THE SINGARENI COLLIERIES COMPANY LIMITED
(A GOVERNMENT COMPANY)
Regd. Office: Kothagudem Collieries (PO)-507101, Bhadradri Dist., Telangana
State CIN: U10102TG1920SGC000571

EXPRESSION OF INTEREST

Singareni Collieries Company Limited (SCCL) is situated in southern part of India and having its operations in six districts of northern Telangana i.e., Kumuram Bheem Asifabad, Mancherial, Peddapalli, Prof. Jaya Shankar Bhoopalpalli, Bhadradri Kothagudem & Khammam Districts. SCCL is supplying coal to most of the customers situated in Telangana and to some extent in southern parts of India and some parts in Maharashtra. SCCL has produced 62.01 Million tonnes of coal during 2017-18 and dispatched 64.62 Million Tonnes of coal to various categories of consumers during 2017-18 and set a production target of 65.00 Million Tonnes for the year 2018-19. SCCL is operating 29 underground mines and 19 Opencast mines to meet the linkage requirements of major Power (66%), Cement (13.5%), Captive Power (6.6%), Sponge Iron (3.1%) and other Customers (10.8%). SCCL is a Pioneer in introduction of various state of the art underground technologies in its mines such as Longwall, Blasting Gallery and Continuous Miner technologies etc.

SCCL invites Expression of Interest for carrying out pre-mining activities, development and extraction of coal seams by introducing 3 nos continuous miner technology equipments in a phased manner by outsourcing model in KK6 Incline, Mandamarri Area:

I. Drivage of tunnels, Shaft sinking, Underground installations like belts for coal transportation, underground strata bunkers, Electrical and Mechanical installations and drivage of inter seam tunnels.

II. Procure, install, operate and maintain continuous miner technology equipments (3 nos) in a phased manner for excavation of coal by development and depillaring in KK6 Incline, Mandamarri Area:

There are 2 extractable coal seams in KK 6 Incline viz. no 1A seam and no 1 seam with a thickness of about 4.59m and 2.14m respectively. The reserves in no 1A seam and no 1 seam are about 28.76MT and 12.60MT respectively. The gradient of no 1A seam and no 1 seam is about 1 in 5.5.

Two tunnels are proposed to be driven at a gradient of 1 in 5 to reach the coal seams. After reaching the coal seams, trunk roadways will be driven in each seam up to dip side boundary and from there panels are planned on both sides of trunk roadways.

Method of work involves development in board and pillar method and followed by depillaring with caving while retreat, both with the Continuous Miner. The parting between the No.1A seam and No.1 seam is about 20 m. 2 No's Continuous Miner will be deployed in No.1A seam to facilitate faster rate of extraction and 1 No Continuous Miner will be deployed in No.1 seam. In No.1A seam standard height Continuous Miner and No.1 seam low height Continuous Miner will be deployed. The annual capacity of standard height Continuous Miner is considered as 4.5 LTPA and the annual production capacity of low height Continuous Miner as 3.5 LTPA. With this configuration the rated capacity of the project is arrived at by taking average output over the life of the mine, which is around 8.00 LTPA (Peak capacity of 12.30 LTPA). The total life of the project is 19 years including the period of accessing the coal deposit.

No important surface features, except 440 KV NTPC power transmission line, abandoned small Pranahita- Chevella irrigation tank and Palla Vagu, lie over the project area, where it is proposed to leave barriers as per statute.

The coal seams in this project are considered as Degree-I gassiness based on the same seams of the neighboring Mines in Mandamarri area.

A. The proposed scope of work for the Bidder includes:

To expedite the pre-mining works, it is proposed to include the following activities in the scope of the bidder along with development and extraction of coal by continuous miners . The successful bidder shall procure, install and maintain all the facilities required for working of the CM panels i.e., face communication, support, lighting, pumping up to intermediate/main sump located within 500 m distance from the working panel(s), loading and transport of coal up to surface bunker *at surface*, power supply & water, support material, ventilation at the face and environment monitoring within the district

i. Drivage of tunnels — length
   a) Belt cum man way incline – 621M
   b) Haulage incline - 621M.

To expedite the coal production, it is proposed to complete the tunnel drivage in 15 months after award of work, anticipating o progress of about 50m per month in each tunnel.

ii. Shaft sinking -
a) Ventilation shaft (intake) - 120mx5.5M
b) Ventilation shaft (return) -1 69m x 6.9M

To expedite the coal production. it is proposed to complete the shaft sinking work in 12 months after award of work, anticipating a progress of about 15m per month in each shaft.

iii. Underground installations - belts for coal transportation, underground bunkers, electrical installations and drivage of inter seam tunnels are in the scope of bidder.

iv. Procurement of 3 No's of Continuous Miners in a phased manner, transportation and deployment for development of the workings by board and pillar in 5-6 trunk galleries up to the boundary and extraction in panels by retreating.

v. Transport of coal from underground workings up to the surface bunkers through a series of belt conveyors.

vi. Environment Monitoring shall be done by the successful bidder within the CM working district.

vii. The successful bidder shall support the roof suitable in accordance with approved SSR under Coal mines Regulation 2017.

viii. **Scientific study & DGMS permissions**: The successful bidder shall arrange for detailed scientific study and design for extraction, and obtain all the required permissions including DGMS permissions for deployment of Continuous Miner Package in the above mine.

ix. **Strata control:** The implementation & monitoring of the strata control scheme is to the scope of the Successful bidder under the supervision of SCCL.

x. **Ventilation:** SCCL shall supply the required quantity of air as per the statute at the in bye of the panel. The required arrangements for coursing of the air within the panel as per statute shall be the responsibility of the firm.

Preparation, Procurement of required material, within depillaring panels including provision of auxiliary fans etc., shall be the responsibility of the successful bidder.

xi. Safety precautions against Fire, gases, inundation etc. and its

controlling measur

xii. es whenever required within the working depillaring panel is with the scope of the Successful bidder.
The successful bidder shall make arrangements for suppression and dealing of fire as per the directives of DGMS in case of occurrence of fire due to spontaneous heating

xiii. **Pumping & Drainage:** Pumping of within the development/ depillaring panels upto the intermediate/ main sump located within 500 m from the working CM panels shall be under the scope of the Successful bidder & management of water within the working panel is also to the scope of Successful bidder.

xiv. **Material transport:** The material transport and the facilities for the same up to the entry of the panel from the surface of the mine shall be provided by SCCL. However, handling of material on surface, loading, unloading etc. and the material transport within the panel shall be to the scope of the successful bidder. If any delay due to breakdown or any other reason and subsequent loss of production if any is not attributable to SCCL.

xv. **Stone Cutting**: Stone cutting may be required for the reasons like change in geo-mining conditions, thinning down of the working seam, change over in working section etc. The successful bidder shall have to arrange for stone cutting either by blasting or machine cutting if required.

xvi. The period of contract is proposed for production period of 10 years plus a construction period of 18 months, to achieve a production of about 80 LTs.

B. The proposed scope of work for SCCL includes:

Construction of all surface buildings (Hauler shed/Fan House/ Sub stations/ Canteen, Filter beds, office buildings,Coal storage bunkers at surface and other structures as per FR) is to the scope of SCCL.

i. Main Ventilation Fan - installation, operation and Maintenance is to the scope of SCCL.
ii. Men Transport - installation, operation and Maintenance is to the scope of SCCL.
iii. Haulage and Track extensions required for material transport is to

the scope of SCCL.

iv. Construction of Fire Seals, Preparatory Stoppings/ Isolation stoppings and their maintenance etc., as per statute is to the scope of SCCL.

v. Supervision & Manpower: Statutory supervision shall be to the scope of SCCL.

vi. Electric Power:

- SCCL will install a Sub-station and supply electricity at 3.3 KV voltage up to the Load center of Firm on free of cost. The Firm shall step down to the required operating voltages.
- The Firm shall make all arrangements for transmission and distribution of electric power to the face equipment from Power center/ Load center. The Company shall in no way be responsible for any interruption/breakdown to the supply of electric power supply beyond its control.

vii. **Supply of Water:** The filtered water in the sand filter bed situated at surface pit mouth at the required pressure and quantity will be supplied by SCCL on free of cost up to the entrance of the workings.

viii. **Ventilation:** SCCL shall supply the required quantity of air as per the statute at the in bye of the panel. The required arrangements for coursing of the air within the panel as per statute shall be the responsibility of the firm.

ix. Pumping: Pumping of water from intermediate sump/main sump up to the surface is to the scope of SCCL.

x. Construction of Fire Seals, Preparatory Stoppings/ Isolation stoppings and their maintenance etc., as per statute, will be the responsibility of SCCL.

xi. Cap lamps and flame safety lamps for Contractor's workers and supervisory personnel, shift wise on free of cost will be provided by SCCL.

Date: 15.05.2019, Time: 11:00 AM.
Venue: Singareni Bhavan, Hyderabad.

General Manager (CP&P)
Corporate, Kothagudem,
Bhadradri Kothagudem District,
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CHAPTER-1

INTRODUCTION

1.1 GENERAL

In the year 1871, Dr. King of the Geological Survey of India discovered coal near the village of Yellandu in Khammam district and one of the important coal seams bore his name. The Hyderabad (Deccan) Company incorporated in England acquired mining rights in 1886 to exploit coal found in Yellandu area. The present Company was incorporated on 23rd December 1920 under the Hyderabad Companies Act as a public limited company with the name "The Singareni Collieries Company Limited" (SCCL). It acquired all the assets and liabilities of Hyderabad (Deccan) Co.Ltd. The State of Hyderabad purchased majority shares of the Company in 1945. From 1945 to 1949, the Hyderabad Construction Co. Ltd., was acting as Managing Agent. In 1949 this function was entrusted to Industrial Trust Fund by the then Government of Hyderabad. The controlling interest of the Company devolved on the Government of Andhra Pradesh in 1956 pursuant to the organization of States. Thus, the SCCL became a Government Company under the Companies Act in 1956.

Out of 470 Km long Pranahita Godavari valley Coal field, 350 Km sector is lying mostly in the south Indian States of Telangana & Andhra Pradesh. Over the years, the Company had expanded its exploitation activity in Adilabad, Karimnagar, Warangal and Khammam districts of Telangana State.

SCCL currently operates 16 opencast and 32 underground mines. Technologies used are Longwall, Blasting Gallery, Conventional hand section method, LHD, SDL Continuous Miner Technology and opencast mining. SCCL has made a head start in blending the power of information technology with mining by developing software for integrated Opencast and Underground Mine Management Systems. Further, the entire business processes and operations of various area offices are linked with Corporate Office through various network systems under SAP. The performance of SCCL has been commendable in recent years and it has been setting new milestones in production, productivity, turnover and profitability.

The Company has drawn an ambitious production plan to meet the ever increasing demand for coal and achieved a production of 50.47 MT during 2013-14 and set production target of 55.00 MT for the year 2014-15. There is huge demand for enhancement in coal production to meet the requirement of Telangana State as the state is planning to set up new power plants within 5years to meet 6000MW power requirement. Hence, there will be additional demand for 40MT of coal.

SCCL, being the only coal producing company in Southern India, has the onerous responsibility of meeting large portion of coal demand in this part of the country

To bridge the gap between coal demand and coal production, SCCL is planning to open new mechanized underground mines and opencast mines.

SCCL is taking the following steps for increasing the coal production.

1) Reconstruction of existing mines for optimum production by introducing intermediate and high technology wherever feasible.
2) Opening of new mines in the new geological blocks – opencast or underground
3) Adopting opencast technology for higher depths with higher stripping ratios wherever feasible for high rate of production and conservation.
4) Reconstruction of shallow underground workings for extraction of seams by opencast method.
5) Extension of the existing opencast workings to further dip side up to optimum level.
6) Improving the production and productivity in the existing mines by improving the utilization of the equipment.
7) Opening up of deep shaft blocks for large-scale production and to exploit deeper deposits of 300 m to 700 m depth.

In this context, opening of new underground mine has been examined by SCCL for production enhancement. Geological blocks namely Sector-D and Sector-E of Mandamarri area have been studied and identified as a potential blocks for opening up a new mine. Hence the Feasibility Report of Kalyani Khani -6 Incline (i.e.MMSB Sector D&E Project) is prepared and life of the project is 19 years.

1.2 PROJECT BACKGROUND

Kalyani Khani -6 Incline (i.e.MMSB Sector D&E Project) is carved out from Somagudem–Indaram Coal Belt which is located in Adilabad District and falls under jurisdiction of Bellampalli Region of SCCL.

There are four correlatable seams viz. IA, I, III, IV (Top) and IV (Bottom) in Kalyani Khani - 6 Incline mine. Of the above III, IV (Top) and IV (Bottom) seams have not been considered due to low seam thickness and IA, I seams are proposed for extraction as these seams attained workable thickness.

The combined borehole density of MMSB Sector-D&E blocks (***hereinafter named as Kalyani Khani-6 Incline Mine***) is 7.13BH/Sq Km (having 30 numbers of exploratory bore holes over an area 421.61 Ha). The borehole density in Sector-E is only 4 and it needs to be further explored to have better understanding of structure. In Sector-D the borehole density is 11 which is sufficient to projectize the block. In Sector-E a major fault of 710 mts throw runs along southeast side of the block and the No7 boreholes drilled along rise side of the block are sufficient to delineate the incrop line of No1A and 1 seam. Further exploration is required adjacent to the major fault where some sympathetic faults are expected. Further the concentration of boreholes in Sector-E in an area of around 1.19 Sq.Kms lying adjacent to Sector-D having borehole density of around 7 which is again sufficient to projectize to that extent in Sector-E. However scheduling is done in such a way that the development and depillaring activities are planned initially in these areas for a

period of about thirteen years and in the meanwhile the borehole density can be increased in the remaining area of Sector-E for better understanding of the structure in that area. Only limited galleries required for trunks and ventilations shafts are planned in the area where the borehole density is less in Sector-E. (Plan enclosed)

This is an underground Coal mining project proposed for mechanized method of Bord and Pillar mining with Continuous Miner technology.

1.3 PRESENT PROPOSAL

Keeping in view of the increase in demand for coal in the SCCL command area, it is proposed to open new underground mines to enhance production capacity of SCCL.

The total geological reserves estimated in the Kalyani Khani-6 Incline mine are 59.196 MT in four seams up to a depth of 600m. The present proposal is to extract No.1A and No.1 seam deploying continuous miner technology. No. III seam, IVT seam and IVB seams are considered as Non-Workable seams as the thickness of these seams are too low. The geological reserves and extractable reserves of the two workable seams are 41.36 MT and 15.65 MT respectively. It is proposed to extract coal with Continuous Miner Technology. The rated capacity of the project is arrived at by taking average output over the life of the mine, which is around 8.00 LTPA (Peak capacity of 12.30 LTPA). The total life of the project is 19 years including the period of accessing the coal deposit.

SALIENT FEATURES OF THE PROPOSED PROJECT

Descripion	
Mining Lease	The project area partly (17.14 Ha) falls within the existing North Godavari Mining lease valid up to 21.05.2030. Fresh mining lease has to be obtained for the rest of mine take area i.e 404.47 Ha.
Life of the Project	19 Years
No. of seams present	6
Names of the seams present	IB, IA, I, II, III, IV (Top), IV (Bottom).
No. of seams assessed	4
Names of seams assessed	IA, I, III, IV (Top), IV (Bottom).
No. seams considered for extraction	2
Names of seams considered for extraction	IA, I
Seams not considered for extraction	III, IV (Top), IV (Bottom).
Total thickness of seams considered	6.73 m (average.)
General gradient of the seams	1 in 5.5

Geological reserves of seams considered for extraction	41.366 MT
Mineable Reserves	36.89 MT
Extractable reserves	15.65 MT
Percentage of extraction of coal	37.85%
Rated Capacity	0.80 MTPA
Overall Grade (after coal washing)	G9 (4750 kcal/kg)
Technology	Continuous Miner Technology
No. of Continuous Miners	3 sets
No. Diesel operated shuttle cars	Four
No. Electrical operated shuttle cars	Two
Total Land Requirement	421.61 Ha
Forest land	88.51 Ha
Maximum depth of the mine	565 m
Minimum depth of the mine	107 m
villages for Rehabilitation	Nil.
Mode of dispatch	Pit head bunkers capacity of 6 X 100 T are envisaged at pit head to delivery ROM coal to RKP coal washery by lorries. Washed coal will be dispatched to RKP CHP.
Washing of coal	coal washery is proposed and washed coal grade will be G9(4750 K.Cal/Kg)
This Project is expected to attain its rated capacity production 0.8 MTPA in 4th year	
The required manpower will be adjusted from the closing mines of SCCL by suitable re-deployment and training.	

