Risk analysis provides a numerical measure of the risk that a particular facility poses to the public. It begins with the identification of probable hazardous events at an operational area and categorization as per the predetermined criteria. The consequences of major events or accidents are calculated for different combinations of weather conditions to stimulate worst possible scenario. These predictions of consequences are combined to provide numerical measures of the risk for the entire facility. Risk assessment should be done on the basis of past accident analysis at similar projects, previous judgments and expertise in the field of risk analysis especially in accident analysis.

The possible risks in the case of mining projects are erosion, inundation/floods, accidents due to vehicular movement and accidents during mineral loading and transporting etc. Mining and allied activities are associated with several potential hazards to both the employees and the public at large. A worker in a mine should be able to work under conditions, which are adequately safe and healthy. At the same time the environmental conditions should be such as not to impair his working efficiency. This is possible only when there is adequate safety in mines.

1.1.1 Risk Management:

The following precautionary measures shall be taken to prevent any accident

- Elimination of the source of hazard
- Substitution of hazardous process and materials by those which are less hazardous
- Geographical/ physical isolation of hazards from vulnerable communities
- Use of engineering controls to reduce the health risk
- Adoption of safe working practices such as regular equipment maintenance
- Use of Personal Protective Equipment should be mandatory.
- Top edge of opencast workings shall be kept properly fenced.
- Regular dressing of bench sides to ensure safety of workers employed within 5m or working face.
- Safety precautions will be as per statutory mines regulations and circulars issued by DGMS time to time.
- Provision of safety belt or rope while persons are at work at work benches in case of open cast mine and stopes in case of underground mine where there are chances of falling down for more than 1.8m.
- Spoil banks not to be retained by artificial means at an angle of repose in excess of its natural angle.

- For safe mining in case of blasthole stoping method, closer sublevels will be created considering the rock mass in the ore body. Though a level interval of 50 m is suggested, but the sublevels may be reduced upto 15 to 20 m depending upon local conditions.
- Drafting and implementation of preventive maintenance schedule for various kinds of machinery deployed in opencast workings, same will be done for underground working.
- Provision of maintenance of properly laid haul roads with parapet wall fencing or guards and road signs at strategic points.
- Training and retraining (at specified interval) of the machinery operators.
- Adequate maintenance of electrical equipments.
- Adequate illumination after daylight.

1.1.2 Hazard Identification

It is a mining project which may have the following types of hazards associated with it.

Natural Hazards

- Earthquake
- Flooding – Heavy Rainfall/ Water Bodies

Man-Made Hazards

- Bench Slope Failure
- Vehicles and Machinery
- Loading and Excavation of Mineral
- Drilling and Blasting
- Fugitive Emissions from Mining Operations
- Hazard due to underground working

1.1.3 Assessment of Risks involved during Mining and Mitigation Measures:

Factors of risk involved due to natural calamities and human induced activities in connection with mining operations are as under:

1. Floods

The state of Odisha is predominantly located at the sub-tropical coastal location and is therefore prone to tropical cyclones, storm surges and tsunamis. Floods have been observed in the following 6 districts of the state, flash floods affecting the downstream areas of mainly, Mayurbhanj, Balasore, Bhadrak, Keonjhar, Jajpur and Ganjam districts during 1980, 1982, 2001 and 2003.

Risk Involved: Flood is not reported in the area where lease is situated because it's on elevated grounds. Nearest surface water bodies are Damsal Nala-0.74 Km NW, Damsal Canal-4.13 km SW, Karchamula Nala-2.93 Km W, Nadibarana Nala-3.88 Km W, Right Bank Canal-4.11 Km W, Pandara Nala-4.54 km S, Puagaghua Nala-4.16 km W and Sasubhuashuri Nala-4.5 km NW.

Ragada Dam is at 4.15 km NW which is far from the M.L. area.

Incase of underground working there is a possibility of inundation for which two dewatering pump will be installed of capacity 72KL/hr.

