

RISK ASSESSMENT & MANAGEMENT PLAN

Mining and allied activities are associated with several risks to the employees. Hence, mine safety is one of the most essential aspects of any working mine. Indeed, safety of the mine and the employees is to be taken up as per Mines Act 1952 and Coal Mines Regulation (CMR) -2017.

Risk Assessment: It is a process that involves measurement of risk to determine priorities and to enable identification of appropriate level of risk treatment (i.e. risk management).

Risk Assessment process involves the following steps:

- a) Formation of Team
- b) Identifying the Hazards (Activity wise)
- c) Assessment of the Risk & Ranking and
- d) Treatment Controls and Action Plans

Risk Management: It is the overall description of the steps taken to manage risk, by identifying hazards and implementing controls in the work place. Risk Management process involves the following steps:

- i) Induction, Training & Continuous Improvement
- ii) Accident / Incident Reporting & Investigation
- iii) Auditing & Review / Revise

Identified of Hazards:

The coal is being excavated by underground method in this mine. Based on Risk Assessment process, the following are the various activities identified, which can cause risks/accidents/incidents in an underground Mine.

- Mine gases
- Mine fires and spontaneous heating
- Explosions in the mine
- Rock burst
- Subsidence
- Inundation
- Roof fall

1.1 Mine Gases

The following gases are found in underground coal mines:

- Carbon monoxide (CO)
- Carbon-dioxide (CO₂)
- Methane (CH₄)
- Hydrogen Sulphide (H₂S)
- Sulphur dioxide (SO₂)

The production of these noxious and inflammable gases beyond tolerable limits in underground mines creates environmental hazards. The factors, which are responsible for the production of these noxious and inflammable gases, are as follows:

- Exhalation by man
- Blasting and explosion
- Underground fire
- Spontaneous heating
- Coal dust explosion
- Decay of timber
- Bacterial action
- Distillation of coal

1.2 Mine Fires and Spontaneous Heating

The various factors governing mine fire and spontaneous heating in underground mines are as follows.

- a) Chemical composition of coal
- b) Friability
- c) Presence of Iron Pyrite
- d) Nature of adjoining strata
- e) Depth of the seam
- f) Thickness of the seam and
- g) Geological disturbances

1.3 Explosives and Shot firing

The main danger from explosives in u/g coalmine is the ignition of firedamp. It may take place in the following ways:

- By incompletely detonated explosive: Such explosive may continue to burn like an ordinary combustible material.
- By incandescent particles coming out of the shot hole after blasting and contact with coal dust or gas.
- By the flame and hot gases.
- By the compression wave of the blast, this may compress the gases in the cracks connected with the shot hole and raise the temperature of the compressed gas to such an extent as to ignite it. 20 fold compression is known to be sufficient to ignite all inflammable mixtures of firedamp and air.

1.4 Explosion in Mines

An explosion is a sudden process of combustion of great intensity accompanied by spontaneous release of large amount of heat energy and in which the original gas or solid substance like coal dust is instantaneously converted into gaseous products. An explosion is invariably accompanied by violence on a large scale. Explosions in coal mines are due to (1) firedamp and/or (2) coal dust. Firedamp has been the main cause of explosion in coal mines when mixed with air in explosible limit. The following precautions are taken to prevent a firedamp explosion. Possible causes of explosion can be attributed to the following factors:

- Flames naked lights, damaged flame safety lamps and contrabands.
- Heated surface – overheated lamp gauges, electrically heated wires, heated rock surface, incandescent coal, overheated broken blocks, un-lubricated haulage rollers, rope friction, conveyor troughs rubbing against its support,
- Sparks – Electric sparks and arcs, static sparks from compressed air pipes, friction sparks from iron pyrites, friction spark from light metal alloys, and
- Explosives – Resulting into flame and hot gases, compressive wage set up by explosives, especially in a break adjacent to the shot hole, incandescent particles ejecting from the shot hole, incompletely detonated explosives, etc.

Vakilpalli mine is a degree one gassy mine and so far no explosion recorded in this mine.

1.5 Rock Burst

A rock burst or bump in coal mine is a sudden and violent failure or collapse of the rock in situ under stresses greater than it can normally withstand and on a scale sufficient to cause material damage to endanger the safety of the workers. So far no incident of rock burst is recorded in this mine.

1.6 Subsidence

Subsidence is an important aspect of underground mining activity. Underground mining operations can give rise to undesirable effect, such as:

- Damage to surface installations, like buildings, railways, roads, pipelines for water supply, power line, etc.
- Produce fractures in another coal seam, immediately above the one being currently exploited.
- Cause fractures on the surface which may in turn cause flooding of the underground working by drawing water from the sources on the surface.
- Cause damage to other mining installations and as well affect roots of the vegetation.