1.4 DEMAND AND SUPPLY

SCCL is the only coal mining company existing in Southern India and supplying coal to the major power utilities of TSGENCO, APGENCO, KPCL and Maha GENCO. Currently, SCCL has signed fuel supply agreements with power utilities for supply of 27.71 MTPA. Apart from power utilities, coal is being supplied to cement, captive power plants, steel and other consumers through fuel supply agreements under NCDP and has also signed FSAs for 20.15 MTPA. Further, SCCL is supplying coal to small and medium scale sector units to the extent of 3.00 MTPA. During the financial year 2013-14, SCCL has supplied 38 MTPA to power, against 27.71 MTPA

of FSA quantity. SCCL is also supplying coal through E-auction platform and has a mandate to sell 10% of production through E-auction.

After bifurcation of Andhra Pradesh State, Telangana State has become power-deficit State. To overcome the power deficit, Government of Telangana has embarked on an action plan for capacity addition of around 6000 MW. SCCL is also constructing a power plant of 1800 MW capacity in Srirampur area. Further, NTPC also has the mandate as per AP Re-organization Act to set up 4000MW power plant in Telangana State.

With the addition of new power plants, there will be an additional demand of SCCL to the extent of 40 MT of coal over and above the existing supplies. Therefore, SCCL, being a state-owned public sector company, has the responsibility to cater to the needs of the new power plants coming up in the State. Considering the likely expansion of existing power projects and construction of new power units, the production and demand gap will further increase. In view of this the company has undertaken certain fast track Opencast and Underground projects to increase production. This Project is one among them.

This proposed UG mine will reduce the gap to the extent of its rated capacity of 0.80 MTPA.

1.5 JUSTIFICATION

1. Coal production from this block would ensure consistent supply of quality coal required for power plants and other industries.
2. As the coal deposit is not amenable for opencast mining, Underground Mining with Continuous Miner technology is proposed.
3. Continuous Miner technology provides better recovery/conservation of coal in the low height seams with more productivity.
4. Underground method causes less damage to the environment compared to Open cast method.
5. The development of this coal block will provide better social and economic life. It will also give a boost to the industrial activity in around the coal block area with direct and indirect employment opportunities.

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CHAPTER-4

MINING

4.1. CHOICE OF MINING METHOD AND JUSTIFICATION:

The following options described below are considered for arriving at the suitable method for exploitation of the coal seams in Kalyani Khani - 6 incline mine.

4.1.1. Open Cast Method

The general seam gradient of Kalyani Khani - 6 incline mine is about 1 in 5.5 and the minimum and maximum depth is 107mt and 565m respectively. Further the minimum depth of Sector –D, in particular is about 300m.If the reserves were to be exploited by OC method the tentative stripping ratio would be around 1:45. The cost of production by opencast would be about Rs 6000/tonne of coal. Open Casting beyond 300m depth line in most of the blocks of Godavari Valley coal fields is uneconomical due to higher stripping ratios and requirement of considerable area of additional land (other than coal bearing area) for dumping of OB. Hence exploitation of coal seams by Open cast method is ruled out.

4.1.2. Underground Method

The following Technological options have been considered before selecting the suitable technology for Underground method of exploitation.

I. Conventional Bord & Pillar

II. Bord & Pillar with Continuous Miner

III. Longwall (Mechanized) retreating with powered supports

The Board & Pillar method of extraction by SDL's has not been taken in to consideration due to the following reasons.

a. Not suitable for higher productions.
b. Concentration of man power is more at working places resulting in poor working environment.
c. The cost of production is substantially high.
d. Not suitable for bigger pillar dimensions(i.e. 85 m X 50 m)

The Blasting Gallery method of extraction is not feasible as this technology is not suitable for the seams having thickness less than 8.0 m.

Longwall method of mining is also not preferred for the following reasons:

a) The same set of Longwall equipment cannot be utilized in the both No.1A and No.1 the seams as the variation in the thickness of the seams are high.

b) Lengthier panels cannot be designed due to presence of faults, geometry of the block and presence of Palavagu over the block.

As per “Geo-Mining Parameters and selection of Mining Technology”, it is proposed to work No.1A & No.1 seams by Continuous Miner Technology for the following reasons.

a) Suitable for bulk production.
b) Better strata management can be maintained.
c) Less manpower oriented technology.
d) The cost of production would be less as bulk production can be achieved with less manpower.

Access to the deposit is through two inclines (i.e. Belt incline and Haulage incline) which will pass through No.1 seam. The inclines are proposed to be driven at a gradient of 1 in 5 whereas the seams are dipping at 1 in 5.5. Hence, access to No.1A seam is made from No.1 seam by two tunnels in Sector-E. After reaching the coal seams, trunk roadways are driven in each seam up to dip side boundary and from there panels are planned on both sides of trunk roadways.

Method of work involves development in board and pillar method and followed by depillaring with caving while retreat, both with the Continuous Miner. As the parting between the No.1A seam and No.1 seam is about 20 m, sufficient time is allowed for settlement of goaf of No.1A seam i.e. 300-500 days before extraction of No.1 seam. No.1A will be extracted by caving with two Continuous Miners deployed in the same panel to facilitate faster rate of extraction within the incubation period.

The development and extraction in Kalyani Khani - 6 incline mine (No.1A & No.1 seams) is proposed to be worked with following equipment as detailed below:

a) Trunk Development - By Continuous Miner

b) Panel Development and Depillaring - By Continuous Miner

4.2. JUSTIFICATION FOR OPTIMISATION OF TARGETED CAPACITY

The rated capacity of the project is arrived at by taking average output over the life of the mine, which is around 8.00 LTPA (Peak capacity of 12.30 LTPA) is based on mainly technical and economical parameters. The factors considered in optimisation are listed below.

- Geological boundary of the proposed mine.
- Surface topography and surface features.
- Geological complexity of the block.
- Depth of the block and gradient of the seams which restricts the technological choice.
- Number of workable seams and total mineable reserves
- Details of coal seams such as thickness, quality and incubation period etc.
- Geotechnical characteristics.
- Optimizing capital requirement.
- Based on the capacity and life of equipment to be deployed
- Based on the transportation networks available in the area.

- Legislation.

Based on the above factors it is proposed to deploy Continuous Miner technology in No.1A seam and No.1 seam. 2 No's Continuous Miner will be deployed in No.1A seam to facilitate faster rate of extraction and 1 No Continuous Miner will be deployed in No.1 seam. In No.1A seam standard height Continuous Miner and No.1 seam low height Continuous Miner will be deployed. The annual capacity of standard height Continuous Miner is considered as 4.5 LTPA and the annual production capacity of low height Continuous Miner as 3.5 LTPA. With this configuration the rated capacity of the project is arrived at by taking average output over the life of the mine, which is around 8.00 LTPA (Peak capacity of 12.30 LTPA). The total life of the project is 19 years including the period of accessing the coal deposit.

ASSUMPTIONS MADE

- No.1A seam and No.1 seam are the two seams considered for mining in this project.
- The dip of the both seams is ranging from 1 in 5 to 1 in 5.8. To facilitate working of Continuous Miner and movement of shuttle cars etc, the main trunks are planned at a gradient of 1 in 6 to 1 in 7. The pillars are designed to form parallelogram shape having dimensions ranging from 72 M X 55 M to 86 M X60 M along strike and dip directions respectively. This design would facilitate easy maneuvering of shuttle cars as the resultant dip gradient would be 1 in 8. However care is taken in the design of the pillar to have an inscribed square pillar having dimensions of 50 M X50 M to have better stability during development and as well as extraction on retreat.
- No important surface features, except 440 KV NTPC power transmission line, abandoned small Pranahita- Chevella irrigation tank and Palla Vagu, lie over the project area.
- It is proposed to leave solid coal pillars exactly beneath the towers of 440 KV power lines un-extracted and to divert Pala Vagu for a length of about 400 M to minimize blockage of reserves. Further the irrigation tank would be backfilled to surface level to prevent accumulation of water.
- The output per Standard height Continuous Miner is considered as 4.5 LTPA, Low height Continuous Miner as 3.5 LTPA.
- The coal seams in this project are considered as Degree-I gassiness based on the same seams of the neighboring Mines in Mandamarri area. However, gas survey will be conducted in both seams (No.1A &No.1 seams) as soon as development work starts.

4.3. GEOLOGICAL RESERVES CONSIDERED FOR MINING VIS-À-VIS EXTRACTABLE RESERVES.

There are four correlatable seams viz. IA, I, III, IV (Top) and IV (Bottom) in Kalyani Khani - 6 Incline mine.

The details of the seams of Kalyani Khani - 6 Incline mine including the reasons for considering particular seams for mining is tabulated below:

SEAM	Average Thickness (m)	RESERVES (Mt)	Considered for Mining	Remarks
IA	4.59	28.764	**Considered**	--
I	2.14	12.602	**Considered**	--
III	1.20	9.896	**Not considered**	Low thickness
IV(TOP)	0.76	4.642	**Not considered**	Low thickness
IV(BOTTOM)	0.75	3.292	**Not considered**	Low thickness
Total		**59.196**		

Seam wise geological reserves considered for* Kalyani Khani - 6 Incline *mine is given below:

SEAM	*AREA (Ha)*	*RESERVES (MT)*
No.1A	*421.61*	*28.764*
No.1	*421.61*	*12.602*
TOTAL		*41.366*

Geological reserves v/s extractable reserves:

Following are the comparison of Geological reserves v/s extractable reserves of workable seams:

Seam	Geological Reserves(Mt)	Extractable Reserves (Mt)	% Extraction
No.1A	*28.764*	*10.85*	***37.76***
No.1	*12.602*	*04.81*	***38.11***
Total	*41.366*	*15.66*	***37.85***

Location, Length & Depth of Shafts, Inclines, and other Mode of Entries:

S.No	Description	Length/Depth(m)	Width/Diameter(m)	Height(m)
1	Belt cum man way Incline	***735***	***5.6***	***3.0***
2	Haulage incline	***785***	***4.8***	***3.0***
3	Ventilation shaft(Intake)	***120***	***5.5Φ***	
4	Ventilation shaft(Return)	***169***	***6.5Φ***	

4.4. SEQUENCE OF MINING OPERATIONS

In general the sequence of Mining operations in Underground coal mine involves development and depillaring (Final Extraction). The proposed two main inclines (i.e Belt incline and Haulage incline) will be driven up to No.1 seam with dimensions as described above. Another two inter-seam tunnels will be driven up to No.1A seam from the trunk galleries of No.1 seam. Trunk galleries will be developed in No.1seam and No.1A seams of Sector-E up to dip side of the mine boundary and access to the Sector-D will be made from No.1seam of Sector-E by driving 5 No's of level galleries to No.1A seam of Sector-D as No.1 seam of Sector-E comes in line with No.1A seam of Sector-D due to 20 m down throw fault (F8-F8) existing between Sector-E and Sector-D. In Sector D trunk galleries will be developed in No.1A seam and No.1 seam up to dip side of the mine boundary. Having completed trunk galleries development, panels will be developed from dip side of the mine boundary in No.1A seam and immediately depillaring will be taken up there at. In No.1seam development and depillaring activities will be taken up under settled goaf of No.1A seam after a period of two years and proceed towards the rise side. After completion of extraction in Sector-D, extraction commences at Sector-E in similar fashion.

4.5. EQUIPMENT CONFIGURATION

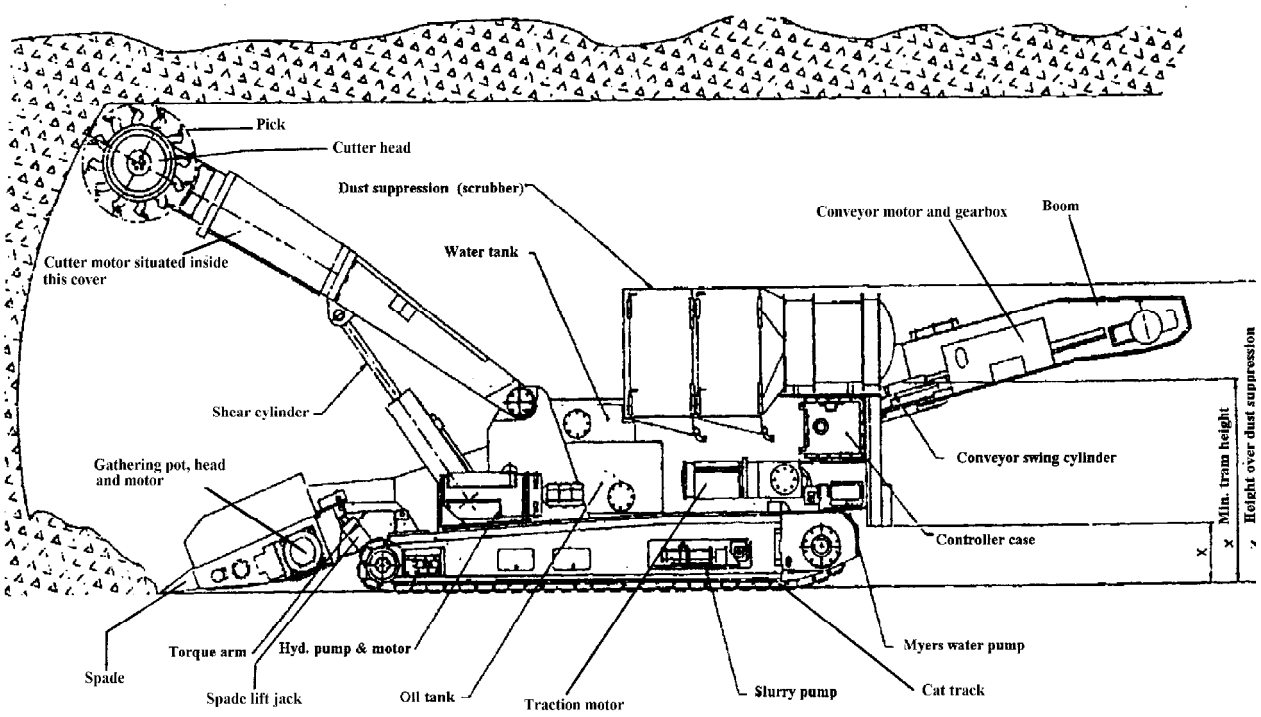
4.5.1. General

The targeted production is to be achieved by operating the following equipment. Two different sets of Continuous Miner package are proposed in Kalyani Khani - 6 incline mine to deal with the varying heights of extraction.

