Risk Assessment Report

1 Introduction

Mining operations involves dangers/risks like fires, inundation, gas explosions and failure of machinery etc. which need to be investigated, addressed and mitigated. Disaster management plan is formulated with an aim to take necessary precautions to avert disaster and also to take corrective action after the disaster to limit the damage to the minimum.

Preliminary risk assessment is based on the philosophy that “Prevention is better than cure”. Mining operations may be carried out with utmost safety but there is always some element of danger or risk involved in it.

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 the mine workings (opencast and underground).

1.1 Significance of Risk Management (Safety Management System (SMS)

To minimize adverse effects of the risk, to which the workers are exposed in execution of different activities. Risk management involves the entire staff in the realization of safety improvement programme with responsibility and accountability sharing proportionately with the decision making authority.
The Directorate General of Mines Safety issued following Technical Circular to implement SMS:

a) DGMS. Tech. Cir.13 of 2002 - Safety Management System - A guideline for Implementation.
b) DGMS. Tech. Cir.8 of 2009 - System Study and Safety Audit for the purpose of eliminating the Risk of Accidents & Dangerous Occurrences.
c) DGMS (Tech) (S&T) Circular 2 of 2011 - Provision for Audit and Review of SMS.

1 Safety Management System (SMS)

- Identify the hazard.
- Dissect each activity to as smallest node as possible,
- Assess risk by considering the exposure, probability and consequence
- Prioritise and implement control measures
- Find out the residual risk, if any and procedures for handling of situations
- Continual improvement by adopting new methods and procedures

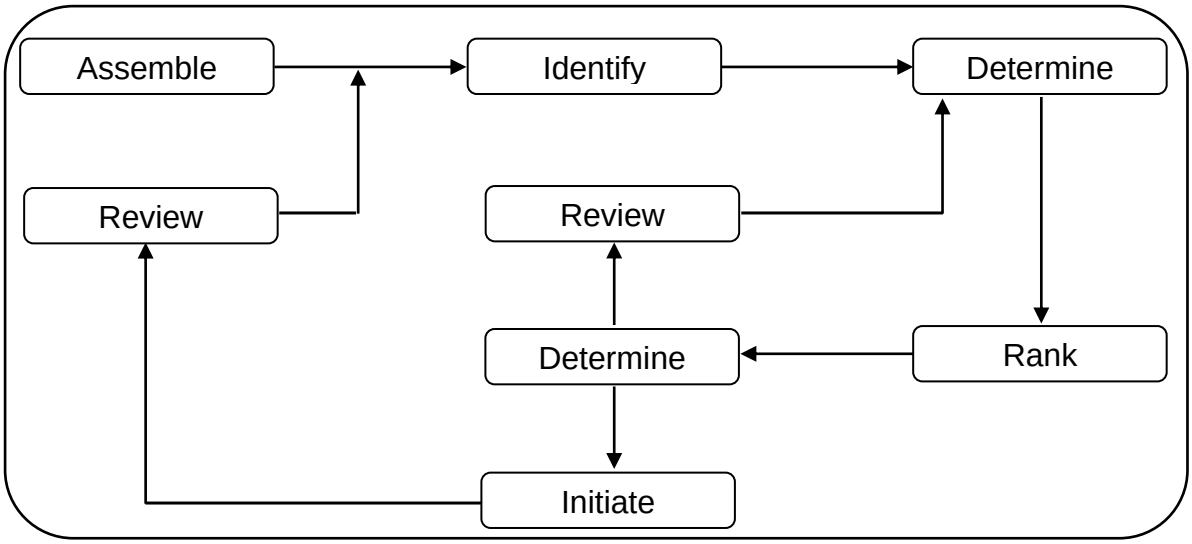
Hence, **Safety Management System** is one of the most essential aspects to operate the mine in safe way.

2 Risk Assessment Process

Risk Assessment is to be performed on a regular basis. The goal for each risk assessment session is to identify hazards, determine risk rating and controls, and to review the implementation of risk controls from previous risk assessment sessions.

The following workflow diagram illustrates the areas involved in performing a risk assessment process.

Risk Assessment Process:



3 Identifying the Hazards

The process of identifying hazards is the most important part of the whole risk assessment process.

Kakatiya Khani OC-III project involves extraction of virgin coal seams and some patches of developed underground workings by opencast method, as well as extraction of coal by underground method by development and depillaring by caving operations, the risks are involved in both underground and opencast method of working.

Hazard Identification can be done in many ways but the objective is to ensure that all of the possible Hazards are identified.

Being a Mixed/Integrated project (open cast cum underground mine), the Hazards were identified based on the previous experience of open cast operations (shovel dumper combination) and Underground operations (SDLs).

Hazards identified for the open cast operations based on the previous experience and on the following criteria.

i. Design parameters of the proposed mine
ii. Work process evaluation
iii. Accidents or occurrences
iv. Consultation with employees.
v. Safety statistics
vi. Significant incident, near miss or accident reports
vii. Inspection in the mine

The following are the possible hazards identified for the proposed project basing on the Tasks / Activities / Work places involved.

a. Adjacent UG Workings to the Dip Side (KLP Mine Workings in Highwall Batters of OC Mine)
b. Extraction of Already Developed Coal Pillars.
c. Movement of HEMM
d. Drilling and Blasting Operations
e. Slope Stability
f. Fire Fighting
g. Inundation

4 The measures to be taken to mitigate the identified hazards are explained in detail.

4.1 Adjacent UG Workings to the Dip Side (KLP Mine Workings in Highwall Batters of OC Mine)

The KTK OC III is formulated to convert major part of existing KLP mine into an opencast mine apart from continuing the underground operations for 9 years. To ensure maximum conservation of coal, the underground operations are proposed to extract blocked reserves in the highwall batters of the proposed opencast project. As such both opencast and underground mine will be worked side by side within the same boundary. Following steps are proposed to mitigate the effect of opencast workings on the underground mine.

a) In the seams proposed to be worked by underground method, the workings are planned in each seam by leaving a 60 meter solid barrier from the probable seam intersection line of the respective seam.
b) The production schedule of underground mine and sequencing of opencast project is planned in such a way as to keep adequate distance between the underground workings and opencast bench faces.
c) Further the underground workings are planned be ceased well before the opencast workings come to a distance of 300 meters from the already developed workings in the opencast project area.