2. Open Cast Bench Slope Failure

Risk Involved: Reasons for failure are -

- Inadequate nos. of competent persons for carrying out statutory inspections.
- Lack of supervision.
- Failure to make and keep the quarry sides secure by proper benching, sloping and keeping benches of adequate height and width.
- Undercutting so as to cause dangerous covering.

Mitigation Measures:

For determining factor of safety, the bench slopes are to be monitored regularly by sensitive instruments at precise level at regular intervals to check for any possible ground movement. A well-developed drainage system over the lease hold area is to be ensured to check the storm water flows out of the lease area.

- Failure to make and keep the quarry sides secure by proper benching, sloping and keeping benches of adequate height and width.
- Inadequate nos. of competent persons for carrying out statutory inspections.
- Lack of supervision.

The pit will be dug by following all the safety measures and maintaining overall slope is $<30^0$ with individual bench adequately sloped.

As we know that the overall management of the slopes created during the development of an open pit mine requires an ongoing assessment of the stability of these slopes. This assessment depends on good geological, geotechnical and groundwater models as well as an understanding of the risks and economic consequences of slope instability.

Slope stability study of the mine has also been done by CSIR- CENTRAL INSTITUTE OF MINING & FUEL RESEARCH, DHANBAD (CIMFR) to avoid risk.

There shall be adequate supervising staff and mining operation will be done under strict supervision of the Mining Engineers and Asst. Mining Engineer to avoid any mishap.

3. Vehicular Movement

Risk Involved:

- Possibilities of road accidents are possible due to rash driving/brake failure/lack of visibility.
- Possibility of overloading may injure the passer-by public.
- Vehicles moving in a steep gradient or on benches of inadequate width.
- Accidents are common due to reversing of vehicles.

Mitigation Measures:

- The trucks will be properly covered with tarpaulin and overloading will not be allowed to avoid accidents.
- Width of bench is being maintained from 8 to 12 mtrs and gradient of haul road is 1:16.
- Proper maintenance of vehicles and weekly examination by an engineer and daily examination by a competent person.

4. Mineral Loading, unloading and Transportation/Use of machinery:

Risk Involved:

- Use of substandard equipment.
- Dust generation from loading & unloading will affect the respiratory health of workers and nearby population.
- Accident due to generation of fly rock.
- Attempt to clean moving parts of machinery.
- Non-provision or removal of guards for moving parts of machinery.

Mitigation Measures:

- Drafting and implementation of preventive maintenance schedule for various kinds of machinery deployed in opencast workings, same will be done for underground working.
- Dust suppression systems (fog system) has been installed at the site to abate dust generation. Same practice shall be followed during expansion too.
- Precautions against danger while traversing dumpers, excavators etc. by installing audio-visual alarms and appointment of spotters.
- Proper maintenance of vehicles and weekly examination by an engineer and daily examination by a competent person.
- Training and retraining (at specified interval) of the machinery operators.
- Transportation of mineral within mine workings by vehicles under the direction, supervision and control of Mine Management only.

5.Drilling and blasting:

Risk Involved: Drilling is common to the mining of hard rock's/ores. The main hazards are:

- Drill Falling from the edge of a bench.
- Inhalation of dust created during drilling operation.
- Increase in PM levels will affect the respiratory health of mine workers and nearby population.
- Noise produced during drilling and blasting.
- Inadvertent handling of explosives.

- Fly rock and vibration due to blasting.

Mitigation Measures:

- The mining will be done with open cast mechanized method with drilling and blasting as required. Hence, explosives and detonators will be used under supervision for dislodging of hard materials when necessary.
- Providing a ventilation system on drilling rig with dust filter to remove harmful dust.
- Sprinkling of water is being done to avoid dust created during drilling and blasting operations.
- All the persons working will be provided safety shoes and helmet to prevent them from fly rock.
- Explosives will be used under strict vigilance of the Mining Engineer and Assistant Mining Engineer.
- Dust suppression and water sprinkling system are installed for suppression of particulates. Wet drilling is being carried out to minimize dust generation. Drilling machines are equipped with dust collector arrangement.
- Personnel working on the drills and near the drilling area will be provided with dust mask and other required Personal Protective Equipments (PPE). Same practice will be done during expansion also.