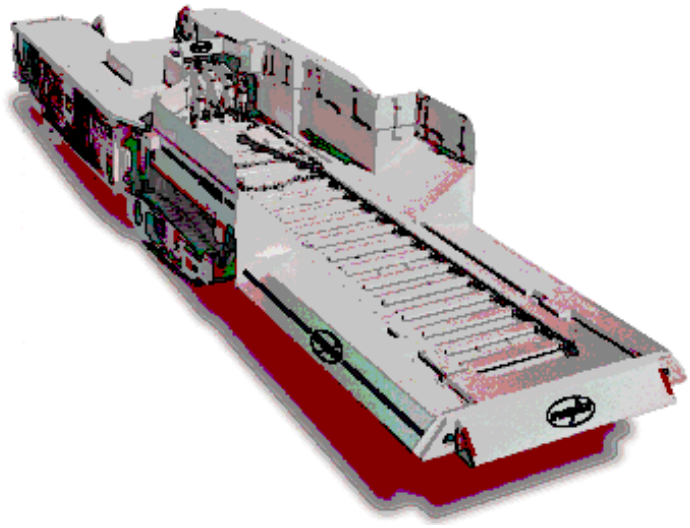
The low height Continuous Miner set is proposed in No. 1 seam and standard height Continuous Miner in No.1A seam. The project is designed with maximum of three sets of Continuous Miners (two standard heights and one low height), for achieving the desired targeted output.

TABLE: CONTINUOUS MINER EQUIPMENT

a)	Continuous Miner	• Low height Continuous Miner, capable of cutting 1.00-3.20m height. Cutter drum width of 3.3m, Total installed power of 588 kW continuous rating/723 kW 1 hr rating and Operating Voltage 1140V, 3 Phase, 50 C/S Complete with all Accessories. • Standard Height Continuous Miner, capable of cutting 2.0 m - 4.5 m height. Cutter drum width of 3.30m, Total installed power of 599 kW continuous rating/709 kW 1 hr rating and Operating Voltage 1140V, 3 Phase, 50 C/S Complete with all Accessories.
b)	Shuttle cars	• Electrical operated Shuttle Cars for Low height Continuous Miner with a bucket capacity of 13 m^3 (considered 10.0T) having minimum operating height of 1.0m. • Diesel operated Shuttle Cars for Standard height Continuous Miner with a bucket capacity of 19 m^3 (considered 15.0T) having minimum operating height of 1.5m.
c)	Feeder Breaker	• Feeder Breaker 500 TPH Capacity Operating Voltage 1140V, 3 Phase, 50 C/S Complete with all Accessories.
d)	Diesel utility vehicle	• Low height: LHD with an attachment for material transport. • Standard height: LHD with an attachment for material transport.
e)	Roof Bolter	• Twin Bolter Equipment for bolting.
f)	Electricals	• Electrical and Signalling Equipment complete with Transwitch unit, Gate end boxes, Cables, etc.
g)	Auxiliary fan	• Auxiliary fan 15 cum/S, 170-250mm WG, 45KW complete with electrical.
h)	SDL	• To make initial development in No.1&1A seams for accommodating CM's and also to make important ventilation connections between intake and return air shafts.



Continuous Miner



FEEDER BREAKER

The detailed list of equipment, Phasing of equipment and the capital requirement is enclosed in annexure no. DFR 2.4.

Connected load and power consumption details are given in annexure no. DFR 3.4.

4.6. PRODUCTION CAPACITY OF CONTINUOUS MINER

The production capacity of Continuous Miner depends mainly on height of extraction of seam and the capacity of shuttle cars. In Kalyani Khani - 6 Incline, No.1A seam and No.1 seam are having height of extraction of 4.5 m and 2.1 m respectively.

From the below calculation the system capacity of Continuous Miner for standard height i.e. No.1A seam is taken as 4.50 LTPA and for the low height Continuous Miner i.e No.1 seam is taken as 3.50 LTPA are calculated as shown in the following tables.

TABLE: Production capacity of Standard height Continuous Miner

Tentative Roof Rating (RMR)	51
Avg. Ht of extraction	4.5 m
Max. Depth of working	510 m
Permissible Board width B	8.41 m
Considered board width	6.60 m
Permissible Cut out distance	8.95 m
Considered Cut out distance	8.2 m
Considering Cut distance of 8.2 m and gallery width of 4.8 m output per one cut	197 T
Time taken for one trip for shuttle car with average lead of 180 m	14 min
The capacity of shuttle car	15 T
No of trips required by two shuttle cars to clear coal	7

Time required for clearing one cut coal	92	min
Time required for marching of Continuous Miner	30	min
Total cycle tine for one cut for CM	122	min
Time required for drilling and grouting one roof bolt by bolter	3.5	min
Time required for drilling and grouting one side bolt by bolter	4.5	min
Time required for drilling and grouting 9 bolts (5 roof+4 side) for one row	35.5	min
Total Bolting time required for one cut out distance	213	min
Marching time for bolter	30	min
Total Cycle time of bolter	243	min
As two bolters are provided, cycle time is taken as cutting cycle time	122	min
No. of cuts in a day taking 18 hours working time in day (Six hours for maintenance & shift change over)	8.85	
Output per day at the rate of 100% performance	1745	T
Output per year at the rate of 100% performance	5.24	LT
Output per day at the rate of 85% performance	1484	T
Output per Month at the rate of 85% performance	37500	T
Annual output at the rate of 85% performance	**4.5**	**LT**

Table: Production capacity of Low Height Continuous Miner

Tentative Roof Rating (RMR)	48	
Avg. Ht of extraction	2.0	m
Max. Depth of working	530	m
Permissible Board width B	7.75	m
Considered board width	6.60	m
Permissible Cut out distance	8.36	m
Considered Cut out distance	8.20	m
Considering Cut distance of 8.2 m and gallery width of 4.8 m output per one cut	122	T
Time taken for one trip for shuttle car with average lead of 180 m	10	min
The capacity of shuttle car	10	T
No of trips required for two shuttle cars to clear coal	6	
Time required for clearing one cut coal	61	min
Time required for marching of Continuous Miner	30	min
Total cycle tine for one cut for CM	91	min
Time required for drilling and grouting one roof bolt by bolter	3.5	min
Time required for drilling and grouting one side bolt by bolter	4.5	min
Time required for drilling and grouting 7 bolts (5 roof+2 side) for one row	26.5	min
Total Bolting time required for one cut out distance	159	min

Marching time for bolter	30	min
Total Cycle time of bolter	189	min
As two bolters are provided, cycle time is taken as cutting cycle time	95	min
The overall cycle time of CM can be taken as	95	min
No. of cuts in a day taking 18 hours working time in day (Six hours for maintenance & shift change over)	11.43	
Output per day at the rate of 100% performance	1394	T
Output per year at the rate of 100% performance	4.18	LT
Output per day at the rate of 85% performance	1185	T
Output per Month at the rate of 85% performance	29166	T
Annual output at the rate of 85% performance	**3.5**	**LT**

4.7. PRODUCTION SCHEDULE

Zero Date: It is considered as the date of approval by the Board and all initial development activities like shaft sinking, drivage of inclines etc. would commence after obtaining all necessary statutory clearances which would generally take 3 years from the date of approval.

Time Schedule for Shaft Sinking & Incline drivages: It is considered as 8 months and 11.2 months for intake and return shaft sinking respectively. 10.06 months and 9.42 months are considered for drivage of Haulage and Belt tunnels respectively.

The Project implementation schedule (Schedule of major activities) is given as Plate No. XIV.

Table No.4.1: SEAM WISE ANNUAL PRODUCTION & QUALITY (Inband thickness)

Years	SEAM WISE PRODUCTION (LT)		Total Output (LT)	QUALITY							Yield		
	No.1A Seam	No.1 Seam		GCV No.1A Seam	No.1A Seam Grade	GCV No.1Seam	No.1 Seam Grade	Combined GCV	Combined Grade GCV	Expected energy yield 85%	%Yield at 4750K.cal/kg	Proposed % of Yield	Production at proposed % of yield (LT)
1	**0**	**0**	**0**	-	-	-	-	-	-	-	-	-	
2	**0.260**	**0.520**	**0.780**	4453	**G10**	4777	**G9**	4669	**G9**	3969	83.55	**83**	**0.65**
3	**6.123**	**1.650**	**7.773**	4295	**G11**	4919	**G8**	4428	**G10**	3763	79.23	**80**	**6.22**
4	**8.816**	**0.000**	**8.816**	4441	**G10**	0	**Nil**	4441	**G10**	3775	79.47	**80**	**7.05**
5	**6.071**	**2.007**	**8.078**	4314	**G10**	4919	**G8**	4464	**G10**	3795	79.88	**80**	**6.46**
6	**4.466**	**2.558**	**7.025**	4443	**G10**	3802	**G12**	4210	**G11**	3578	75.33	**75**	**5.27**
7	**8.063**	**3.226**	**11.289**	4526	**G10**	3802	**G12**	4319	**G10**	3671	77.29	**77**	**8.69**
8	**8.123**	**3.495**	**11.617**	4225	**G11**	4980	**G8**	4452	**G10**	3785	79.67	**80**	**9.29**
9	**8.168**	**3.434**	**11.601**	4064	**G11**	4461	**G10**	4182	**G11**	3555	74.83	**75**	**8.70**
10	**8.648**	**3.320**	**11.967**	4226	**G11**	4882	**G9**	4408	**G10**	3747	78.88	**78**	**9.33**
11	**8.745**	**3.401**	**12.146**	4141	**G11**	4967	**G8**	4372	**G10**	3716	78.24	**78**	**9.47**
12	**8.565**	**3.264**	**11.829**	4234	**G11**	5077	**G8**	4467	**G10**	3797	79.93	**80**	**9.46**

13	**8.858**	**3.445**	**12.303**	4394	**G10**	4919	**G8**	4541	**G10**	3860	81.26	**80**	**9.84**
14	**8.738**	**3.434**	**12.171**	4494	**G10**	5495	**G7**	4776	**G9**	4060	85.47	**85**	**10.35**
15	**8.513**	**3.320**	**11.832**	4134	**G11**	5308	**G7**	4464	**G10**	3794	79.88	**80**	**9.47**
16	**6.383**	**3.434**	**9.816**	4249	**G11**	5225	**G7**	4590	**G10**	3902	82.14	**82**	**8.05**
17	**0.000**	**3.445**	**3.445**	0	**Nill**	4897	**G9**	4897	**G9**	4162	87.62	**87**	**3.00**
18	**0.000**	**3.355**	**3.355**	0	**Nill**	4899	**G9**	4899	**G9**	4164	87.67	**87**	**2.92**
19	**0.000**	**0.723**	**0.723**	0	**Nill**	4777	**G9**	4777	**G9**	4061	85.49	**85**	**0.61**
TOTAL	**108.536**	**48.031**	***156.567***	**4309**	**G10**	**4830**	**G9**	**4520**	**G10**				***124.84***

Above table provides year wise production programme (seam wise production with quality) for the entire life of the mine as per the above phasing taking 25 working days per month.

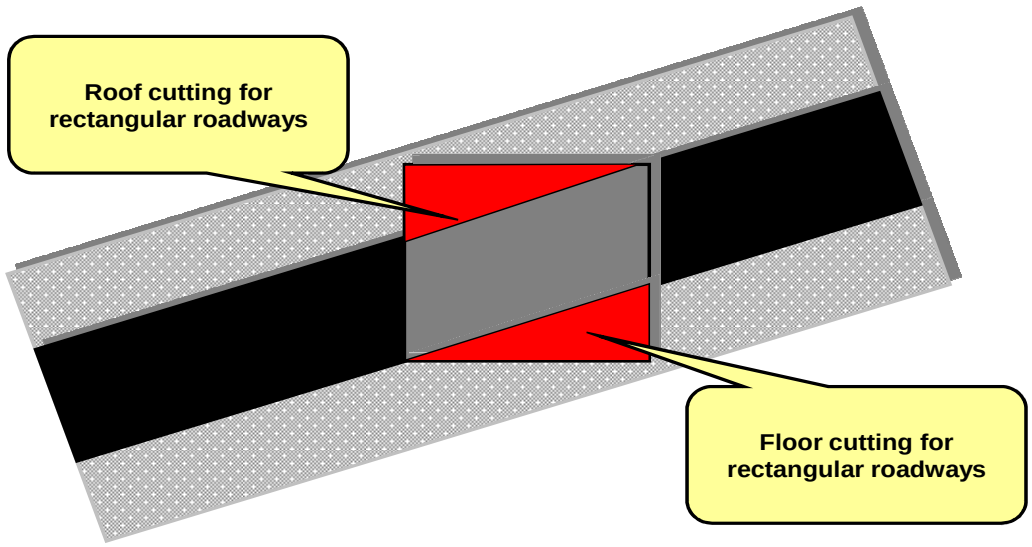
****Annual Production schedule specified above is only tentative and it is likely to vary depending on the field conditions encountered at the time of actual operation.***

Influence of stone cutting on the resultant grade of coal seams

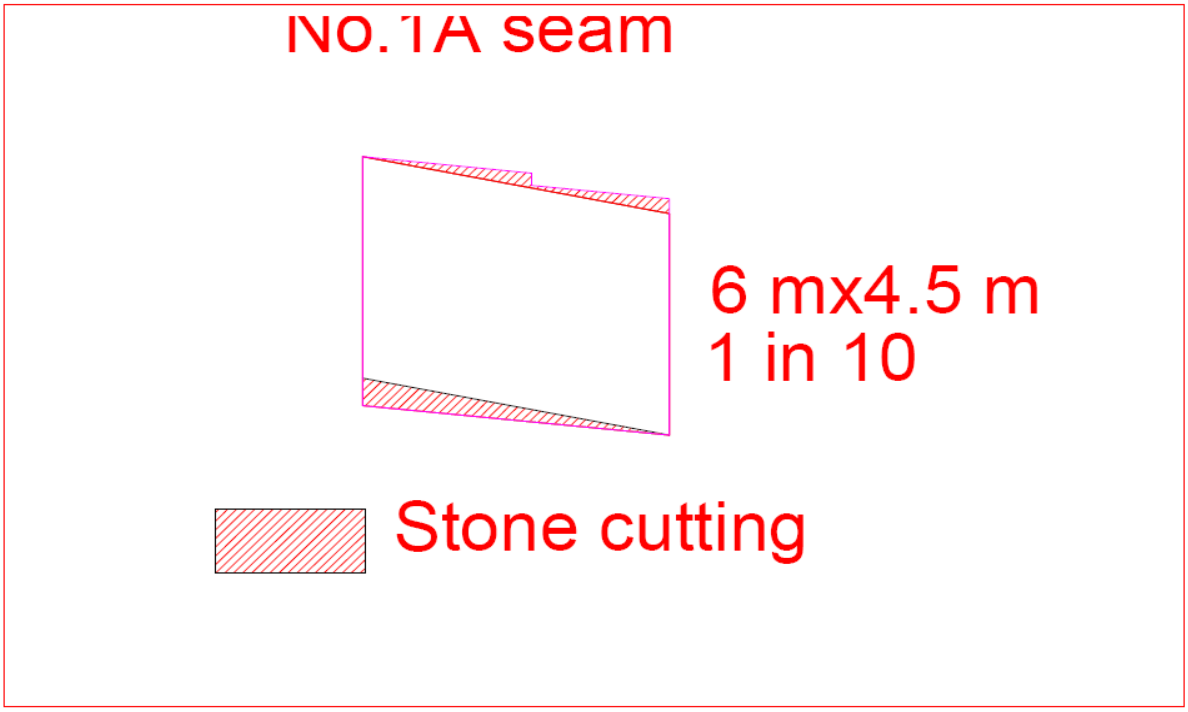
Since the full dip of the seam is 1 in 5.7, the dip galleries in both No.1A and No.1 seams are planned in apparent dip direction with a gradient of 1 in 7.5 to facilitate the movement of the tyre mounted shuttle cars. Though there will not be any problem for the movement of shuttle cars in the dips there will be problem while driving level galleries as the full dip of the seam (1in 5.7) gets exposed along the whole width of the floor so it becomes difficult for the shuttle cars to ply in these cross gradients. The minimum cross gradient where shuttle car can ply is 1 in 9 i.e. 6.5^0.

In order to maintain the cross gradient in level as well as split galleries at 1 in 9 certain amount of floor is to be cut which in turn also results in cutting of equal proportion of roof due to the limitations in maintaining the cutting horizon with Continuous Miner as it can only cut a nearly rectangular cross section .The amount of stone to be cut in the level galleries in both No.1A and No.1 seams is shown in figures below.