4.2 Extraction of Already Developed Coal Pillars:

While working in the area where coal seams are developed, all precaution will be taken to ensure safety of men and machinery. Different safety rules in force and regulations made under Mines Act 1952 will be strictly complied with in the mine. Various precautions as laid down in DGMS circulars issued from time to time in this regard will be followed. The problems associated with extraction of standing pillars by opencast method are due to the following activities/reasons.

- Spontaneous heating & fire
- Deployment of HEMM
- Coal dust explosion
- Collapse of parting
- Drilling & Blasting

4.2.1 pontaneous Heating and Fire During Extraction of Already Developed Coal Pillars:

In the old workings, due to long standing of developed pillars, blasting and movement of heavy machinery creates fractures in the intervening parting and pillars. In this fractured zone, auto oxidation and heat build-up ultimately resulting into open fire. The crushed coal in the developed workings will catch fire due to spontaneous heating. The main factors attributable to the bench fire due to spontaneous heating are:

- Presence of micro/macro cracks in bench walls
- Long exposure of bench walls to the open atmosphere Accumulation of loose coal on the bench floor.

Precautions taken to prevent spontaneous heating and fire are.

❖ Where seams are liable to spontaneous heating a minimum coal bench exposure will be maintained. As far as possible optimum quantity of blasted coal will be made available.

- In case of any indication of fire in pilot boreholes, the seams will be drowned with water. During de-watering with the advance of quarry face, slow rate of de-watering will be maintained to prevent water gas explosion.
- Exposed galleries will be blanketed with overburden.
- To lower the chemical activity of coal, the exposed coal will be treated with anti-pyrogen like Hygroscopic – Calcium Chloride, Magnesium Chloride, Sodium Chloride & Dolomite powder.
- Fire fighting plan will be prepared and will be implemented to combat anticipated and unexpected fires.
- Separate Fire Fighting crew will be trained for firefighting in the underground developed area.
- To deal with fires, various control techniques like digging out, trenching, sealing, hydraulic sand-stowing, flushing with water/bentonite mixture through boreholes, inert gas infusion and isolation will be followed.
- Fire fighting ranges will be laid along the spoil heap side and along high wall with sufficient water pressures.

4.2.2 Deployment of HEMM During Extraction of Already Developed Coal Pillars:

- The galleries will be clearly demarcated over the benches with lime, flags, etc for safe movement of men and machine.
- HEMM movement will be only over the pillars or over the galleries filled up and compacted with blasted material for safety of men and machinery.
- The thickness of parting in coal will be maintained not less than 6m so as to prevent the heavy machinery from falling into the underground workings.
- Holes will be drilled from the pillar sides and the parting dropped so as to fill in the void for easy working of the heavy machinery.

4.2.3 Coal Dust Explosion During Extraction of Already Developed Coal Pillars:

Danger of coal dust explosion during extraction of developed pillars by opencast method exists due to accumulation of coal dust in floor of developed galleries and heavy blasting. To preclude any such occurrence, the DGMS has issued guidelines and precautions to be taken for avoiding danger of coal dust explosion as outlined hereunder:

- As the underground workings are accessible, they will be surveyed, cleaned of coal dust and thickly stone dusted before abandonment.
- Immediately prior to commencement of opencast workings in UG developed area, the area will be properly stone dusted to obviate danger of coal dust explosion due to heavy blasting in opencast mine. For the purpose, holes will be drilled from first OB bench or surface to underground gallery junctions and at least 2 tonnes of stone dust (preferably dry, water proofed limestone or dolomite dust) per hole is pushed down and then dispersed in working with the help of compressed air.

4.2.4 Collapse of Parting During Extraction of Already Developed Coal Pillars:

The strata between a quarry bench floor and roof of an old underground working may be weak and may collapse as a result of movement of HEMM and equipment may fall in the excavated space of old workings. In case of any fire in underground workings it may lead to accident.

Precautions to prevent collapse of parting are furnished below.

- A parting of 4m/ 6m of OB/coal over the developed pillars will be maintained and to ensure the parting advance pilot boreholes will be drilled.

- A plan showing the parting thickness, position of underground galleries and junctions will be marked and maintained.
- Pilot holes will be drilled to know the roof levels of U/G workings. The position of underground standing pillars will be earmarked by drilling additional pilot bore holes randomly in advance of 100 to 200m from coal bench to adopt suitable precautionary measures.

4.2.5 Drilling and Blasting During Extraction of Already Developed Coal Pillars:

The works of drilling and blasting, including transport of explosives, in the quarry all the drilling and blasting operations are placed under the charge of a person designated as blasting officer possessing at least First Class Manager's Certificate of competency.

Drilling and blasting over the underground developed galleries poses a major hazard compared to that of over the virgin patches. Apart from the standard precautions that will be taken during drilling and blasting operations in the opencast mine special precautions as mentioned below will be taken during extraction of developed pillars.

Precautions to prevent dangers associated with drilling and blasting are furnished below.

- The thickness of parting over developed seam will be maintained not less than 6m to prevent chances of the heavy machinery from falling down into the underground workings.
- The actual working plans of the opencast mine and the plans of the developed underground mine workings will be maintained and checked regularly.
- The galleries and junctions of the developed underground workings will be plotted accurately and clearly on the plan of the opencast workings, and also demarcated on the OB and coal benches.
- Holes will be drilled in the pillar and the parting allowed to be dropped so as to fill in the void for easy working of the heavy machinery.
- The spacing of the holes in the last overburden bench (immediately above the coal seam) will be adjusted that the holes will not lie immediately above the galleries, as far as possible, to ensure that the blast holes do not directly fire into the underground workings.
- The depth of hole, in the last overburden bench will be ensured in such a way as to leave at least 2 m of thickness of the overburden above the gallery in the coal seam. To ensure compliance with this requirement, a pilot hole will be drilled in for each round of blasting to determine the total thickness of the overburden over the coal seam.
- No blast hole will be connected to galleries. If strata found cracked, bottom 2m of blast hole will be filled with sand.
- For blasting in hot coal strata, special explosives will be used after bringing down the blast hole temperature to below a certain permissible limit (80°C) with the help of water. Blasting operations will be carried out within 2 hours after charging of explosive.
- Slurry/Heat resistance emulsion explosives will only be used in case of blasting in hot strata.
- The manner of extraction of pillars is by drilling and blasting holes in the coal pillars only from top downwards. During blasting bottom initiation system will be adopted.
- No delay detonators will be used for blasting in coal.
- All blast holes in last OB bench and in coal will be charged with water ampoules or with moist sand for at least 0.6m in length, at the bottom of the hole.
- The blasted coal will be evacuated as early as possible.