1.7 Inundation

The panels are being extracted from dip to rise. This ensures self drainage of the panels and thereby no water would be accumulated in upper horizon than the working panels. The water would flow through drains into the sump. Adequate capacity of sumps and provision of suitable pumping arrangements have been made.

2.0. RISK MANAGEMENT IN THE MINE

2.1. Measures being taken to avoid mine gases

- The quantity of inflammable gas given out in each ventilation district is determined at least once in a month and similarly borehole samples once in a quarter.
- The quantity of air sent into each district is such as to keep the percentage of inflammable gases in the district return airway below a percentage of 0.75 to 1.25 at any place in the mine.
- Flameproof apparatus has to be installed at each and every working face to monitor the weather in the area of development or depillaring in each and every discontinued gallery as also in all other places, where the percentage of CH₄ in the general body exceeds 0.2%.
- Detection with flame safety lamps, air sampling and analysis will continuously monitor the state of atmosphere near the stopping.
- There is strict adherence to latest safety manuals and statutory acts.
- A suitable mechanical ventilator installed on the surface should ventilate working.
- Approved types of stone dust barriers are provided at the specified places, if required.
- A ventilation officer will assist the Manager.
- Adequate quantity of air is coursed to working face
- Air samples are frequently collected of the roof of the working face and analyzed timely for the presence of CH₄.

2.2. Measures to avoid fires in the underground mine are as under

- Checking the workers before proceed to underground for match box, lighters and other contrabands.
- Do not allow burning of fire inside the mine and also within 15 m of an incline/pit.

- Avoid welding of headgear pulley or the headgear frame unless adequate timely precautions are taken.
- Avoid welding in underground repair without adequate precautions.
- Restrict the storage of inflammable and combustible material like oil, grease, timber etc., in underground.
- Remove all wood cuttings as also oily and greasy cotton wastes out from underground of the mine.
- Install the electrical cables and equipment with due care and maintain them properly with regular inspections.
- Use only approved safety lamps, which will be taken underground in locked condition.
- Machinery to be used underground will be meticulously assembled and properly operated so as to ascertain that during use it does not cause any dangerous sparks or for that matter not generate any hot surface.
- Break blocks of underground machinery like haulage engines, locomotives, etc., shall be adjusted periodically to avoid their overheating and
- Avoid at any cost, accumulation of dangerous static electric charges on the equipment using air by earthing.

2.3. Measures to avoid accidents due to explosives and shot firing

The following precautions are taken to avoid accidents due to explosives and shot firing.

- Person handling explosives or engaged or assisting in the preparation of charges or in the charging of holes shall not smoke or carry or use a light other than an approved enclosed light/electric torch.
- Person shall not take any light other than an approved electric torch into any explosive magazine.
- Person shall not have explosives in his possession except as provided for in this regulation (CMR-2017).
- Any person finding any explosive in or about a mine shall deposit the same in the magazine or store premises. Every such occurrence shall be reported to the manager in writing.
- All precautionary measures as laid down in the regulations (CMR-2017) to be taken.

2.4. Measures against mine fires / spontaneous heating

The following precautions are taken to avoid mine fires / spontaneous heating:

- Adequate size coal pillars are being maintained in trunk roads.
- Panels are planned to extract within the incubation period.
- Continuous monitoring of CH₄, CO₂ & CO at goaf edge and other strategic points.
- Flushing of Nitrogen / CO₂ in the goaf, if needed.
- Filling of subsidence cracks on the surface by soil, etc.

2.5. Measures against explosion

Measures to prevent fire damp explosion:

- For avoiding dangerous accumulation of firedamp, it will be ensured to keep it below its lower limit of explosibility.
- Avoiding sources of ignition, which may cause the firedamp to explode.
- Proper ventilation of the mine is the main to prevent dangerous build-up of firedamp.
- Besides this, regular inspection of places where firedamp may accumulate is very essential in addition to making provision of proper ventilation.
- The motors, switch gears and transformers will be provided with flameproof enclosures.

Measures to prevent coal dust explosion:

- Reducing the formation of coal dust in the working faces, haulage roads, etc.
- Preventing its spread.
- Rendering the coal dust harmless by wetting it with water or mixing the same with inert stone dust.
- Making provision of stone dust barriers or water barriers wherever necessary.
- Water spraying at loading points, transfer points as also over the loaded coal tubs help in reducing the dissemination of coal dust. Dust at the transfer points is being collected with use of dust extractor.