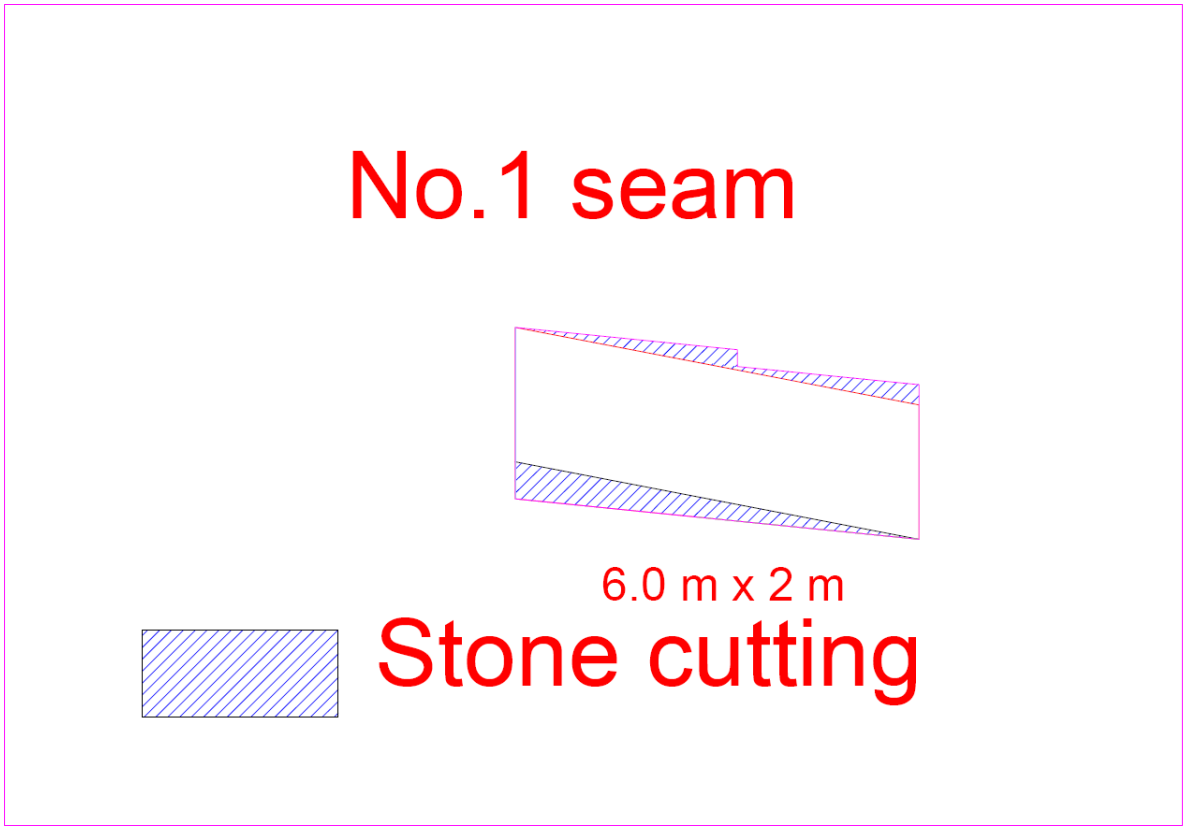
Cutting into Floor and Roof



General gallery profile after driven by Continuous Miner



Stone cutting along floor and roof during development and splitting in No.1A seam.



Stone cutting along floor and roof during development and splitting in No.1 seam.

The amount of stone to be cut in the level galleries expressed in terms of volume for every one meter advance in both No.1 and No.1A seams is 1.918 and 2.65 respectively. Further for drivage and formation of one pillar the % of stone cutting in No.1 and No.1A seams are 8.96 and 4.31 respectively.

The influence on the grade in No.1A seam:

The average inband grade of No.1A seam is G10 with a GCV of 4309 K.Cal/Kg. With the contamination due to clay and stone the average GCV becomes G12 with a GCV of 3741 K.Cal/Kg considering 'zero' GCV for stone and clay. Further if the negative impact of stone is considered the average GCV still falls down to G14.

The influence on the grade in No.1 seam:

The average inband grade of No.1 seam is G9 with a GCV of 4830 K.Cal/Kg. With the contamination due to clay and stone the average GCV becomes G14 with a GCV of 3276 K.Cal/Kg considering 'zero' GCV for stone and clay. Further if the negative impact of stone is considered the average GCV still falls down to G16.

The project becomes unviable with this resultant poor quality of coal and the establishment of coal washery becomes imperative.

The washery of 1.0 MTPA capacity is being planned with throughput coal of combined grade of No.1A and No.1 seams varying from G13 to G14 and to have an output of G9 with GCV of 4750 K.Cal/Kg. The coal washery is proposed to be established near RK 1A underground mine vide Order No: **7600003140.** Around 70% to 75% yield is expected after washing the coal contaminated with stone and clay. Only the in-band thickness of the coal seams is considered while calculating production and arriving at the grades each year. Hence while calculating the yield from the production figures, around 75% to 85% of yield is obtained after washing. The quantity of clay and stone is not accounted while calculating the production quantities. However they are accounted while calculating the rejects.

4.8. METHOD OF WORK

4.8.1. Development of Trunk Roadways

It is proposed to develop trunk roadways up to the boundary by Continuous Miner. Two diesel /electrical operated shuttle cars will be used for coal hauling for each Continuous Miner. These shuttle cars dump coal in the feeder breaker unit and the crushed coal is transported through series of belts up to surface bunkers. Two twin roof bolters are proposed to support roadways for each Continuous Miner. Two twin bolters are proposed to optimize the utilization of Continuous Miner as well as to improve safety by way of supporting the roadways as soon as the roof is exposed. The sizes of proposed Trunk roadways are presented in below table.

Table: Dimensions of proposed trunk roadways

S.No.	Seam	Technology	Trunks (m x m)
1	No.1A	Continuous Miner	4.8 X 3.0
2	No.1	Continuous Miner	4.8 X (2.0 -2.5)

4.8.2. Development Heading Drivage by Continuous Miner

The technology involves drivage of multiple headings with Continuous Miner, which is provided with the width of 3.3 m cutter head. A five heading system is proposed to achieve optimum utilization of Continuous Miner. In this layout it is proposed to cut 8.2 m heading which is considered as the safe cut out distance.

Empirically, two approaches, namely, Bieniawaski□s RMR (1976) and CMRR by NIOSH (Mark, 1999) can be used to delineate cut-out distance.

The details of the work out of cut out distance are furnished below:

1. NIOSH□s CMRR approach:

Bauer (1998) established the following formula to estimate the safe cut-out distances:

$$CutDepth = 8.1 + 0.564\,(CMRR) - 0.152\,(B) - 0.0029\,(H)$$

where $CMRR$ = Coal Mine Roof Rating

B = Bord width (ft)

H = Depth below surface (ft)

2. *Bieniawski established relation between RMR & bord width as given below*

$$RMR = 13 + 1.4\,B$$ **(**Mark 1999)

B= Bord width in feet.

Based on the above formula the cut out distance calculated for No.1A & No.1 seam is tabulated below:

No 1A seam:

RMR	51
Max.Depth (m)	510
Board width (m)	6.6
Permissible Cut out distance(m)	8.95
Considered Cut out distance(m)	8.20

No.1 seam:

RMR	48
Max.Depth (m)	530
Board width (m)	6.6
Permissible Cut out distance(m)	8.36
Considered Cut out distance(m)	8.20

However a detailed scientific study shall be done at the time of trunk development by taking roof rock samples and analyzing them in order to arrive at the safe cut out distance. At the time of cutting the face the operator is positioned under the supported roof. After an advance of 8.2 m, the heading will be released for roof bolter to support. Then the Continuous Miner moves to the adjacent heading. As the cycle time of bolting is more, provision is made for two twin-bolters so as to avoid the under utilization of Continuous Miner. Provision is made for a utility vehicle (FBL) in the district for ancillary works like cleaning and material transport. Thus, roof bolting machine and Continuous Miner work in close succession. Favorable angles are to be provided for turning of shuttle car as well as for Continuous Miner. In the layout 115^0 angle is proposed between level and dip. All the faces must advance in a given sequence so as to minimize the movement of shuttle car and facilitate ventilation of faces. The sizes of proposed drivage of panel headings are presented in the table below:

Table: Dimensions of proposed panel headings

S.No	Seam	Technology	Panel Headings
1	No.1A	Continuous Miner	4.8 x 3.0
2	No.1	Continuous Miner	4.8 x (2.0-2.5)

In No.1A seam development headings height in each panel will be 3.0 m where as in No.1seam development headings height in each panel equal to seam height, where seam height is less than 1.8m belt roadway will be heightened to 1.8m by cutting the floor with Continuous Miner to facilitate movement of persons and machinery.

4.8.3. Pillar Dimensions

Pillar size has been designed keeping in view the estimation of factor of safety of pillar, provision of Coal Mines Regulations and Method of work. The factor of safety is taken as 2 for pillar design purpose. Care has been taken in designing the pillar dimensions in such a way that the same dimensions have been kept in the panels of the both the seams lying vertically below the other for uniformity and better stability. The pillars are designed in the parallelogram shape to facilitate the movement of the shuttle cars and other tyre mounted equipment with the dimensions varying from 75 m to 86 m centre to centre along strike direction and 50 m to 60 m centre to centre along dip direction. However in the designing he dimensions care has been taken that 50 m X 50 m square pillar fits in the parallelogramed shaped pillar for better stability.

4.8.4. Size of Panel

The panel width is designed to have a standard of four pillars for the optimum extraction of Continuous Miner Panel and this width is about 200 m in both seams. The size of the panels has been decided keeping in view the incubation period of the coal seams and the method of extraction. The Incubation period of all seams is considered to be 18 months as per the records established for same seams of the adjacent mines.

4.8.5. EXTRACTION OF PANELS

Option-I: Extraction of No-1A & No-1 seams simultaneously

In this option it is proposed to extract No.1A seam and No.1 seam panels by simultaneous extraction by caving with Continuous Miner. The extraction of panels will proceed from dip to rise or in bye side to out bye side. Though the partition between No. IA seam and No. I seam is about 20 m, simultaneous extraction has been proposed due to the following reasons.

a) There is a presence of clay band of about 0.5 M thick along the roof in No.1 seam.
b) It may become difficult to develop No.1 seam under the goaved out panel of No.1A seam as the concentration of the stresses induced will be more on the inter seam partition particularly in the areas where snooks and barriers are left out in the upper seam.
c) These stresses in turn may act on No.1 seam creating adverse roof and side conditions during development and depillaring. This effect is magnified due to the presence of the clay band along the roof of the seam.
d) To offset these problems simultaneous extraction of the both the seams is studied. Further to match the rate of retreat in both the seams 2 No's Continuous Miner are planned to be deployed in the same panel of No.1A seam where depillaring is done.

   However this option is ruled out keeping in view the difficulty in maintaining the sequence in simultaneous extraction with three Continuous Miners. So far no experience is gained with simultaneous extraction elsewhere in the country.

Option-II: Extraction of No-1A initially and followed by extraction of No-1 seams under the settled goaf :

In this option it is proposed to extract No.1A seam initially with two Continuous Miners. These two Continuous Miners are proposed to be deployed in the same panel to facilitate faster rate of extraction within the incubation period and also to allow sufficient time i.e. 300-500 days before extraction of No.1 seam. Further by deployment of two Continuous Miners in the same panel would ensure consistence in rated production which in turn ensures better economics.

The reason for proposing two Continuous Miners in the same panel.

- It takes a minimum of 12 to 16 months to complete the total extraction of the panel with one Continuous Miner. It takes half of the time with two Continuous Miners.
- As per the proposed pillar dimensions the pillar is to be split in to four stooks. This requires drivage of three splits. The approximate time taken to complete the splitting with supporting is about 21-24 shifts.
- The complete extraction of the pillar by slicing takes an approximate 18-21 shifts time as per the pillar dimensions.
- A total of 39-45 shifts are taken for complete extraction of the pillar. It is also observed that almost equal time is being taken for splitting/ slicing operations. Further DGMS permits splitting of one pillar ahead of the pillar under extraction.
- In view of the above it is proposed to deploy two Continuous Miners, one for splitting operations and one for slicing operations in the same panel. To

facilitate easy movement and to avoid foiling of cables diesel shuttle cars are proposed in the panel.

- The extraction of the complete panel can be completed comfortable within the incubation period. Faster rate of extraction results in better strata control and overall safety improves.

  Alternatively the two Continuous Miners can also be deployed in two adjacent panels. The second Continuous Miner can be deployed in the panel adjacent to the panel where the extraction of half of the panel has been completed.

  In view of the above advantages option-II is proposed and scheduling has been done considering accordingly.

Table : Height of extraction and avg. grade

S.No	Seam	Height of Extraction Height (m)		Average Grade(Inband)
		Development	Depillaring	
1	No.1A	3.0 m	Full height	G12
2	No.1	2.0-2.5 m	Full height	G14

The layout of the sequence of depillaring of pillars is presented in plate No. XII (ii) and XII (iii).

4.8.5.1. Manner of Extraction Proposed:

Split and fender method

It is observed during the practice that if large pillars require splitting, then the split and fender method is preferred. Again the number of required splits should fit the size of the pillar to accommodate the length of the slices. For the conditions and size of the pillars in this block, three equal level splits is found to be suitable one, where a 6.6 m span of the slice needs to be shadowed by a rib of 3m width and the out bye rib of 8.2 m x 8.0 m is to be left against the original gallery in each split. The size of snook/rib to be left in each pillar against the original galleries is 8.2 m x 14.0 m. The safety factor of these snooks is found to be 0.5 as per Showery formula and 1.46 as per Salmon formula, which will provide support against the junction at the time of extraction of last out bye slice in the stook but yields slowly without impeding the fall in the goaf. In the beginning (before break of the beam), the size of all these snooks needs to be diluted to allow caving, except a few left for the instrumentation purposes. However, attempts will have to be made to optimize the size of these snooks as per the result of the field instrumentation and study for better safety and recovery.