4.3 Movement of HEMM:

In Kakatiya Khani OC- III Project coal extraction of seams of more than 2m thickness is proposed to by departmental HEMM and OB removal along with thin seams is proposed by outsourcing. As such movement of HEMM poses a major risk for safety of persons employed. Measure to Prevent Accidents due to trucks and dumpers are as under:

- ❖ All transportation within the mine working will be carried out directly under the supervision and control of the management.
- ❖ The vehicles will be maintained in good condition and checked thoroughly at frequent intervals by the competent person authorized for the purpose by the Management.
- ❖ Sufficient lighting and road signs will be provided at each and every turning point specially for the guidance of the drivers at the night.
- ❖ To avoid danger to human life while reversing at the embankment and tipping points, these areas will be maintained human free. Human movement in the haul roads will be avoided.
- ❖ All statutory provision of the fences, constant education, training etc. will be arranged to reduce accidents.
- ❖ Drains will be provided on either side to keep the road dry. Sharp curves will be avoided.
- ❖ The haul road width of 30 m has been designed considering space for dozer track, pipes, electric lines, cables.
- ❖ Haul roads will be designed in such a way to have one way traffic where ever possible. Where one way is not possible there the haul road will be sufficiently widened.
- ❖ Separate haul roads provided for coal and OB transportation.
- ❖ Separate way for light vehicles will be maintained.
- ❖ Traffic rules will be framed and strictly implemented in true spirit.
- ❖ Properly trained workmen will be employed in the mine.
- ❖ Safety gadgets like radium jackets, whistles will be provided to all workmen.
- ❖ The safety procedures to be followed by contractor will be incorporated during tendering process itself.

4.4 Drilling and Blasting Operations:

In Kakatiya Khani OC III Project breaking of Overburden and coal will be done by drilling and blasting system, which involves use of explosives in large quantity. ***In the top most benches at areas falling within 500 m from village boundaries blasting will not be done and rock breakers of suitable capacity will be used for breaking of both overburden and coal in order to avoid danger of fly rock.***

4.4.1 Drilling Operation :

Accidents occur while transporting, positioning of drill machines and during drilling operations. The following precautions will be taken.

- ❖ While transporting drill machine, its mast will be lowered, even within the drilling area on inclined plane (High gradients) to avoid toppling of drill machine.
- ❖ While positioning drill machine on inclined planes, wedges will be used under jack pads for levelling of the drill machine.
- ❖ While changing drill rods, proper Holding of drill rods on drill mast is ensured.
- ❖ The drilling crew will be provided with radium jackets.

4.4.2 Blasting Operation

Opencast operations involve heavy blasting in overburden and coal. Most of the accidents in blasting occur due to the projectiles, as they may sometimes go even beyond the danger zone, mainly due to overcharging of shot holes or as a result of

certain special features of the local ground. Fly rocks, Vibrations, dust and noise problems are common problems associated with blasting operations.

Proper precautions will be taken by way of posting guards, siren etc. at the time of blasting. Men and machinery will be withdrawn to safer place before blasting. Blasting will be done between shift timings. Proper care in storage, transport and handling of explosives will be taken to ensure safety in blasting operations.

By following controlled blasting techniques ground vibrations resulting from blasting will be minimized. The peak particle velocity of vibration is now accepted as the more reliable criterion for assessing the damage potential of vibrations. This factor takes into account both frequency and amplitude giving an indication of the level of hazards and fairly accurate indication of the "nuisance" value of the movements.

Chargé/hole will be restricted as per distance from villages. Safety zone as required by mining statutes will be ensured.

There are a large number of factors that influence fly rocks. Most important of these factors are long explosive columns with little stemming at the mouth of the hole, irregular shape of face, long water column in holes, loose stones on face of the surface blasting area, and strong wind.

4.4.3 Measures to Control Ground Vibrations & Fly Rocks:

- Shots will be muffled so that the flying fragments do not project beyond a distance of 10 meters from the place of blasting.
- Optimum delay sequence and stemming to column ratio will be maintained to minimize the fly rock distance and ground vibration intensity.
- Basing on the distance of the nearest sensitive areas from the epicentre of the blast, charge weight shall be altered to meet the stipulated standards.
- Blast hole geometry will be designed considering bench height, diameter of hole, type of explosive, nature of rock, level of fragmentation required etc.
- Total charge per blast will be divided in to several parts so as to keep minimum explosive per delay i.e. use of milli-second delay detonators & relays.
- Concentration of explosive is avoided by using deck charging technique.
- Distance between blasting point and the structure to be protected will be earmarked.
- Always free face will be maintained.
- In multi row blasting, greater relief will be provided between rows using suitable delay intervals.
- All loose debris will be cleared off the blasting site before blasting.

4.5 Slope Stability

4.5.1 Stability of Quarry Benches:

Collapse of sides/slopes is likely to pose problems in the opencast mine. Proper benching and sloping will be ensured to guard against collapse of sides. For stability of benches at top soil & sub soil areas, the benches up to 880m RL are designed to have 5m height, 10m berm width and 70° angle with horizontal. With this design, the overall slope angle at low wall side and final high wall side will be at 28° to 32° and 37° to 38° respectively, which ensures better stability. Corridors of 30m width for every 90m depths from surface are envisaged at high wall side for final high wall stability and also for safe movement of HEMM to be deployed for the sake of internal dumping. Alternate active benches are designed to have 40m width, 10m height & 70° angle to the horizontal.

- Drains will be provided to protect the slope surfaces against rain-cuts and seepage during rains. These make a safe way to discharge top and surface water to the bottom of the quarry.
- Constant vigilance will be maintained on the conditions of benches with special reference to accumulation of water and development of cracks.

4.5.2 Over Burden Dumps:

The high overburden dumps may cause landslides. High overburden dumps created at the quarry edge may cause sliding of the overburden dump or may cause failure of the pit slope due to excessive loading, thereby causing loss of life and property. The following precautionary measures will be taken to ensure slope stability.