6. Accidents due to Machinery

- During reversal operation
- Unauthorized driving of vehicles (mostly by helpers)
- Riding of vehicles unauthorized
- Attempt to ride moving vehicles
- Overloading
- Driving vehicles in a intoxicated stage
- Vehicles moving in steep gradient or on benches of inadequate width

Mitigation Measures:

- All transportation within the mining lease working will be carried out directly under the supervision and control of the management.
- The vehicles is being maintained in good condition and checked thoroughly at least once a month by the competent person authorized for the purpose by the management.
- Road signs will be provided at each and every turning point up to the main road (wherever required).

- To avoid danger while reversing the equipments/ vehicles especially at the working place/loading points, stopper should be posted to properly guide reversing/spotting operating, otherwise no person should be there within 10m radius of machine.
- The maximum permissible speed limit shall be ensured.
- Overloading of material will be avoided.
- A statutory provision of the fences, constant education, training etc. will go a long way in reducing the incidents of such accidents.

7. Other than Transportation Machinery

- Use of substandard equipments
- Accident due to generation of fly rock
- Attempt to clean moving parts of machinery
- Non provision or removal of guards for moving parts of machinery

Mitigation Measures:

- All the trucks loading and operating machines will have horns and proper maintenance of mining machinery shall be done.
- Regular maintenance of machineries and equipment is being done and same will be continued during expansion also.
- Height of the bench will be maintained as per approved mining plan to avoid over hanging of rocks.
- The mineral will be loaded in trucks mechanically *i.e.* by JCB during mining. There is least possibility of injury to the person during loading operation at mine.
- There shall be fencing of the mined-out area to prevent any accident of mine nearby habitants of nearby village and their livestock.
- The complete mining operation will be carried out under the Management and control of experienced and qualified Mines Manager having Certificate of Competency to manage the mines granted by DGMS.
- All the provisions of Mines Act 1952, MMR 1961 and Mines Rules 1955, RMMCR 1986 and other laws applicable to mine will strictly be complied with.
- During heavy rainfall the mining activities will be closed.

8. Risk involved during underground working:

- Fall of roof and sides

- Collapse of pillar in mines
- Runaway of tubs due to breakage of rope, failure of attachment to rope, failure of couplings and drawbars.
- Non-functionality of safety devices.
- Fire arising from electric defects.
- Inundations
- Ventilation
- Illumination

Mitigation Measures:

- Rock bolting will be done to provide support to the roof or sides of the cavity.
- During sinking of shafts, the face shall be ventilated properly by auxiliary ventilation fan. The mail ventilation fan of adequate capacity shall be installed for the mine ventilation of underground working.
- Two dewatering pump will be installed of capacity 72KL/hr to avoid inundations.
- To avoid breakage rope condition and joints shall be inspected and maintained properly. Improper or damaged ropes shall be replaced immediately.
- To avoid electrical hazards Inspection of equipment will be done regularly for signs of overheating, partial discharge and mechanical damage. Inspection of earthing point will be regularly.
- Separate and independent emergency light source should be provided at all places where a hazard could be placed by failure if light.

9. Risk Involved due to COB Plant Operation

- Emissions from the operation of the plant will cause respiratory problem to the workers at site and nearby population
- Pollutants emitted from stack will increase the Ground Level Concentration of pollutants which will affect the respiratory health of people in nearby area

Mitigation Measures:

- Crusher and vibratory screens will be enclosed to avoid dust emissions.
- Crushing, grinding and all other processes in COB plant are proposed to be wet process.
- Adequate stack shall be provided in order to minimize the GLC.
- Low Sulphur fuel shall be used in operation of DG sets.

1.1.4 Vulnerability Analysis

A vulnerability assessment was performed was performed for the hazards associated with the project.