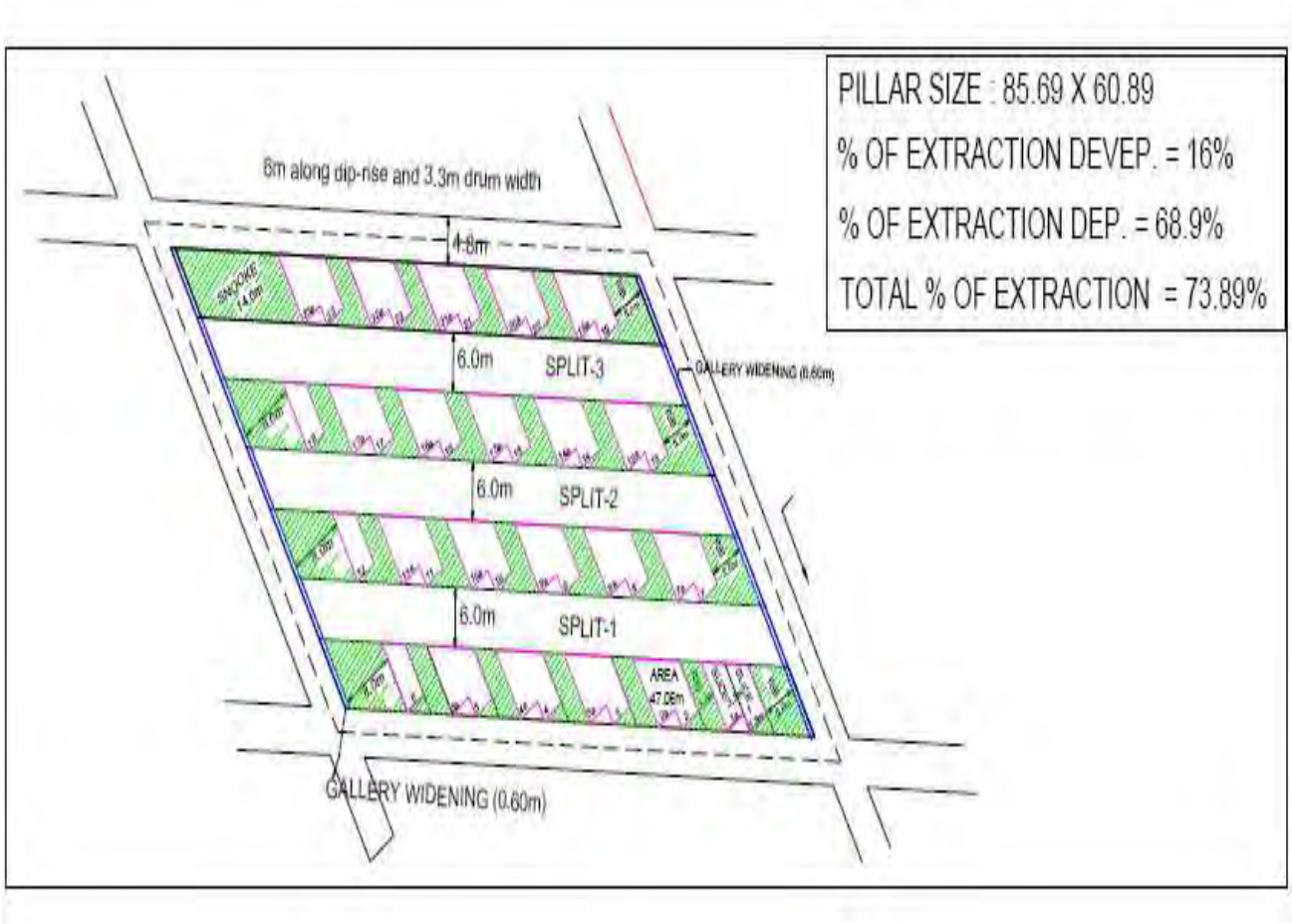
The advantage of the three levels splitting equally based fender method is that operator has a competent pillar on his back

As per the conditions of the proposed panel, it is suitable to go for a level split and dip slicing. From the available PMP data it is observed that overlying strata is found to be easily cavable and, therefore, a straight line of extraction may be adopted. However, if the complete exhaustion of first pillar does not initiate any caving then an attempt may be made for inducing caving. Application of high density roof bolts based breaker line (detailed in support section) is an important consideration for the conditions of the seams present in this block.

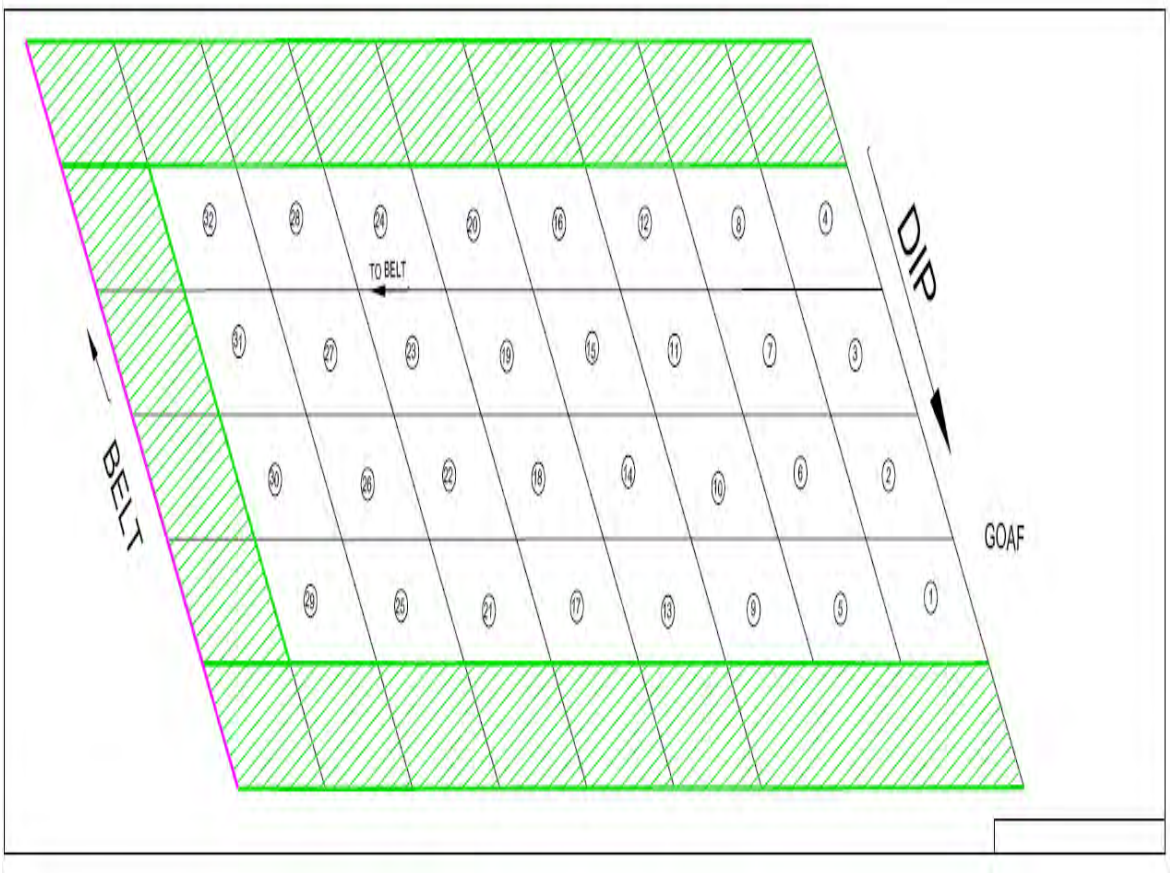
Method of extraction by CM

The Technology involves drivage of multiple headings with Continuous Miner. The Continuous Miner cuts the face and the coal is loaded on to the tyre mounted diesel/electrical operated shuttle cars which transport and unload coal onto a feeder breaker. The coal is then conveyed to the belt conveyor for onward transportation to trunk conveyor. As the operator is 8m away from the cutter head, he will always be under the supported roof providing an advance of 8.2 m before the heading is released for the purpose of roof bolting for support. Then Continuous Miner moves to the adjacent heading.

During development, gallery dimensions proposed to form panels are 4.8m wide and 3.0 m height/height equivalent to the seam height. The belt conveyor roadway proposed in the centre of the panel for No.1 seam and for No.1A seam two roadways are proposed for belt conveyor as two Continuous Miners have been planned. While extraction, three level splits of 6.0m width are proposed in each pillar. Dip slices with a rib of at least 3 m between the slices and outer rib of not less than 8 m, which will be extracted judiciously on retreat. The proposed method of extraction will be modified as per the DGMS permission conditions from time to time. The schematic layout of pillar extraction is shown below.



Method of extraction of Parallelogram shaped pillars of 85mX60m



Sequence of extraction of pillars in a Panel.

4.8.5.2. Proposed Support System during Panel Development

All developed galleries are proposed to be supported by five non-retractable resin grouted roof bolts of 1.8 m length for No.1A seam and 1.2 m length for No.1 seam and 22 mm diameter with high strength tendons. Proposed support system in developed galleries is shown below.

Calculation of support resistance for Trunk roads and Split levels based on RMR:

The support requirements for drivages of Gate roads and Split levels are estimated based on RMR method.

1. Calculation for estimation of Rock Load:

Expected rock load (P) in tonnes/m^2 is estimated by using the following empirical formula

$$P = W \times \gamma \times (1.7 - 0.037\ RMR + 0.0002\ RMR^2)$$

Where W = Span of the gallery in meters

γ = mean rock density in t/m^3

RMR = Rock Mass Rating.

2. Bolt Capacity

Bolt Capacity is taken as 18 T in case of 2.4 m length bolt, 12 T in case of 1.8m length bolt and 10 T in case of 1.2m length bolt.

3. Support resistance is estimated as follows:

Generally Support Resistance is calculated based on the following formula.

$$\text{Support Resistance} = \frac{\text{Support Density}}{\text{Area supported by one row of support}}$$

4. Factor of safety is estimated as follows:

$$\textbf{F.S} = \frac{\textbf{Support resistance}}{\textbf{Rock load}}$$

Trunk roads and Split galleries are planned to be developed with the following dimensions.

S.No	Description	No.1A seam	No.1seam
1	Trunk roads	4.8 mx3.0 m	4.8 mx2.0/2.50m
2	Split galleries	6.0mx4.5 m	6.0mx2.0/2.5m

Estimation of Rock load for Trunk roads:

Seam	Type of roof	RMR	Density gm/cc	Gallery Width Considered	Rock load in T/M^2	Support resistance T/M^2	F.S
No.1A	Stone	51	2.05	4.8	3.28	15.0	4.58
No.1	Stone	48	2.05	4.8	3.79	15.0	3.96

Estimation of Rock load for Split galleries:

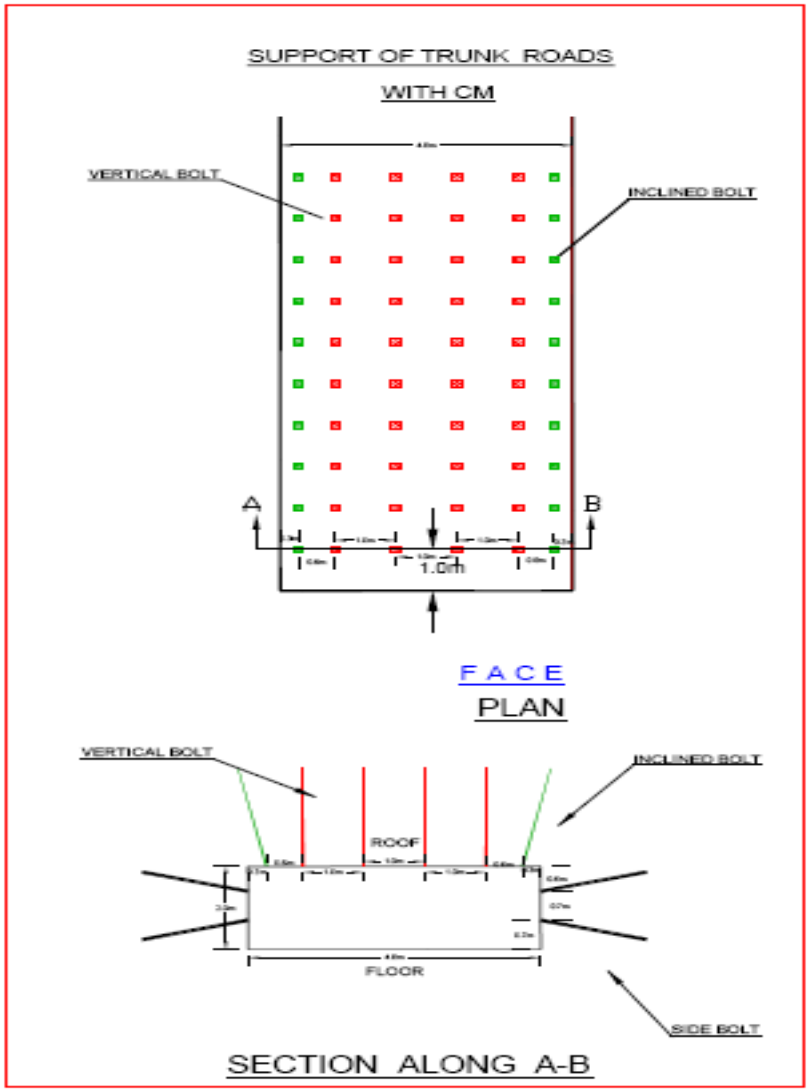
Seam	Type of roof	RMR	Density gm/cc	Gallery Width Considered	Rock load in T/M^2	Support resistance T/M^2	F.S
No.1A	Stone	51	2.05	6.0	4.10	10.0	2.44
No.I	Stone	48	2.05	6.0	4.73	10.0	2.11

The following support system in trunk galleries of No.1A and No.1 seam is adopted.

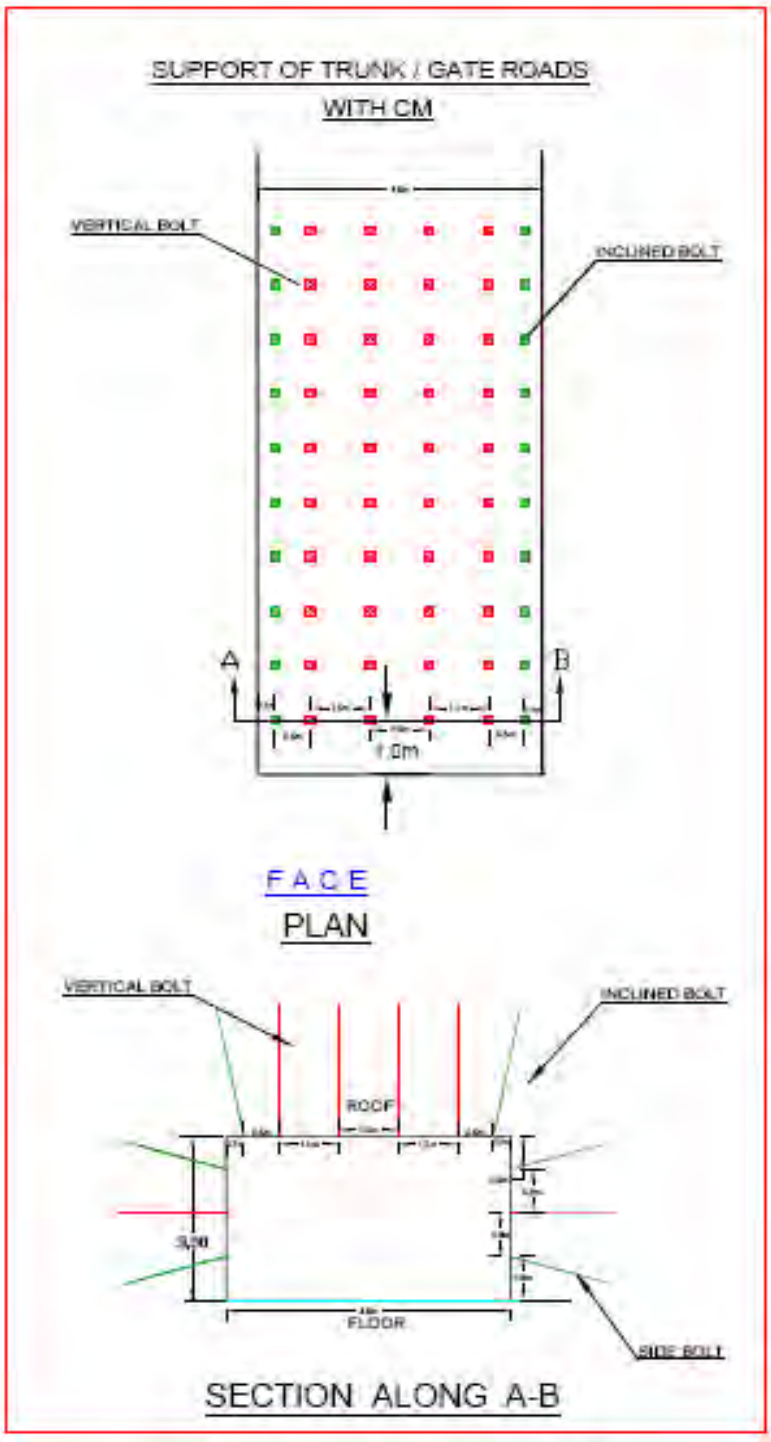
The distance between the rows of the roof bolts as well as between the two consecutive roof bolts in the same row should be 1.0 m. The roof bolts nearest to the pillar should be kept 0.6 m away from the edge of the pillars. At geologically disturbed places, the galleries should be additionally supported by roof bolts of 1.8/2.4 m length (flexi bolts or hydra-bolts may be tried) with W-straps.