- Top soil is removed from the external dump area before Start of dumping.
- The floor of internal dump is roughened before start of dumping.
- Hard OB will be dumped with height of decks restricted to 30m.
- Maximum height of external dump is restricted to 120m. The maximum height of internal dump will be restricted to 60m above ground level.
- Width of berm is kept at least 30m for stability & also for allowing safe machinery movement.
- Dump slope for each deck to be at natural angle of repose of 37.5° and overall slope will be 25°64".
- Track Dozers will be deployed for shaping the dumps.
- Trees will be planted to improve the stability of dumps and to prevent erosion.
- A sturdy stone toe wall is built around the toe of each deck of dumps.
- At the edges of finished decks the slope angle will be flattened by about 5° lower than the angle of repose which varies from site to site but it is generally expected to be around 37.5°.
- Planting vegetation as early as possible over the overburden dump slopes.
- The drainage channels along the overburden dump toe will be maintained to provide additional protection.

Provision is made for slope stability radar and construction of toe wall at the base of external dump in view of 120 m height and close proximity of the Gundla Vagu Nallah & Dharmaraopet Cheruvu.

4.5.3 Slope Stability Radars:

In view of close proximity of Dharmaraopet Cheruvu & Gundla Vagu nallah to the External dump yard, "Slope Stability Radars will be provided for monitoring of stability of external dump. The "slope stability radar" will remotely scan the rock slope and` continuously monitor the spatial deformation of the face. Using differential radar interferometry, the system can detect deformation movements of a rough wall with sub-millimetre accuracy, and with high spatial and temporal resolution. The effects of atmospheric variations and spurious signals can be reduced via signal processing means. The advantage of radar over other monitoring techniques is that it provides full area coverage without the need for mounted reflectors or equipment on the wall. In addition, the radar waves adequately penetrate through rain, dust and smoke to give reliable measurements, twenty-four hours a day.}

4.6 Inundation:

There is a remote chance of inundation of Kakatiya Khani OC III Project workings due to inrush of surface water in the rainy season and due to also stagnant water in underground mines since provision is made in FR for adequate pumping arrangements. The main precautions that will be taken to prevent inundation are as follows:

- Sufficient water garlands will be provided to prevent inrush of surface water into the quarry from dump yards and catchments water from surface areas.
- Construction/strengthening of berms/bunds on surface along quarry boundary will be done during every rainy season. Suitable monitoring system will be established to take care of any contingencies.

- ❖ When the workings are drenched with water due to fire the water level is maintained according to progress of face advancement in such a way that men and machinery can work safely.
- ❖ Proper drains will be cut around the quarry to divert away the water during rainy season, from entering the quarry. The drains will be connected to natural drainage system of the area. Sumps and pumps of adequate capacity will be provided within the quarry.
- ❖ The actual working plans of the opencast mine and the old plans of the developed underground mine workings will be maintained and checked regularly. The HFL of the nallah, river or tank is marked on the plan.
- ❖ Proper arrangements for embankment or diversion if any will be made.

5 Risks associated with Underground Method

The major risks associated with underground method in this project are

- Strata Problems
- Inundation
- Mine fires and spontaneous heating
- Explosion in the mine
- Mine gases

The measures to be taken to mitigate the risks are.

5.1 Strata Control:

Underground mining is fraught with danger of roof and side falls. Different safety rules in force and regulations made under Mines Act 1952 will be strictly complied with in the mine. Various precautions as laid down in DGMS circulars issued from time to time in this regard will be followed. In addition to this scientific study will be conducted to ascertain the stability of the rhombus shaped pillars.

5.2 Inundation:

The following precautions and measures are taken against the danger of water from surface.

a) All entries are planned above the HFL zone thus posing no danger of inundation.
b) All boreholes drilled for exploration and other purposes will be plugged properly.
c) Though subsidence is not expected due to depth and lower thickness of seams subsidence monitoring will be done above depillaring areas during life of mine as well as post closure stage (3 Years after ceasing of UG activities).
d) To avoid danger of accumulated water in opencast mine entering underground workings a solid coal barrier of 60 meters will be left between edge of underground workings and opencast workings.

The following measures are taken against the danger of water from Underground.

a) The galleries in the panels are so designed that rising towards the boundary of property so as to have self-drainage of water.
b) 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.
c) Adequate capacity of main sump and auxiliary sumps with pumps has been provided.

5.3 Mine fires and spontaneous heating:

Adequate precautions to prevent spontaneous heating

a) Various precautions as laid down in DGMS circulars issued from time to time in this regard will be followed.
b) Development will be done in strict adherence to panel system of mining.
c) Panels are planned to be extracted completely within the incubation period.
d) Continuous monitoring of CH4, CO2, CO at goaf edge and other strategic points.
e) Filling of subsidence cracks, if any on the surface by soil etc.

5.4 Explosion in the mine:

The following measures are taken against the danger Explosion in the mine.

5.4.1 Fire damp explosion:

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

5.4.2 Coal dust explosion:

a) Reducing the formation of coal dust in the working faces, haulage roads etc.
b) Preventing its spread.
c) Rendering the coal dust harmless by wetting it with water or mixing the same with inert stone dust.
d) Making provision of stone dust barriers or water barriers.
e) 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 will be collected with use of dust extractor

5.4.3 Mine gases:

The following measures are taken against the danger mine gases.

a) The quantity of inflammable gas given out in each ventilation district will be determined at least once in a month and similarly borehole samples once in a quarter.
b) The quantity of air will be supplied into each district so as to keep the percentage of inflammable gases in the district return airway below 0.75% to 1.25% at any place in the mine.
c) The state of atmosphere near the stopping will be continuously monitored by flame safety lamps, air sampling and analysis.
d) There should be strict adherence to provisions of CMR 2017, with regards to gas emission.
e) All workings will be ventilated by a suitable mechanical ventilator installed on the surface. Approved types of stone dust barriers will be provided at the specified places.
f) Adequate quantity of air will be coursed to all the working faces as stipulated in the CMR 2017 and air samples will be collected at regular intervals at the roof of the working faces and analysed timely for the presence of CH_4 and other gases

5.4.4 General risks associated with the mining operations:

5.4.4.1.1 Electricity:

Accidents / Incidents may occur due to switching on power when persons are at work, dragging of cable by hoisted body of dumper / drill where the Transmission lines / cables cross the haul roads.