Table 7-1, Vulnerability Analysis

S.NO.	HAZARD IDENTIFICATION	Severity (1-5)	Likelihood (1-5)	Severity x Likelihood (1-25) (Hazards scoring 1-9 are less serious hazards & 9-25 are very serious hazards &require risk assessment)	Proposed General Mitigation Measure/ Control
	Natural hazard				
1	No natural hazard is expected	3	1	3	• The location of the mining lease is very subtle and therefore natural hazards are less likely.
	Man-made hazards				
2	Opencast bench Slope Failure	2	2	4	• The depth of mining will be average depth up to (-) 2 mRL for Band I and 46 mRL for Band II. The ultimate maximum bench height will be upto 8m with minimum working width of 8-12m till the end of plan period. The overall slope will be<30^{o}, with individual bench adequately sloped as per mining plan. Hence, it is less likely that any slope failure will take place in this mine. However, slope stability study has been conducted through CSIR-CENTRAL INSTITUTE OF MINING & FUEL RESEARCH, DHANBAD (CIMFR) and an ongoing assessment of the stability of these slopes will be regularly done. • There shall be adequate supervising staff and mining operation will be done under strict supervision of the Mining Engineers and Asst. Mining Engineer to avoid any mishap. • For determining factor of safety, the bench slopes shall be monitored regularly by sensitive instruments at precise level at regular intervals to check for any possible ground movement.

					• Stability of benches and slope shall be ensured by full compliance of the mine plan duly approved by IBM.
3	Vehicular Movement	4	4	16	• All transportation within the mining lease working shall be carried out directly under the supervision and control of the management. • The vehicles will be maintained in good condition and checked thoroughly at least once a month by the competent person authorized for the purpose by the management. • Road signs will be provided at each and every turning point up to the main road (wherever required). • To avoid danger while reversing the equipment's/ vehicles especially at the working place/loading points, stopper shall be posted to properly guide reversing/spotting operating, otherwise no person shall be there within 10m radius of machine. • Reverse horns will be fitted in all vehicles. • The maximum permissible speed limit shall be ensured. • Overloading of material will be avoided. • A statutory provision of the fences, constant education, training etc. will go a long way in reducing the incidents of such accidents. • Edge protection will be done to prevent inadvertent movement. • Visibility defects can be eliminated by the use of visibility aids such as closed circuit television and suitable mirrors.
4	Fugitive Emissions during mine operations such as excavation and loading.	2	5	10	• Regular sprinkling shall be done with operations generating dust emission. • Dumpers shall be covered with tarpaulin during transportation of material and waste. • Dust masks shall be provided for operations involving high fugitive emissions or when required.

5	Mineral Loading and Excavation / Machinery Operation /Slip and Trip of Workers in Working Areas	4	4	16	• Regular safety audit shall be carried out. • Only authorized personnel will be allowed in the operation area. • Vocational training shall be given to all operators and workers of the mine. Mining operations shall be carried out under proper supervision. • All the trucks loading and operating machines will have horns. • Chromite ore will be loaded in trucks mechanically *i.e.* by JCB during mining. There is least possibility of injury to the person during loading operation at mine. • Complete mining operation will be carried out under the Management and control of experienced and qualified Mines Manager. • During heavy rainfall the mining activities will be limited. • All persons in supervisory capacity will be provided with proper communication facilities. • Competent persons will be provided first aid kits which they will always carry. • Mobile Fencing shall be installed during operation at the bench. • Signage shall be installed for all movement areas of machines and everyone on site will be made to wear PPE in these areas. • All machines and vehicles shall be maintained by the maintenance incharge.
6	Drilling	2	2	4	• Training shall be given for proper drilling operation • Proper PPE shall be used for drilling operation • Signage and restricted entry shall be done in areas of drilling operation

7	Fall of roof and sides	4	3	12	• Roof and side of working will be kept secure. • Support will be set as per systematic support rules. • Workers will not be permitted to work under unsupported roof.
8.	Collapse of Pillar	4	3	12	• Rock bolting will be done to provide strength to pillars. • As per recommendation of NIRM for underground support system below -250 mRL, following support design is proposed: ➢ In all the waste drive and x-cuts there shall be three roof bolts in a row with row spacing of 1.2 m. ➢ In ore drives and x-cuts there shall be four roof bolts in a row with row spacing of 1m. • The support system have been designed considering a bolt capacity of 8 tons for the 1.8 m long, 20mm dia.
9.	Inundations	3	3	9	• Two dewatering pumps will be installed of capacity 72KL/hr to avoid inundations. • Shaft sites will be located away from faults and other geological disturbances.
10	Subsidence	3	2	6	• As per NIRM study the stopes will be backfilled by cemented fill material. Therefore, subsidence is not expected. • The stability of void shall be monitored regularly by strata monitoring instruments. Also, subsidence survey shall be carried out at regular interval.
11	Ventilation	3	3	9	• Ventilation of bottom of shaft by auxillary ventilation fans.