During the development of trunk roadways with width of 4.8m, the number of bolts in a row will be 6 of which 2 bolts will be fixed at an inclination towards the pillar side. The distance between the rows of the roof bolts as well as between the two consecutive roof bolts in the same row shall not exceed 1.0 m. and the distance between the side of the pillar and the last bolt would be 0.3 m which is fixed at an inclination towards the pillar side. The sides of the pillars shall be supported in split and original galleries by two cuttable bolts of 1.5 m length in No.1 seam and three cuttable bolts of 1.5 m length in No.1A seam. In No.1 seam the distance between two consecutive rows of side bolts shall be 1.0 m and the first side bolt shall be 0.6 m below the roof and second bolt shall be 0.7 m above the floor and distance between the bolts is 0.7m. In No.1 seam the distance between two consecutive rows

of side bolts shall be 1.0 m and the first side bolt shall be 0.6 m below the roof and bottom bolt shall be 0.8 m above the floor.



Support system for trunk roadways in No.1 seam



Support system for trunk roadways in No.1A seam

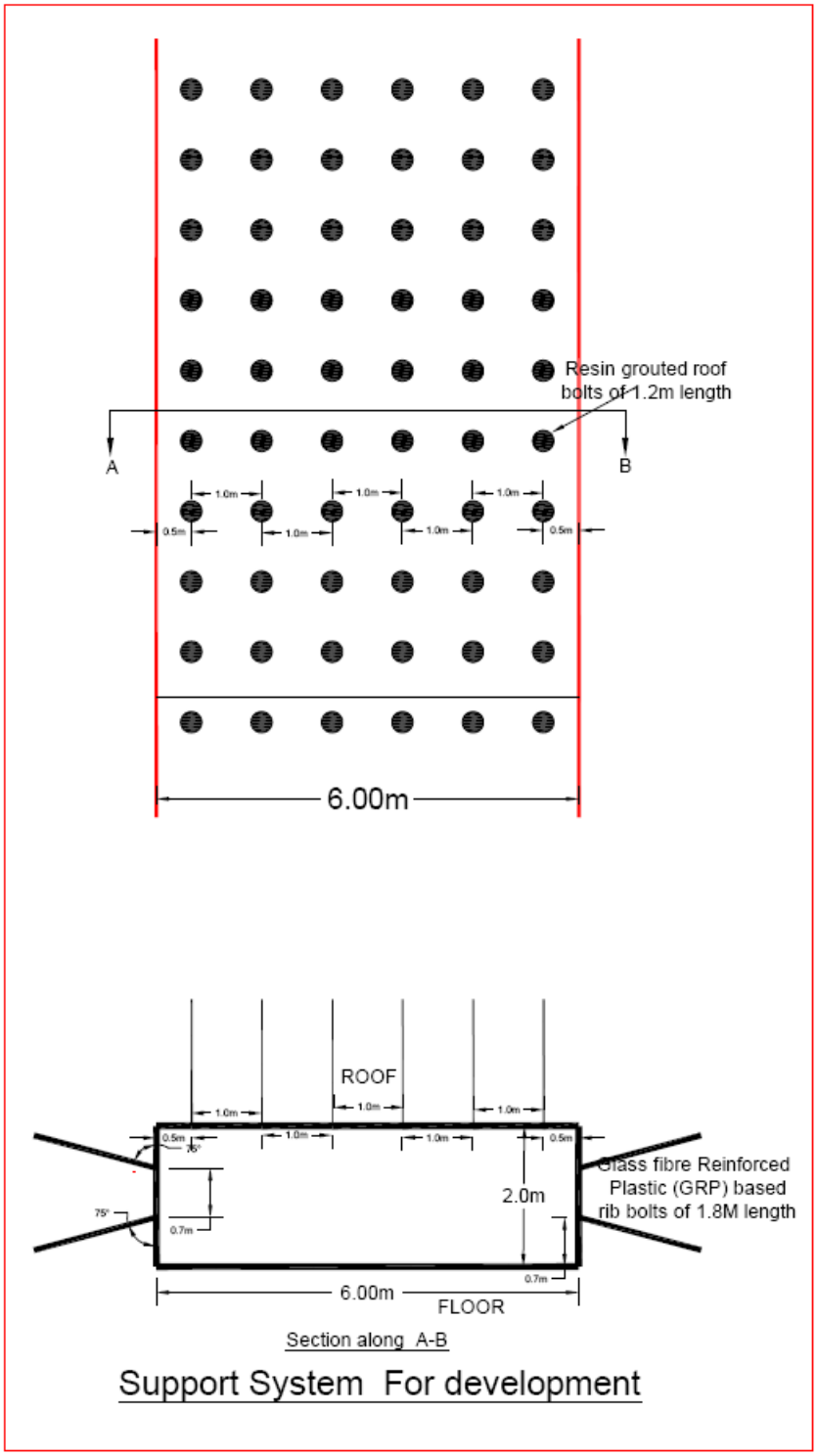
The following support system during the extraction of the pillars in No.1A and No.1 seam is adopted.

a) For splits support (Roof)
   i. All splits galleries shall be supported by six non-retractable resign grouted roof bolts of 1.8 m (No.1A seam) / 1.2 m (No.1 seam) length of 22mm diameter with high strength resin capsules.
   ii. The distance between the rows of the bolts as well as between the two consecutive roof bolts in the same row shall be 1.0m
   iii. The roof bolts nearest to the pillar shall be 0.5m from the edge of the pillar.

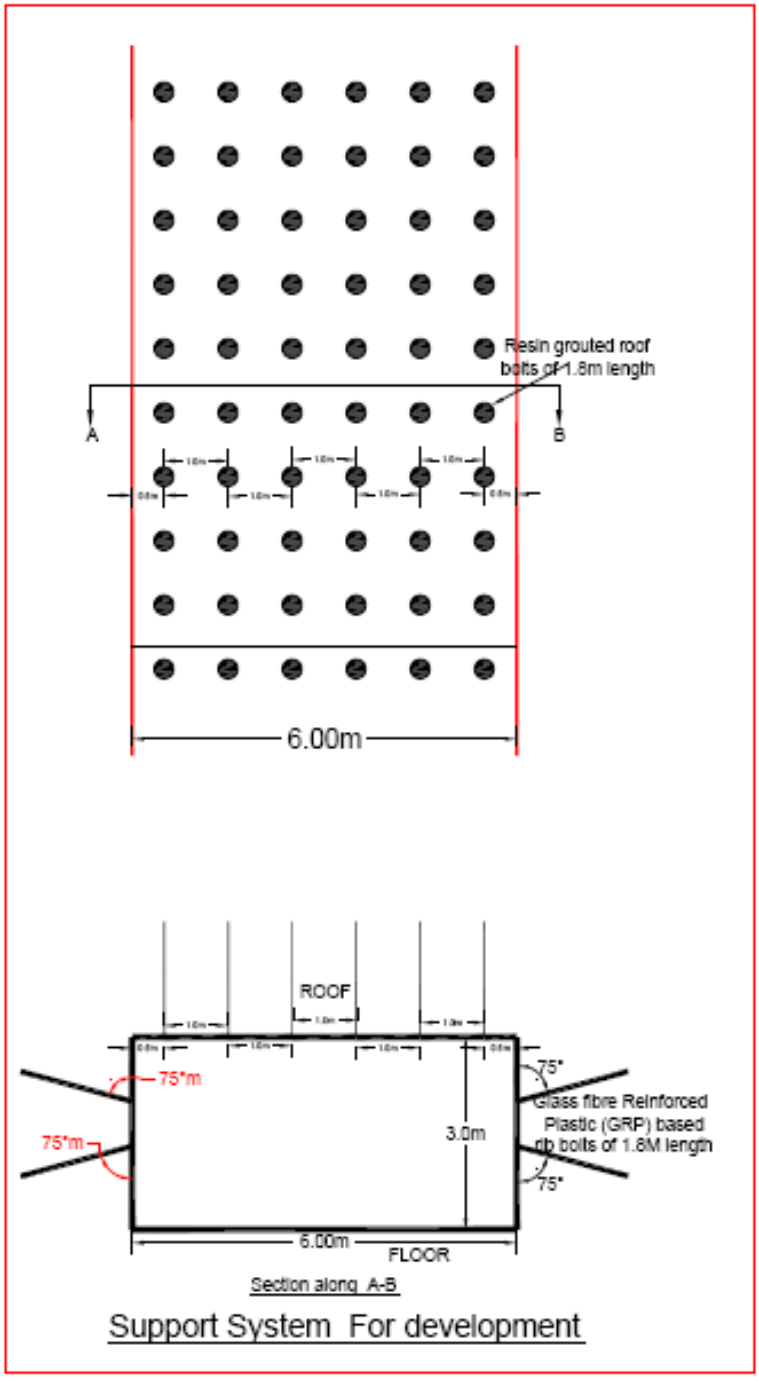
b) Splits support (Sides)
   i. Sides of the pillar shall be supported in split galleries by two cuttable (No.1 seam)/ by three cuttable (No.1A seam) side bolts of 1.5 m length.
   ii. The distance between two consecutive side bolts shall be 1.0 m

c) Goaf Edge (Breaker Line) support
   i. All the goaf edge support shall be supported by two rows of non-retractable 2.4m (No.1A seam)/1.2m (No.1 seam) long fully resign grouted steel bolts. The distance between the two adjacent rows of bolts and that between two adjacent bolts in a row shall not be more than 1.0m. Such rows of the bolts shall be installed in between the rows of the roof bolts already installed in the gallery. Such goaf edge supports shall be provided at the ribs left in the split and original galleries and at the end and level galleries.
   ii. The breaker line roof bolts nearest to the pillar shall be installed 0.5 m away from the edge of the pillars.
   iii. In addition to the breaker-line bolts, a timber prop shall be erected within the breaker line at the active goaf edge as a policeman post to provide visual warning of the onset of weighting of roof at the goaf edge/ along the goaf edge.

d) Junction supports
   i. At junction five rows of roof bolts shall be installed in 1.0 m grid pattern.
   ii. Additional roof bolts shall be installed whenever necessary.

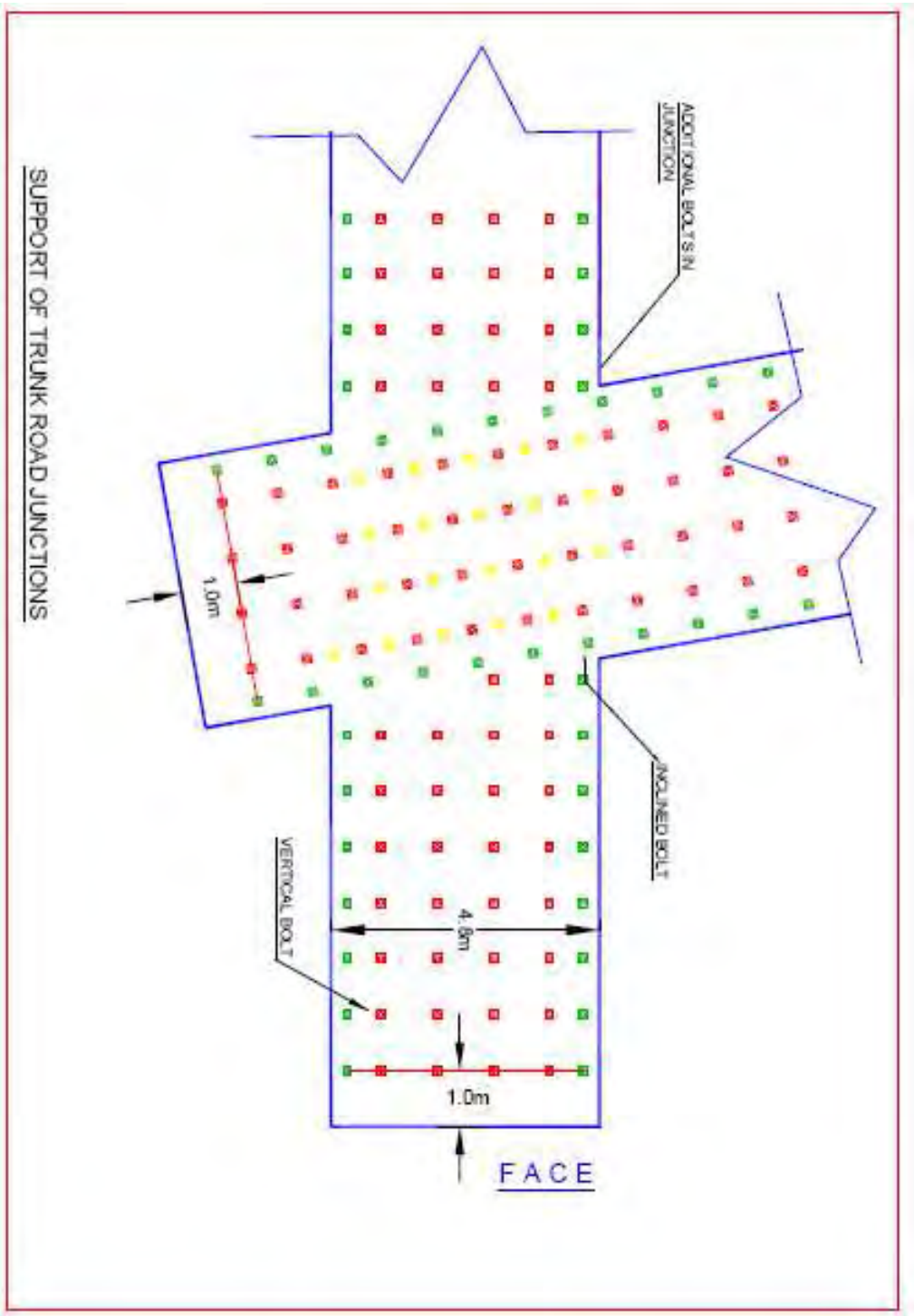


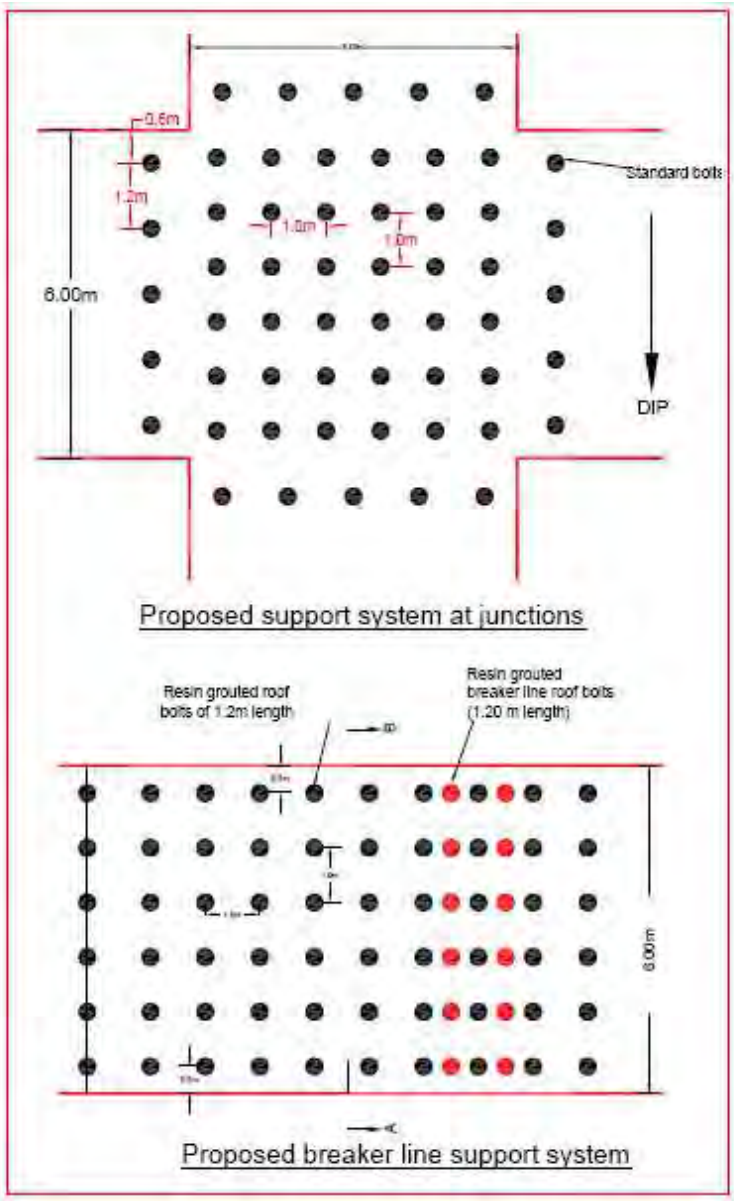
Support system for panel development roadways in No.1 seam