5.4.4.1.2 Lighting:

There are chances for accidents due to insufficient lighting at work places.

5.4.4.1.3 Health Hazards:

Health hazards due to inhalation of air borne dust, while working in dust atmosphere and noxious gases while working near fiery coal in coal yards. Noise levels can create stress, increase workplace accident rates.

Occupational safety and health is very closely related to productivity and good employer – employee relationship. This subject is dealt with strictly as per circulars and orders of DGMS including the Mine Rules and Coal Mines Regulations, 2017. Some of the measures proposed for occupational safety and health have been listed below:

1. Effective dust removal system in the crusher house
2. Provision of wet drilling
3. Provision of rest shelters for mine workers with amenities like drinking water, fans, toilets etc.
4. Provision of personal protection devices to the workers.
5. Rotation of workers, if necessary, exposed to noise to reduce exposure time
6. Closed control room in crusher house with proper ventilation.
7. Dust suppression of haul road and dumps
8. First - Aid facilities in the mining area
9. Provision of communication network between pit working areas and manager.
10. Provision of alarm system at working areas
11. Training of personnel including contract workmen in Mines Vocational Training Centres to inculcate safety consciousness through modules, video clippings, slogans and posters and introduction of safety awards
12. Safe design of height, width and slope of working benches of OB & coal, overall pit slope kept less than 38°.
13. Safe design for formation of OB dumps, over all dump slopes kept at 28 degrees.
14. Safe design of haul roads.
15. Provision of fire fighting equipment
16. Safe storage of explosives and other inflammable substances.
17. Regular / periodical monitoring of mine environment to ensure the efficacy of various protective measures.
18. Initial and Periodical medical examination for the employees.

5.4.5 Storage, Handling and Disposal of Hazardous Waste:

Hazardous waste generated such as used oil, waste oil, empty oil drums, batteries, non-ferrous scrap etc due to mining activities. Explosives, HSD oil, Hydraulic oils will be handled, stored, disposed, transported as per Hazardous Waste (Management, Handling and Transboundary Movement) Rules and CPCB guidelines.

1. The waste generated shall be disposed as per HWM rules within 90 days from date of generation to authorized recycler.
2. The handling, transport and storage of explosives shall be as per Indian Explosive Act.
3. Transportation and storage of explosive shall be as per the approved code of practice.
4. Flammable, ignitable, reactive and non-compatible wastes shall be stored separately and never stored in the same storage shed.

5. Adequate storage capacity (i.e. 50 % of the annual capacity of the hazardous waste incinerator) shall be provided in the premises.
6. Storage area shall be provided with the flameproof electrical fittings and strictly adhered to.
7. Adequate fire fighting systems shall be provided for the storage area, along with the areas in the facility.
8. There should be at least 15 meter distance between the storage sheds.
9. Loading and unloading of wastes in storage sheds shall only be done under the supervision of the well trained and experienced staff.
10. Fire break of at least 4 meter between two blocks of stacked drums shall be provided in the storage shed. One block of drum should not exceed 300 MT of waste.
11. Minimum of 1 meter clear space shall be left between two adjacent rows of pallets in pair for inspection.
12. The storage and handling shall have at least two routes to escape in the event of any fire in the area.
13. In order to have appropriate measures to prevent percolation of spills, leaks etc. to the soil and ground water, the storage area should be provided with concrete floor.
14. Measures shall be taken to prevent entry of runoff into the storage area. The storage area shall be designed in such a way that the floor level is at least 150 mm above the maximum flood level.
15. The storage area floor should be provided with secondary containment such as proper slopes as well as collection pit so as to collect leakages / spills etc.
16. All the storage yards should be provided with proper peripheral drainage system connected with the sump so as to collect any accidental spills in roads or within the storage yards as well as accidental flow due to fire fighting.
17. The stacking of drums in the storage area should be restricted to three high on pallets (wooden frames). Necessary precautionary measures should be taken so as to avoid stack collapse. However, for waste having flash point less than 65.5°C, the drums shall not be stacked more than one height.
18. Drums containing wastes stored in the storage area shall be labelled properly indicating mainly type, quantity, characteristics, source and date of storing etc.
19. The storage areas shall be inspected daily for detecting any signs of leaks or deterioration if any. Leaking or deteriorated containers should be removed and ensured that such contents are transferred to a sound container.
20. In case of spills / leaks / dry adsorbents / cotton should be used for cleaning instead of water.
21. Proper slope with collection pits shall be provided in the storage area so as to collect the spills / leakages.
22. Proper records with type of waste received, characteristics as well as the location of the wastes that have been stored in the facility need to be maintained.

The following table illustrates in detail about the control measures and action to be taken for each hazard for elimination or reduction of risk involved.

Identified Hazards	**Mechanism**	**Control**	**Action**
(1)	**(2)**	**(3)**	**(4)**
1. Inundation	No tanks exist over quarry area and one nalla passes besides dump area.	The existing drainage network shall be diverted to realign the original tank.	Shift In charge to inspect the surface drainage system at weekly. Periodicity to arrest any possibility of water entry to the quarry.
	Catchment Area water during Rains	All around the dumps drains are to be prepared to collect the rain water from the catchments of the	Weekly inspection of the drains by competent person and also immediately after every rain.