1.2 DISASTER MANAGEMENT PLAN:

Safety of mine and the employees is taken care of by the mining rules & regulations as per Metalliferous Mines Regulations 1961, which are well defined with laid down procedure for safety, which when scrupulously followed safety is ensured not only to manpower but also to machines & working environment. Disaster Management Plans are prepared as proactive measures which help reduce effect of the accident/disaster and enable quicker recovery.

Plans for Disaster Management

Onsite emergency planning:

An onsite emergency is caused by an accident or hazard that takes place within the plan area and the effects are confined to the plant area.

The onsite emergency plan consists of following key elements:

- Planning as per hazard analysis
- Preventive measures
- Emergency response procedure
- Recovery procedure

On Site plan shall be in place which includes the following:

a. Regular safety audit/inspection
b. Incident Response team and role and responsibility of each member
c. Procedures for taking care of incidents/emergencies
d. Mock drills
e. Assembly point
f. Communication system/arrangement with administrative and regulatory agencies, media and public etc.
g. Siren for declaring/closing emergency.
h. Regular training on first aid and evacuation etc.

<u>Flood</u>

- The problem is not likely in the area but, a training plan will be prepared for mine workers to cope up with the disaster. A mock drill will be carried out before the start of the rainy season so that at the time of disaster workers do not panic and can do pre-assigned jobs regarding safeguard of themselves and others.
- Limited Mining will be done during rainy season.
- The meteorological department gives pre warning on possible heavy rains or floods or cyclones. Hence during any such case the project site will be evacuated or if possible the excavated site will be fenced.
- To prevent inadvertent entry of people near the excavated pits, long poles will be grouted as a sign of excavated site.

- There will be warning signs in local language will be erected at the site to avoid any mishappening. Nearby villagers will be informed.

Waste Dump Management

Waste generated till 2017-2018 is 11221721 Cum which will be dumped over the existing dump yard.

The OB/waste generated from the open cast mining till conceptual period will be 21.30 lakhs cum from Band I and 67.64 lakhs cum from Band-II. The mined-out OB/waste will be dumped in existing dump yard and will be backfilled in the mined-out areas of Band I.

From underground mining 428940 cum of waste will be generated till lease period which will dumped in the existing dump yard and mined out areas of Band I and Band II.

The common dumping along boundary line has been proposed between M/s IMFA and M/s BAL. Necessary permission from Director General of Mines Safety has been obtained vide Lr No BJA/CH-2 & 12/P-111 (3)/2013/413-14, dated 13/02/2013. Parapet wall along with garland drain along with settling pond is constructed at the toe of the both OB and subgrade dump and both dumps are terraced properly.

Fire Management

There shall be provision of mobile fire extinguishers at the mine office. There will also be buckets for sprinkling sand if there is a fire outbreak as water is not readily available at the site.

Explosive Handling

Drilling and blasting will be carried out when hard rock patch is encountered hence mining will be mainly limited to excavation, processing, loading and transportation

Training

Following training shall be provided to the workers from time to time:

- Safety Education & Awareness
- Holding annual safety weeks
- Imparting basic and refresher training to new and old employees respectively.

Communication

An internal communication system for the department head and to their line of command should be maintained. Having the telephone nos and addresses of adjoining mines, rescue station, police station, Fire service station, local hospital, electricity supply agency and standing consultative committee members is essential.

Offsite emergency planning:

Offsite emergency plan defines the various steps to tackle any offsite emergencies which may affect surrounding areas of the project has to be prepared after due final discussion with local panchayat and revenue officials.