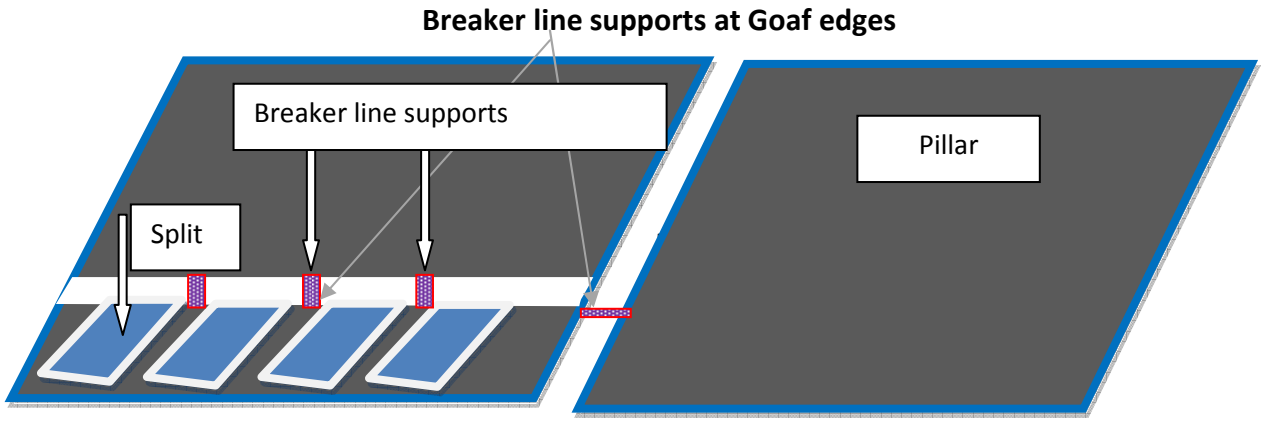
Support system for panel development roadways in No.1A seam

At the junctions, the bolting density is to be increased by 20%.





Proposed breaker line support system.



The support plan is enclosed as plate No. XII(iv).

The SSR framed is only tentative and the support plan shall be prepared by the manager in consultation with scientific institution and DGMS.

4.8.5.3. Instrumentation

Description of different types of instruments to be installed in the panel is given below:

a) **Stress meters**

Design of underground structures and pattern of excavation is greatly influenced by the quantity and range of mining induced stress (vertical). Vibrating wire type stress meter is used to monitor the mining induced vertical stress developed over the pillars/stooks/fenders. It is a reliable and preferred instrument for long term monitoring due to use of frequency as output signal rather than voltage in case of conventional electrical resistance or piezoelectric transducers. The stress meter is installed into the horizontally drilled borehole in the pillars by setting tool and tightened with wedge and platen assembly.

b) Dual Height Telltales

This instrument provides visual indication of movement of roof strata in the opening of a coal seam. The cut-off values are also designated on the instruments, which gives warning of possible roof failure. Remedial actions may be taken if the observed value exceeds the cut off value. It is proposed that these instruments should be installed at all junctions (as shown in figure) to confirm the stability of the roof strata.

c) Rotary Telltales

When the movement of roof strata is low, then this instrument is used to measure the movement of roof strata (<10mm) as this instrument magnifies vertical displacement in to a rotational movement i.e. 5mm = 60° of rotation. During development, the amount of roof movement is low, under this condition; this instrument may provide better information. These instruments are proposed to be installed in the middle of the all splits.

d) Borehole extensometers (BHE)

This instrument is basically used for monitoring the separation of different roof stratum during drivage of an opening in the rock. It may be a single, double or multi-point anchor type instrument, depending on the number of roof horizons of interest.

e) Instrumented roof bolts

For monitoring of load distribution along the full column grouted roof bolts, “instrumented bolts” are used, in which strain gauges are fixed along the length of roof/cable bolts at different intervals. Rock bolt load cells of

mechanical, electrical or vibrating wire type are also used to measure the load in roof bolt.

These instruments are proposed to be installed at the proposed locations of breaker line supports during development so that these may provide essential design information with regard to the support performance during development and depillaring of the panel. At least twenty breaker lines of the panel are to be monitored by these instruments.

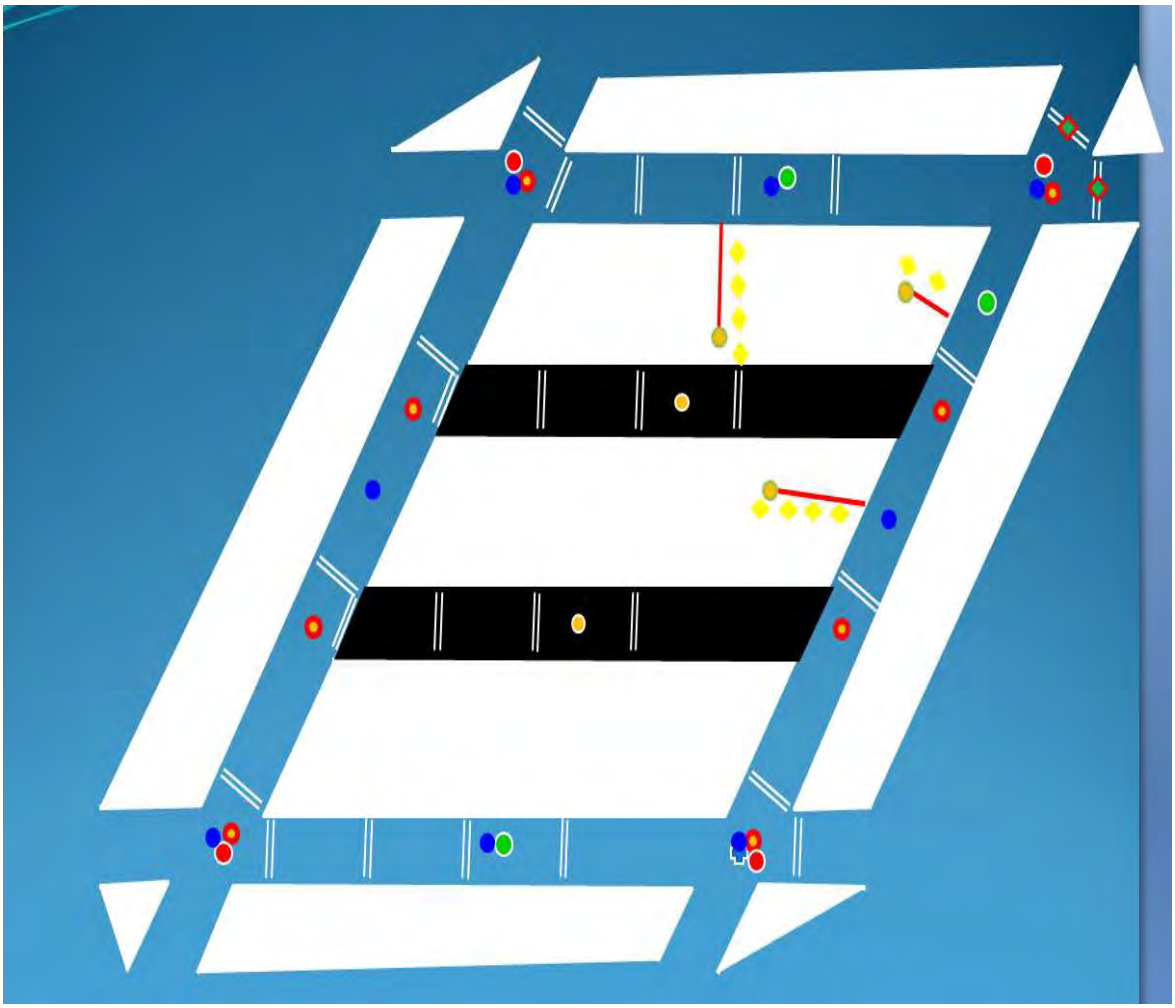
f) Remote type Telltales

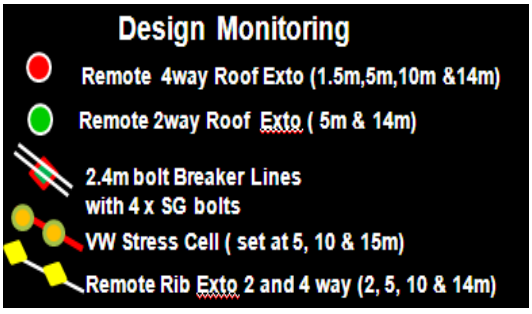
Remote type Telltales are to be installed at each and every stress meter station to supplement the readings of each other.

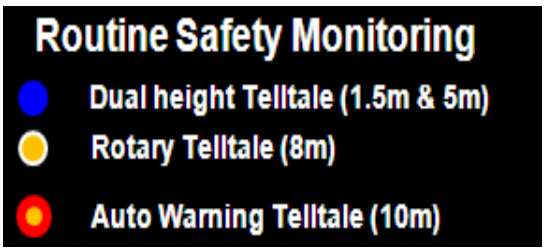
In situ performance monitoring of the designed structures are to be evaluated by all these instruments for their further improvement. First, few X snooks are to be instrumented with two stress meters at deferent depths in horizontally drilled boreholes (as shown in figure given below) for their performance monitoring and accordingly the size of these snooks is to be optimized.

The Scheme of strata monitoring of a model Continuous Miner Panel is shown in the figure.

Strata Monitoring in Continuous Miner Panel (around a pillar)







4.9. TRANSPORTATION

4.9.1. General

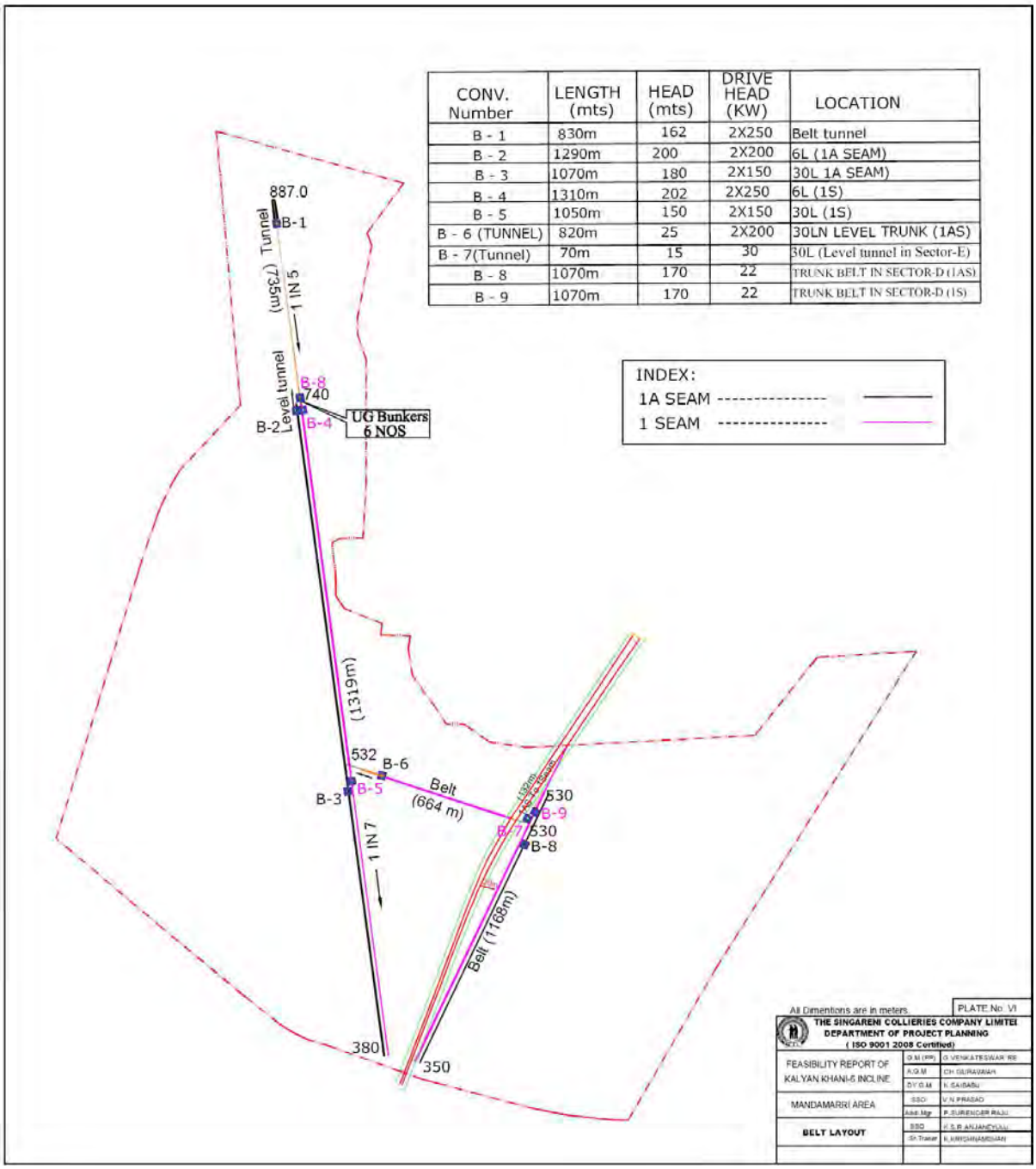
It is proposed to have two no's of inclines and two air shafts. One incline will be utilized for coal transportation, for men transport and as intake airway and another for material transport and intake airway. One shaft will serve for intake air way and other will serve as return airway.

4.9.2. Coal Transportation In CM Panels

The belt incline will be driven from the surface to the bottom most No.1 seam which will serve for coal transportation of the mine. The trunk belt of No.1A seam will feed to coal bunkers of 1000 Tones capacity installed in No.1A seam which in turn will feed coal onto Main belt (No.1 seam) of Belt incline and from there coal is transported up to surface. No.1A seam & No.1 seam coal of sector-D will be fed to 1000 T (No.1A seam) bunkers through B6 belt which will pass through the Tunnel (from 1 seam to 1A seam of sector-E).Coal produced from1A seam of sector-E will be fed to 1000 T bunkers through trunk belts of No.1A seam where as No.1 seam coal will be fed to Main belt through No.1 seam trunk belts.

Coal transportation layout is presented in plate No-XII (v) (b) (i) and XII (v) (b) (ii).

Belt Layout of No.1A seam and No.1 seam.