In addition, by providing proper ventilation system in underground mines, the risks that may arise due to mine gases, fires, explosions will be minimised. The working environment in underground mines is one of the important aspect associated with mining operations. Every mine ventilation system will be planned, established and maintained for creating safe and comfortable environment in mine workings for all the work persons during all stages of mining operations.

Ventilation system of a mine is required to satisfy the following basic needs in addition to comply the statutory requirements:

- To ensure at least 19% of O₂ and below 0.5% of CO₂ in the air circulated at work place.
- To dilute noxious and inflammable gases so as to render it harmless
- To remove or dissipate the coal or rock dust produced in the mine
- To prevent excessive rise of temperature and humidity

In addition to the basic requirements, ventilation system of every underground mine is designed and planned by considering the following important parameters for an optimum and efficient ventilation system:

- Circulating sufficient quantity of fresh-air to all mine workings including Plant & Machinery.
- Air power requirements of the mine will be as minimum as possible.
- System should have optimum energy efficiency.

For extraction of coal by underground operations, entries to the coal seams will be made from surface in the form of tunnels and shafts. Ventilation system is established through these entries by continuously circulating fresh air through some of the entries called as down-cast and taken to surface through other entries called up-cast. This intake air is circulated through all the required work places to take care of the basic requirements for maintaining safe and comfortable working environment.

This system is established by operating a fan called main mechanical ventilator installed at surface over one (or multiple) of the entries and operated continuously as long as the mine is in operation. Capacity of the said fan in respect of air flow rate, pressure and power are pre determined as per the ventilation requirements at various stages of mining activity and installed accordingly.

The Singareni Collieries Company Limited is one of the leading organizations in the country in planning and establishing efficient ventilation systems in its underground coal mines for achieving better comfort conditions. Mine ventilation is precisely and efficiently planned by making use of advanced computing tools such as ventilation network modelling. It is also being established and monitored by efficient equipment and instrumentation.

For mines having deep workings with heavy mechanisation and in needy mines, air cooling systems are also being installed for improving the comfort at work places. Consultancy services and guidance is also taken from reputed scientific institutions of India and abroad for the mines in introduction of advanced systems in respect of underground mining environment. Various modelling software is being procured and used for different applications related to mine ventilation and underground environment.

2.6. Measures against bumps

- Distressing of coal and the surrounding strata.
- Avoiding concentration of abutment loading near the working places.
- By discarding the random selective extraction.

2.7. Measures against subsidence

De-coaled area is being stowed with hydraulic sand/ash stowing wherever important surface features are to be protected (no important structures in VKP mine take area).

2.8. Measures against inundation

Surface Precautions:

- All entries were planned above the HFL zone to avoid danger of inundation.
- Filling up of the subsidence cracks, if any, with OB or any other material is being practiced.

Underground Precautions:

- The galleries in the panels are designed, rising towards the boundary of property so as to have self-drainage of water.
- The panels are planned to be extracted from boundary of mine, this ensures the water would flow through drains into the sump and avoiding the risk of water to other panels. Adequate capacity of main sump and auxiliary sumps with pumps has been provided.

2.9. Measures to counter effects of bursts are as follows

- Distressing of coal and the surrounding strata.
- Avoiding concentration of abutment loading near the working places.
- By discarding the random selective extraction.

2.10. Measures to avoid Inundation

- Working place approached within a distance of 60 m of any other working (likely to contain accumulation of water) shall not be extended further unless it is examined physically and found to be free from accumulation of water.
- Whenever seepage of water is noticed at any place of working, such working shall be immediately stopped. The height of such working shall not extend 2.4 m and at least one borehole near the centre of working place shall be maintained with sufficient number of flank holes. The boreholes drilled above and below the workings at intervals of not more than 5 m. Such boreholes constantly maintained 3 m in advance of the working.

3.0. EMERGENCY PLAN

Manager having workings belowground prepares general plan of action for use in case of fire, explosion or other emergency occurs. This plan prepares under rule 252 of CMR 2017. The plan outlines the duties and responsibilities of each mine official and key men including telephone operators. All officials and key men are thoroughly instructed in their duties to avoid contradictory orders and confusion. The emergency plan provide for mock rehearsals at regular intervals. The mine manager submitted the copy of the emergency plan to regional inspector, mines safety and got it approved.

The emergency plan approved for Vakilpalli UG mine is presented in **Figure 1**.

Figure No. 1: EMERGENCY ORGANISATION PLAN