Identified Hazards	Mechanism	Control	Action
		dumps. In case of any siltation or damage, the drain may cause water entry into the quarry. De-siltation will be done every year before onset of monsoon and when ever required during monsoon. Sufficient height bund shall be maintained all along the edge of the quarry to prevent inadvertent entry of water A berm with dimensions of not less than two metres height and 2 metres width at the top shall be made in trapezium shape all along the edge of each deck to prevent erosion of dumps and gully formation. The terrace shall be kept free of obstructions (OB heaps), sloped in bye and maintained with uniform gradient for free flow of water in order to avoid accumulation of water leading to gully formation and dump slides. Water danger plan will be prepared and maintained.	Sufficient capacity pumps shall be maintained by making proper fund allocation for pumping. Manager, Asst Manager, Under Manager should inspect the protective works.
2. Drowning of persons in main Sump	Foot valve repairing by pump operators / fitters	Safety jackets, life line to be used.	Repairing mechanism to be done under the supervision of foreman / charge hand
3. Fires	Spontaneous heating in coal stock yard Spontaneous heating in the crushed coal Fall of hot material or ash on men and machinery while excavating fiery material.	Water pipeline with sufficient pressure will be laid all along the periphery of the coal stock yard to quench the fire. Coal will be lifted on first dumped first dispatched basis. Sufficient water spraying arrangement will be provided by using Water sprinklers / through pipe lines. No hot / fiery material shall be handled with any machine as it is.	A suitable provision has to be made for this purpose and a separate Fire Fighting Organization with trained personnel shall be maintained for fighting these fires. Separate Fire Fighting crew shall be trained for fighting the fires. Thorough quenching of hot / fiery material shall be done before it is handled.
4. Slope Stability	Failure of Pit Slope when the depth is	The overall pit slope varies from 37^0 to 38^0. This has	The movement of the slope shall be observed by

Identified Hazards	Mechanism	Control	Action
	more and intercepted by number of faults	been done to ensure safe pit slope for the prevalent strata conditions. For Slope stability, special care will be taken while forming the batter in the east side of the quarry fault zone by pre-split blasting. This may, however, be confirmed through slope stability studies	installing subsidence movement pillars. Surveyor should ensure frequently.
	Dump Slope Failure	The overall dump slope for spoil has been kept at $25^0$64'' The dump slope stability be confirmed through studies. To leave safe margin between the dump and quarry. To protect the dump from getting water charged.	The movement of the slope shall be observed by installing subsidence movement pillars. Slope stability radar will be installed for monitoring the stability of the dump. No water shall be allowed to accumulate / stock over any dump top particularly near the edge of the dumps Surveyor should ensure frequently.
5. Sliding	Sliding of OB or coal due to more height of the bench than the digging height of the machine.	a) The height of the benches shall be planned in such a way that they match the digging height of the shovels. b) Not to deploy the shovels where the bench height is more than its digging height. c) No bench shall be allowed to merge with another bench, resulting in increase of bench height. d) Overall pit slope shall not exceed 38^0	a) Drilling should be done in such a way that the bench height will not be more than the digging height of the shovel. b) The excess height of the blasted material should be reduced to match the digging height of the shovel Further where ever the soft layers at the bottom of the bench the same may be reduced by dozing to match the digging height of the shovel. c) Progress of any bench towards a top bench should be stopped at a distance of equal to the height of bench. d) Surveyor should ensure frequently
	Sliding of OB / Coal	a) No bench shall be worked	a)

Identified Hazards	Mechanism	Control	Action
	while excavation near fault plane.	parallel to fault planes. b) Cleaning of top and hade portions of the fault planes must be ensured, whenever the shovel works near fault plane.	i. A plan indicating all the faults position running over the different benches should be maintained and same may be indicated in the parting plan supplied to operation staff and the marking of the same in the field should be ensured always. ii. Benches shall be planned always at right angles or oblique to the fault plane but definitely not parallel to the fault plane. b) While working near fault plane, see that, the reach of bucket is more than the height of fault plane
	Sliding of dump slopes / edges	a) Not to allow excess dump heights or merging of any two dump decks. The height of each deck is limited to 30 m and overall dump height shall not exceed 120 m	i) Top of the dumps up to the edges shall be thoroughly compacted to prevent any possible ingress of rain water and also to provide a gentle slope towards toe drains.
		b) Not to allow any Dumpers / Tippers to move over the un consolidated the dump edge / slope	ii) Individual dump deck height shall be maintained around 30 mtrs. Merging of any two dump decks in any case is not allowed. iii) No movement of Dumpers / Tippers is allowed over the edge of un consolidated dump / dump having excess height. iv) However HEMM can be allowed up to a distance of 3.00 mtrs. from the edge of consolidated dump with the provision of a berm at the edge of the dump as required by law.
6. HEMM movement	i. Failure of vehicle stability resulting toppling.	i) Ensure placement and movement of HEMM only on the stable and level ground. ii) To provide IDEAL conditions at Loading, while Hauling and at unloading points for HEMM. iii) Run the HEMM with in permissible speed limits.	a) Level and compact the blasted material before allowing any HEMM to ply over it. b) Not to allow any HEMM movement with in a distance of 5 m from the edge of blasted / loose bench. a) Provide stable and level

Identified Hazards	Mechanism	Control	Action
		iv) Using good quality tyres	ground at loading point for placement of HEMM. b) Berms shall be provided on both sides of the elevated haul roads as required by law. c) Ensure super elevation at curves of haul roads. d) Arrange level and stable platforms with suitable size of berms as required by law at unloading point with the help of dozer. e) Always ensure a minimum height of 2 feet safety girder at the crusher unloading point. f) Unloading of material shall be done over the stable dumps at a distance of minimum 3.00 mtrs from the edge and ensure tyre height berm at dump edge.
HEMM movement			g) Ensure by surprise checks whether the HEMM is being operated within the speed limits as specified by the Manager. h) Arrange speed locking over HEMM where ever it is possible. i) Replace worn out tyres in time with good quality tyres.
	Run over by vehicles / HEMM	i) Persons/ conveyance vehicles to maintain a safe distance on haul roads and 50 mtrs at loading and unloading points from working HEMM. Prevent unauthorised drivers	a) To develop awareness among employees to maintain a minimum distance of 30 mtrs. on haul roads and 50 mtrs. at loading and un loading points from moving and working HEMM. a) Insist all Operators / drivers to wear identity cards while they are on duty. b) Verify the validity of driver's licensee of operators and drivers before authorisations and identity cards are issued. c) Verify the HEMM operations as per the allotment by surprise checks and also check up the details of drivers /