Offsite emergency planning mainly consists of –

a. Contact details of fire brigade, local police, hospitals, local district administration, factory inspector, state pollution control board, state electricity board etc.

b. Demographic details and topography map of the surrounding area.

c. Communication system/arrangement with above mentioned agencies, media and public.

Communication

The telephone numbers and addresses of adjoining mines, rescue station, police station, fire service station, local hospital, electricity supply agency and standing consultative committee members are also maintained for any emergency requirement.

Disaster Management Team

A standing consultative committee will be formed under the head of mines manager. The members consist of safety officer/medical officer/Asst. manager/ public relation officer/ Foreman/ and environmental engineer.

Roles and responsibilities of the team shall be-

- Any abnormality shall be reported to the Top management.
- The management shall make cordial relations with the local authorities, hospitals etc. to help them during crisis.
- There will be communication facilities provided by the management at the mining site for better response time.
- A doctor and supporting staff will be there to provide first aid facilities to the workers in case of any mishap.
- Provision of Ambulance at the site with first aid facilities.

ACTIVITIES POSING RISKS DURING MINING

1. Loading and Excavation of Mineral

Affected Personnel: All operators of machinery for loading and excavation are at high risk. All helpers and other personnel in the mine are at moderate to low risk.

S.no.	Hazard Identified	Severity (1-5)	Likelihood (1-5)	Severity x Likelihood (1 x 25)	Proposed Mitigation
1	Injury due to Falling of rock from the boom of excavators	4	2	8	• Cabin shall be provided on all excavators/ other machinery so that no rocks hit the operator • All operators and other workers in close proximity shall be trained in their jobs and wear all PPE
2	Accidents due to bench Collapse due to	1	2	2	• Undercutting shall be avoided by mine supervisor

	undercutting of Benches				
3	Accidents due to movement and operation of Heavy Machinery	4	4	16	• Signage in all movement areas of machines • Areas of movement of vehicles shall be marked and everyone in the site will be made to wear PPE at all times when present in these areas. • Only authorized/ designated personnel shall be allowed in the operation area • Reverse horn shall be installed on all machines prior to their deployment for operation • Vocational training to all operators and workers of the mine.Awareness programme for health effects on exposure to mineral dust will be organized for employed person as well as for nearby villagers.
4	Dust Exposure at the mine site	2	5	10	• Personal Protective Equipment (Dust masks) shall be provided to workers • Dust suppression measures such as usage of dust collectors and water sprinkling shall be carried out in working areas.
5	Exposure to Noise	2	5	10	• Mining operation do not include any major source of generation of noise in the working area, thus noise levels are not of significant levels. However, ear plugs will be provided to all workers in the area. • Audiometry test of the workers shall be done regularly & medical health provided wherever required.
Risk during underground working					
1.	Accident due collapse of pillar in underground mine	4	3	12	• Rock bolting will be done to provide strength to pillars. • As per recommendation of NIRM for underground support system below -250 mRL, following support design is proposed: ➢ In all the waste drive and x-cuts there shall be three roof bolts in a row with row spacing of 1.2 m. ➢ In ore drives and x-cuts there shall be four roof bolts in a row with row spacing of 1m.

					• The support system have been designed considering a bolt capacity of 8 tons for the 1.8 m long, 20mm dia.
2.	Accident due to breakage of rope, failure of attachment to rope, failure of couplings and drawbars.	3	2	6	• Rope will be selected properly and maintained with care.
3.	Accident due to fire arising from electric defects	3	2	6	• Inspect equipment regularly for signs of overheating, partial discharge and mechanical damage. • Inspect earthing point regularly. • Use of flameproof and intrinsically safe apparatus. • Cables should be provided with double wire armouring.
4.	Inundations	3	3	9	• Two dewatering pumps will be installed of capacity 72KL/hr to avoid inundations. • Shaft sites will be located away from faults and other geological disturbances.
5.	Deficiency of Oxygen and generation harmful of gases	3	3	9	• During sinking of shaft, the face will be ventilated by auxiliary ventilation fan.
6.	Illumination	2	3	6	• Permanent lighting will be provided in places where equipment can be hazardous. • Separate and independent emergency light source will be provided at all places where a hazard could be placed by failure if light.