Identified Hazards	Mechanism	Control	Action
			operators and confirm.
HEMM movement		ii) Persons to maintain a safe distance from moving vehicles.	a) To ensure no person shall be allowed to enter with in a distance of 30 mtrs of moving vehicles. b) To stop any vehicle / HEMM persons must use whistle / red flags / red light before going near to the machines for any reason.
		iii) Prevent boarding / alighting the moving vehicles.	a) Develop awareness among the employees not to board / alight from moving vehicles/ HEMM.
		iv) Persons shall not be allowed to take rest under / by the side of parked vehicles / HEMM. Prevent sleeping of persons in mine premises.	a) Develop awareness among all the employees not to take rest under / by the side of parked vehicles / HEMM. b) Educate all the operators / drivers to verify the surroundings including underneath the machine / vehicle for possible presence of any person before starting the same. Create awareness among all the employees not to sleep while on duty in mine premises
	Sliding of dumpers / tippers / dozers at dump edge.	i) Restrict the deck height to 30 mtrs. only. ii) No HEMM shall be allowed to work over the edge of any unconsolidated dump.	a) To ensure that the height of each deck doesn't exceed 30 m. under any circumstances a) Always ensure sufficient size of berm at the edge of the dump as required by law. b) Not to allow any HEMM over the edge of any unconsolidated dump. c) To deploy a spotter for guiding the tippers / dumpers at unloading point on elevated platform.
	Simultaneous operations at loading and un loading points. For this purpose the following are considered as (separate) individual operations. i) Drilling ii) Charging &	i) Not to allow more than one operations at the face at a time.	a) To maintain a minimum distance of 50 mtrs. between the places of i) Drilling & Loading ii) Charging & Loading. b) To maintain a minimum distance of 15 mtrs between drilling and charging operations. c) Except as above, no two

Identified Hazards	Mechanism	Control	Action
	Blasting iii) Dozing iv) Grading v) Loading vi) Un loading		operations shall be allowed to undergo at a time at one place. d) To maintain a minimum distance of 15 mtrs. between loading tippers / dumpers and dozer at unloading point.
	Crossing 3 way / 4 way junctions.	i) Not to allow traffic in more than one direction at a time at junctions.	a) To engage a signal men at all the junctions. b) To ensure traffic controlling by surprise checks.
	Un authorised riding on HEMM.	i) Not to allow un authorised persons to ride on HEMM ii) To provide sufficient no. of suitable and comfortable conveyance vehicles to all the workmen, available at their reach when ever they want to move.	a) Educate all the employees about the danger involved in riding on HEMM b) Check the un authorised riding on HEMM by surprise inspections. c) Ensure even authorised person also travel by sitting in the cabin having pillion. a) Ensure whether sufficient no. of suitable and comfortable conveyance vehicles are made available. b) Ensure vehicle availability at the reach of the persons whenever they are required to move.
HEMM movement	Spillage of boulders from loaded tippers / dumpers	i) Avoid over loading of tippers / dumpers. ii) To control speed of the vehicles. iii) To avoid sharp curves.	a) Educate all the operators not to over load the dumpers / tippers. b) Ensure the loading is up to the brim level of the tippers / dumpers. a) Ensure strict implementation of code of traffic rules. a) Haul roads shall be formed without sharp curves. Where ever mild curves are inevitable suitable super elevation shall be provided
	Stoppage of HEMM / vehicles on active haul roads due to break-down.	i) Break down equipment from active haul roads must be attended immediately and repair / remove at the earliest possible. ii) To provide protection	a) To keep emergency steering mechanism in order. So that operator himself can remove the equipment. b) Immediate information to Engineers / Technicians

Identified Hazards	Mechanism	Control	Action
		against break down equipment an active haul roads.	about the break down machine on active haul roads. c) Engineers / Technicians must repair / remove the equipment at the earliest possible. d) Till the equipment is repaired or removed protection against hitting by running equipment shall be provided on both sides by dumping OB heaps. e) To arrange red flags and lights on both traffic sides of the breakdown equipment
7. Drilling	Toppling of drill machine. Mast contact with overhead power transmission line	While transporting drill machine, its mast must be lowered, even with in the drilling area on inclined plane (High gradients) to avoid toppling of drill machine and in contact with over head power transmission line. For positioning on inclined planes (High gradients), wedges must be used under jack pads for levelling of the drill machine.	Transportation of drill should be done under the supervision of competent person.
	While changing drill barrels / rods	Ensure proper holding of drill barrels, while loading / unloading (Attachment / Detaching) on the drill mast.	Drill operator should ensure.
	While drilling	Prior to marking of drill holes as per the designed pattern, care shall be taken up to ensure proper blasting All the holes drilled should be pegged to avoid leg in.	Drill operator should ensure.
8. Blasting	While transportation	Transport the explosives and accessories in vehicle approved under explosive rules. Standard Operating Procedures (SOP) should be followed	Transportation of explosive should be done under the supervision of competent person.
	While charging	i) Blasting design and initiation pattern such that the maximum charge per delay is within the stipulated range.	1. Blasting in charge should design the drilling pattern.

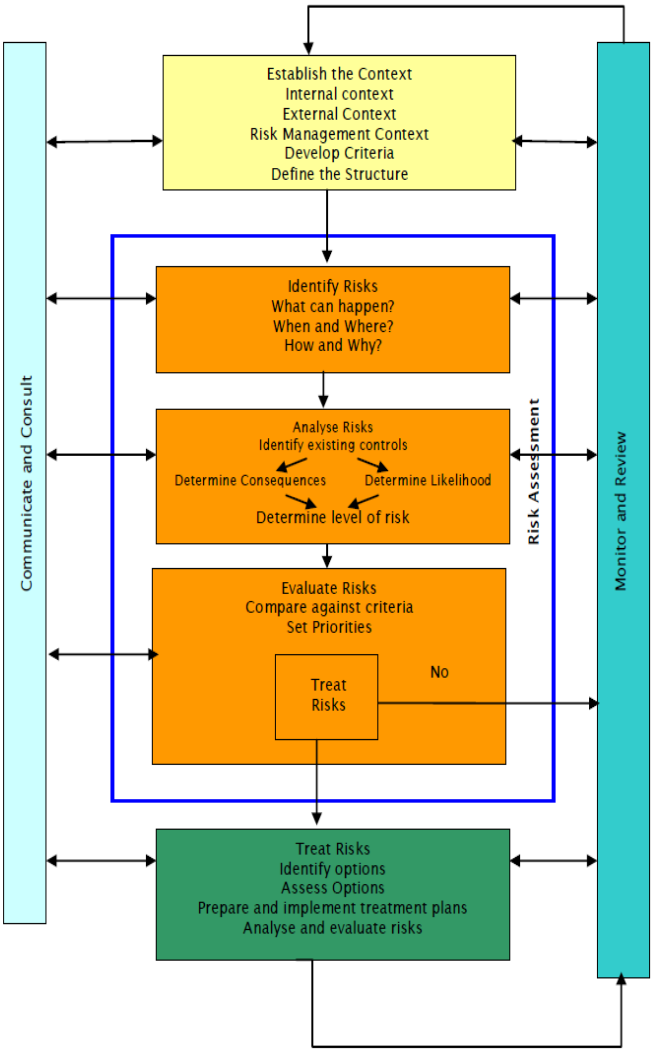
Identified Hazards	Mechanism	Control	Action
		ii) Wherever possible, the progress of detonating holes, through delay intervals, should progress away from the structures to be protected.	2. The blast parameters will be established during actual mining operations, after conducting field trial blasting considering the local geo-mining conditions.
	While blasting	iii) Stray current from nearby power systems	3. Proper earthing of SMS vehicle while charging the holes.
		i) Avoid blasting during cloudy days and when the wind is blowing towards structures. ii) All loose debris will be cleared off from the blasting site iii) A free face will always be maintained. iv) In multi row blasting, greater relief will be provided between rows using suitable delay intervals. v) Proper use of different type of relay / delay detonator for proper sequencing of the blast will be used. vi) If required, all the holes will be suitably muffled before blasting to control the fly rock. vii) Standard Operating Procedures (SOP) should be followed	Blasting in charge should ensure.
9. Electricity	Switching on power when persons are at work Dragging of cable by hoisted body of dumper, where the Transmission lines / cables cross the haul roads.	Shut down procedure shall be strictly implemented. Identification of cables and switches shall be displayed. Transmission lines / cables shall only be laid on 12 meter height towers, as per by Indian Electricity Rules 1956	Supervisors having valid electrical supervisory certificate only shall be deployed on the jobs. Planning shall be done in initial stages for laying of 12 m height towers.
10. Lighting	Insufficient lighting at work places	Working places shall be well illuminated as per the standards fixed by DGMS Circular No.1 of 1976 All persons shall wear radium jackets in during dark hours. All persons shall possess Cap Lamps in dark hours. All persons shall have	Engineer and electrical supervisor shall ensure the lighting as per the DGMS circular.

Identified Hazards	Mechanism	Control	Action
		whistles.	

The Risk Management Plan (RMP) prepared for the project under the provisions of DGMS Circular and Recommendations of 9th and 10th National Safety Conferences will be implemented to tackle risks associated with each and every operation(s).

The RMP will be modified periodically to the changed conditions / circumstances by the project authorities.

Detailed Flow Chart of Risk Management Process in Detail



6 DISASTER MANAGEMENT PLAN

Disaster Management Plan (DMP), a general plan of action for use in the event of inundation, fire, high wall failure, dump failure or any other dangerous occurrence or in the time of emergency. The DMP will have three stages:-

1. Information Stage
2. Assessment Stage
3. Action Stage

6.1 nformation Stage

Any person employed in a mine observes / discovers any dangerous incident; he shall immediately inform to the Manway Clerk (Attendance Clerk) or the nearest official(s) available who shall inform to the Manway Clerk and Manager or Senior Officials in his absence.

The Manway Clerk shall immediately inform the Manager or Senior Mine Official in his absence, inform the rescue station and collect information regarding place of accident / occurrence, number of persons involved and nature of help required. He should record the above information with name of the person who informed and the exact time and pass on the same to the manager. He should not leave the place for any purpose what so ever.

The Manager shall inform the Project Officer, General Manager and Nodal Officer to initiate DMP and also rush to the spot / mine if he is at out of project premises.

Personally assess the gravity of situation by contacting the frontline supervisors / witness available or through wireless set.

Nodal Officer shall rush to the mine and inform: Chief GM (Safety), All Directors, SO to C&MD, DGMS Authorities, District Magistrate and Collector, Supdt. of Police, Mine / Area Level Representative and recognized Union Delegates, Local Dispensary, Chief Medical Officer and All Area Departmental Heads.

6.2 Assessment Stage:

The role and functions of following persons will be envisaged in the detailed DMP available during operation.

1. Role of Mining Sirdar, Overman and Foreman
2. Role of Manager, Project Officer and Area General Manager
3. Role of in-charge at operations or at place accident.
4. Function of Core Committees
5. Function of Support Committees
6. Functions of Surface Control Room

Supporting Committees:

The composition, functions, infrastructure required for core and supporting committees, etc. will be envisaged in the detailed DMP available during operation.

1. Public Relations Committee
2. Catering Committee
3. Medical Committee
4. Men and Material Management Committee
5. Transport Committee
6. Survey Committee
7. Casualty Committee
8. Security Committee
9. Cash Committee
10. Accommodation Committee.

6.3 Action Stage:

Action stage deals with the functions of Disaster Management Committee (DMC) and duties of following personnel.

1. Director, DMP
2. Area General Manager
3. CGM (Safety)
4. CGM/GM (E&M)
5. GM (Personnel)

The Disaster Management Plan for proposed KTK OC - III Project is enclosed as **Figure No. 7.4.3.1**.

6.4 Crisis Management Plan

In case of Disasters involving 50 persons or more – Crisis Management Plan prepared by Ministry of Coal and Mines for Flooding/Fires In Coal mines has been received by SCCL, for implementation.

As per the above Plan, any mishap arising out of flooding and fire in the coalmines will be treated as a Disaster when lives of 50 persons or more deployed below ground in the affected mine are lost or threatened.

The first information report should be sent in the format prescribed (contained in the Crisis Management Plan) by the Colliery Manager to the CMD/Chief Executive and to

District Magistrate/District Collector. The CMD/Chief Executive of the company will in turn inform to the Secretary, Department of Coal. District magistrate/District Collector will inform the Chief Secretary of the State where the mine is located, immediately through Fax/E-mail or any other quickest means of communication within one hour of occurrence of disaster.

7.6 ISSUES RAISED IN THE PUBLIC CONSULTATION ALONG WITH ACTION PLAN AND COMMITMENT OF THE PROJECT PROPONENT

Environmental issues raised during public consultation will be addressed in final EIA / EMP after conducting public hearing for the proposed project. A copy of the proceedings of the public hearing, the points raised by general public and commitments made in tabular form will be incorporated as Annexure in final EIA / EMP.

Presently, no litigations / court cases are filed / pending regarding the proposed project

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