2. Transportation of Material

Affected Personnel: Drivers and operators of machinery are at high risk from this activity. All other personnel working in the mine are at moderate risk by this activity.

S.No.	Hazard Identified	Severity (1-5)	Likelihood (1-5)	Severity x Likelihood (1 x 25)	Proposed Mitigation
1.	Injury due to falling of minerals from truck	4	2	8	• It shall be ensured by senior personnel that trucks are not overloaded. • Material outside the mine shall go in a covered truck; covering shall be done by tarpaulin.
2.	Accidents due to movement of vehicles	3	3	9	• Signage of vehicular movement areas. • PPE shall be worn by operators and workers in these designated areas.
3.	Injury due to falling of machines/ vehicles from bench and in the working area	3	3	9	• Use of helpers during reverse operation of the machine • Working bench width shall be kept adequate to the width and turn of the vehicles/machines • Overcrowding of vehicles shall be avoided near loading areas.
4.	Brake Failure	2	2	4	1. All vehicles/machines shall be maintained by the maintenance incharge.
5.	Speed control	3	2	6	2. Speed of vehicles will be restricted below 25 km/hr to mitigate dust generation while transporting of mineral.

3. Slope stability

Affected Personnel: All workers in the mine are at high risk with respect to this activity

S.No.	Hazard Identified	Severity (1-5)	Likelihood (1-5)	Severity x Likelihood (1 x 25)	Proposed Mitigation
1.	Accidents due to slope stability	2	2	4	• Prior to start of mining operation there shall be a study carried out for fixing of parameters with respect to mining to maintain stability of slope • For determining factor of safety, the bench slopes shall be monitored regularly by sensitive instruments at precise level at regular intervals to check for any possible ground movement. • Stability of benches and slope shall be ensured by maintaining optimum overall slope of 30° and by full

					compliance of the mine plan duly approved by IBM.

4. Blasting

For blasting explosive will be used which will be stored in the existing 5 tons capacity magazine. An explosive van of 2.39 tons capacity is being used for transportation of explosives and accessories to site and back to magazine.

S.no.	Hazard Identified	Severity (1-5)	Likelihood (1-5)	Severity x Likelihood (1 x 25)	Proposed Mitigation
1.	Accidents during blasting such as Sudden blast shock to workers, Dangerous rock conditions after blast,presence of undetonated explosives, and/or initiators, fly rock etc.	4	3	12	• Drillers & blasters will be given protective gears eg. Helmets, goggles, gloves, boots,ear muffs and dust masks to avoid negative impacts of drilling and blasting. • Except for the crew other people's entry will be banned for at least 30 minutes before the blast initiation. • Pre-blast warnings will be given out loud speaker. • All misfires will be safely removed, and other hazardous condition corrected or secured. • First-aid will be provided at the time.
2.	Injury due to Falling of rock from the boom of excavators	1	2	2	• Cabin shall be provided on all excavators/ other machinery so that no rocks hit the operator • All operators and other workers in close proximity shall be trained in their jobs and wear all PPE
3.	Accidents due to bench Collapse due to undercutting of	1	2	2	• Undercutting shall be avoided by mine supervisor

	Benches				
4.	Accidents due to movement and operation of Heavy Machinery	4	4	16	• Signage in all movement areas of machines • Areas of movement of vehicles shall be marked and everyone in the site will be made to wear PPE at all times when present in these areas. • Only authorized/ designated personnel shall be allowed in the operation area • Reverse horn shall be installed on all machines prior to their deployment for operation • Vocational training to all operators and workers of the mine.

5. Plan for Accidents

Mining site shall arrange for /provide at least the following to mitigate any accident that occurs due to operation:

- First Aid facilities at site
- Ambulance
- Tie up with primary health center for immediate treatment
- Strict implementation and training of a detailed on-site emergency plan. The Plan shall be prepared by a competent agency.