The details of Belts with capacities are shown in the following table:

TABLE: DETAILS OF BELT CONVEYORS

S.No	Location	Description
1	B1	Belt conveyor unit 1200mm wide, 810m long 162 m lift, 720 TPH, 2x250KW, 3 mps, 3.3 kv complete with drive, structure, electricals and belt (Type-12)
2	B2	Belt conveyor unit 1200mm wide,1270m long,200m Lift, 550TPH, 2x250 KW, 3 mps, 3.3 KV complete with drive, structure, electricals and belt (Type-12) Drive
3	B3	Belt conveyor unit 1050mm wide, 1070m long,180m lift 200 TPH, 2x125KW , 3 mps, 3.3Kv complete with drive, structure, electricals and belt (Type-6) Belt(Thickness 9.4mm&weight 11.9 Kg/Sqm)
4	B4	Belt conveyor unit 1050mm wide 1310m, long 202m lift 200 TPH, 3 mps 2x125 KW, 3.3Kv complete with drive, structure, electricals and belt(Type-6) Belt(Thickness 9.4mm&weight 11.9 Kg/Sqm)
5	B5	Belt conveyor unit 1050mm wide, 1050m long, 150 m lift 3mps,200 TPH, 2x125 KW, 3.3 V complete with drive, structure, electricals and belt (Type-6) Belt(Thickness 9.4mm&weight 11.9 Kg/Sqm)
6	B6	Belt conveyor unit 1200mm wide,820m long, 25m lift, 550 TPH, 150 KW, 3 MPS 3.3Kv complete with drive, structure, electricals and belt (Type-3) Belt(Thickness 7.5mm Min & weight 9.6 Kg/Sqm)

7	B7	Belt conveyor unit 1050mm wide, 70 long,15 m lift 3mps,150 TPH, 22 KW, 550 V complete with drive, structure, electricals and belt (Type-3) Belt(Thickness 7.5mm Min & weight 9.6 Kg/Sqm)
8	B8	Belt conveyor unit 1200mm wide, 1070m long, 170 m lift 3mps,550 TPH, 2x250KW, 3.3K V complete with drive, structure, electricals and belt (Type-3) Belt(Thickness 7.5mm Min & weight 9.6 Kg/Sqm)
9	B9	Belt conveyor unit 1050mm wide, 1070m long,170 m lift 3mps,200 TPH, 2x125 KW, 3.3KV complete with drive, structure, electricals and belt (Type-3) Belt(Thickness 7.5mm Min & weight 9.6 Kg/Sqm)
10	B10	Belt conveyor unit 1050mm wide, 80m long, -10 m lift 3mps,200 TPH, 22KW,550V complete with drive, structure, electricals and belt (Type-3) Belt(Thickness 7.5mm Min & weight 9.6 Kg/Sqm)
11	Tripper Trolley over Surface bunkers	Belt conveyor unit 1200 mm wide, 50m long 3 m lift, 720 TPH,30 KW,3 mps,550V complete with drive, structure, electricals and belt with tripper trolley Belt(Thickness 7.5mm Min & weight 9.6 Kg/Sqm)
12	Surface belt	Belt conveyor unit 1200mm wide, 200m long, 14 m lift 3mps,720 TPH, 90 KW, 550V complete with drive, structure, electricals and belt (Type-3)(Surface belt) Belt(Thickness 7.5mm Min & weight 9.6 Kg/Sqm)

4.9.3. Transportation of Men / Material

4.9.3.1. Transportation of materials by Haulers

a. **Surface Hauler (**150 HP Direct Hauler complete with electrical) **- 1 no**

b. 87 HP Hauler complete with electrical - 6 no's

c. 40 HP Hauler complete with electrical - 2 no's

d. 60 Endless Hauler complete with electrical - 1 no's

All the Materials are proposed to be transported by haulage through incline.

In underground sufficient numbers of direct and endless haulers will be provided for transportation of material up to working places.

Haulage layout is presented in plate No-XII (v) (a) (i) and XII (v) (a) (ii).

4.9.3.2. Specifications of Man riding Chair lift system

Major part of the distance to be travelled by workmen from the surface to reach the working places will be reduced by providing the man riding system. Three chair lift systems will be in operation to reduce the travelling distance there by reducing the fatigue of workmen and increasing the working hours.

The system shall consist of a drive unit arrangement, a return station, and rope guiding pulleys with fittings and Electricals. The Chair lift system for men transport shall be an endless haulage system driven by Electro- Hydraulic power pack incorporating complete safety devices as necessary for transporting men in Under Ground mines. The speed of the rope shall be adjustable from 0 to approximately 3 M/sec. at maximum.

3 No's chair lift system has been proposed for the Project.

The technical parameters of chair lift system are detailed below:

Distance between 2 chairs	: 15 Mtrs.
Distance between 2 carrier pulleys(posts)	: 15 Mtrs.
Man Riding Capacity (for 1km@1.6m/s)	: 400 Persons per hour
Diameter of the drive unit sheave	: 1.5 Mtrs.
Travelling speed	: From zero to around 3 m/sec
Power of motor	: 550Volts, 3Phase, AC,
Rope diameter	: 16 mm
Rope safety factor (not less than)	: 10

Chair lift system (No.1) will be installed in belt incline roadway and to comply with statutory provisions made for belt and chair lift system 5.6 m gallery width has been proposed for belt incline. Chair lift system (No.1) will be serving for complete life of the mine in No.1 seam.

Chair lift system (No.2) will be installed in No.1A of Sector-E which would serve there at for a period of 3 years from opening of No.1A seam for trunk galleries development. Thereafter chair lift system (No.2) would be shifted to No.1A seam of sector-D where it would serve 5years.Again chair lift system (No.2) will be shifted to No.1A seam of Sector-E where it would serve till the completion of No.1A seam reserves.

Chair lift system (No.3) will be in operation in No.1 seam of Sector-D from 5th year to 10th year from opening of main inclines.

Men transportation layout is presented in plate No-XXII.

4.10. LIFE OF THE MINE

The life of the project is 19 years including the period of accessing the coal deposit.

4.11. COAL RESERVES

Sl No	Seam	Geological Reserves (Mt)	Extractable Reserves (Mt)
1	No.1A	28.76	10.85
2	No.1	12.60	4.81
	Total	**41.36**	**15.66**

4.12. DETAILS OF MINE ENTRIES

Kalyani Khani - 6 Incline mine will have two inclines and two shafts. These inclines will be utilized to approach No.1seam.

Sl. No	Entries	Nature of Air	Area of Cross section (Sq.m)
1	MID(Haulage)	Intake	14.40 (4.80x 3.0m)
2	MWD(Belt cum chair lift)	Intake	16.80 (5.60x 3.0m)
3	Air shaft	Intake	Dia 5.5m, Depth 120m, up to No.1 seam
4	Air shaft	Return	Dia 6.5m, Depth 169m, up to No.1 seam

Gassiness of the Seams

No.1A seam and No.1 seam of Kalyani Khani - 6 Incline mine are considered to be classified as Degree-1 since the adjacent mine (KK-5 Incline) No.1A seam and No.1 seam are classified as Degree-1 based on gas survey. However, after opening of the mine gas survey will be conducted accordingly classification of seams will be done.

4.13. Strata Control

RMR is a primary input for calculating the cut out distance for Continuous Miner as well as for support design. As such Kalyani Khani - 6 Incline mine is a new Underground mine, so RMR values are not available. Hence, the adjacent mine (KK-5 Incline) No.1A seam and No.1 seam RMR has been taken for calculating the cut out distance for Continuous Miner as well as for support design of the mine. However, after opening of the mine samples will be collected from No.1A seam roof (sand stone) and from No.1 seam roof (sand stone) for the classification of the roof.

The tentative RMR values of No.1A seam and No.1 seam is furnished below.

S No.	seam	RMR	Class	Nature of roof
1	No.1A	51	III B fair	Sand stone
2	No.1	43	III fair	Sand stone

4.13.1. Support system in Continuous Miner Panels.

Support system in CM panel has been described at 4.6.5.3

4.14. VENTILATION SYSTEM

4.14.1. General

Various aspects for fulfilling the ventilation requirement of the project have been outlined by carrying out ventilation network optimisation studies. Study envisages details of requirement of air quantity, number and size of entries, proposed ventilation layout and operating pressure, capacity of Main Mechanical Ventilators at different stages of mine workings and Auxiliary Ventilation.

It is planned to develop and extract No.1A Seam and No.1 Seam by deploying 2 Continuous Miners, 4 Diesel powered Ram-cars in No.1A Seam and One Continuous Miner, 2 Electric powered Ram-cars in No.1 Seam. Depth of workings proposed in the mine range from 100m to 550m. Total extractable reserves are about 15.66MT and the life of the Mine is expected to be 19 years with maximum

annual production of 1.23MT. The gassiness of the seams is considered as Degree-I for the purpose of ventilation planning.

Two Incline entries and a shaft will be provided as downcast, another shaft will be provided as upcast to cater the ventilation requirements of the project. It is planned to ventilate workings of the mine with suitable Main Mechanical Ventilator and Auxiliary Ventilators to comply the statutory requirements as well as to provide comfortable workplace environment.

As per coal mines regulation, the wet bulb temperature must not exceed 33.5^0C at any place in underground workings, if the temperature exceeds 30.5^0C arrangements are to be made to ventilate with a current of air moving at a speed of not less than 1m/s. It is most likely that the wet bulb temperature at the depth mentioned above will exceed the acceptable limits. If the wet bulb temperature exceeds 30.5^0C, for a roadway size of 4.8m x 3.0m, the minimum quantity of air requirement would be 14.4 x 1.0 = 14.4m3/s.

However,the temperature of 30.5^0C and above is not acceptable for high productivity workings and it is required to be maintained below 28^0C. In view of the above, it can be inferred that in order to maintain acceptable work place environment and to provide the requisite quantity of air at the working places, cooling of mine air is essential.

Air-cooling plant of suitable capacity and of suitable type may be installed at the mine either in underground or surface considering positional efficiency. This will not only reduce the air quantity requirement but will also provide acceptable workplace environment. The temperature at working places can be maintained at a temperature not exceeding 28^0C.

4.14.2. Air Quantity Requirement

Quantity of air requirement would depend on the stipulation of Coal Mines Regulations with regard to minimum and maximum air velocity and temperature in workings.

The stipulations considered are:

a) Maximum air velocity of 15m/s in ventilation shafts not provided with man winding and Fan-Drifts.
b) Maximum air velocity of 12m/s in ventilation shafts not provided with man winding used for hoisting only.
c) Maximum air velocity of 8m/s in man and material winding shafts, haulage roadways.
d) Maximum air velocity of 6m/s in other roadways
e) Maximum air velocity of 4m/s in belt roadways.
f) Maximum air velocity of 4m/s in developing or depillaring areas including Longwall faces

g) Minimum air velocity of 0.25m/s in blind headings (Degree-I) where tube ventilation is envisaged. This velocity should be available at 7.5m outbye of the discharge end of an air pipe.

h) The wet bulb temperature must not exceed 33.5^0C at any place, if the temperature increases beyond 30.5^0C arrangements are to be made to ventilate the same with a current of air moving at a speed of not less than 1m/s.

4.14.3. Air Quantity Requirement For Development and Extraction With Continuous Miner in No.1A Seam

No.1A Seam is planned to develop and extract with 2 Continuous Miners and 4 Diesel powered Ram-cars. For ventilation planning, the dimensions of trunk roadways, working galleries in panels considered as 4.8m x 3.0m.

In Continuous Miner workings, the quantity of air requirement would depend upon the minimum air velocity requirement at the face, rate of extraction and volume of gas liberated during extraction. Since the mine is classified as Degree-I gassiness, air requirement would depend upon the basis of rate of production, velocity of air in workings. As diesel powered Ram-cars are used, air quantity requirement will also depend on power of diesel engine as well as dilution of exhaust gases to below the specified norms.

If the wet bulb temperature exceeds 30.50C, the minimum velocity of air at the face must be 1.0m/s. Therefore, the minimum quantity of air requirement at the face during development of working galleries would be 4.8 x 3.0 x 1.0 = 14.4m3/s considering maximum gallery dimensions. Annual coal production is expected to be about 8.858 lakh tonnes, minimum air quantity to be circulated in LVC based on the production is about (885800/300)x2.5/60 = 123m3/s. Requirement of air quantity based on the capacity of diesel equipment used will be @ 0.01m3/s/kW of diesel engine power, 4 Ram-cars of about 175kW each needs 4 x 175 x 0.1=70m3/s.

Keeping in view of high capacity equipment, high productivity operations and also to meet the statutory requirements, about 100m3/s air quantity is planned to be circulated during development and extraction.

4.14.4. Air Quantity Requirement For Development and Extraction With Continuous Miner in No.1 Seam

No.1Seam is planned to develop and extract with 1 Continuous Miner and 2 Electric powered Ram-cars. For ventilation planning, the dimensions of trunk roadways, working galleries in panels considered as 4.8m x 2.5m.

In Continuous Miner workings, the quantity of air requirement would depend upon the minimum air velocity requirement at the face, rate of extraction and volume of gas liberated during extraction. Since the mine is classified as Degree-I gassiness,

air requirement would depend upon the basis of rate of production, velocity of air in workings.

If the wet bulb temperature exceeds 30.5^0C, the minimum velocity of air at the face must be 1.0m/s. Therefore, the minimum quantity of air requirement at the face during development of working galleries would be 4.8 x 2.5 x 1.0 = 12.0m3/s considering maximum gallery dimensions. Annual coal production is expected to be about 3.495 lakh tonnes, minimum air quantity to be circulated in LVC based on the production is about (349500/300)x2.5/60 = 48.5m3/s.

Keeping in view of high capacity equipment, high productivity operations and also to meet the statutory requirements, about 60m3/s air quantity is planned to be circulated during development and extraction.

4.14.5. Quantity of Air Requirement for Pumping Stations, Sub-Stations, Isolated and Other Areas

About 30-40m3/s of air quantity will be circulated for proper ventilation of Pumping Stations and Substations during various stages of the project.

The details of ventilation requirements of the project are provided in the following table:

Sl. No.	Place of work	Requirement of Air Quantity			
		Stage-I	Stage-II	Stage-III	Stage-IV
1	CM workings of No.1A Seam (2 CM's & 4 Diesel Ram-cars)	$100m^3/s$	$100m^3/s$	$100m^3/s$	-
2	CM workings of No.1 Seam (1 CM & 2 Electric Ram-cars)	$70m^3/s$	$60m^3/s$	$50m^3/s$	$50m^3/s$
3	Trunk Conveyor Roadways	$50m^3/s$	$50m^3/s$	$40m^3/s$	$30m^3/s$
4	Pumping Stations, Sub-stations, etc.	$40m^3/s$	$30m^3/s$	$20m^3/s$	$20m^3/s$
5	Total air quantity requirement	$260m^3/s$	$240m^3/s$	$210m^3/s$	$100m^3/s$
6	**Air quantity requirement considering VEQ of about 85%**	**$310m^3/s$**	**$280m^3/s$**	**$250m^3/s$**	**$120m^3/s$**

The following table indicates the details of period of operations pertaining to various stages:

Operational Stage	Period of operation	Years of operation
Stage-I	2017-18 to 2023-24	7 Years
Stage-II	2024-25 to 2027-28	4 Years
Stage-III	2028-29 to 2030-31	3 Years
Stage-IV	2031-32 to 2033-34	3 Years

4.14.6. VENTILATION SYSTEM

4.14.6.1. Ventilation system for Continuous Miner workings in No.1A Seam

During the development of trunks and galleries, headings will be ventilated by Auxiliary Fans with Lay-flat Flexible Ducting (simple forcing system) having diameter of 1100mm. To provide required quantity of air at the face, each heading is ventilated by Auxiliary Fan having capacity of 20m3/s at 1.3kPa pressure with approximate power of 37kW (maximum length of ducting connected to the Auxiliary Fan would be about 200m).

As there are 8 to 12 headings in the district, it is proposed to ventilate the workings with an air quantity of about 100m3/s. Discomfort in workings will arise in deeper horizons, hence, air cooling arrangements are to be provided to reduce the temperature.

4.14.6.2. Ventilation system for Continuous Miner workings in No.1 Seam

During the development of trunks and galleries, headings will be ventilated by Auxiliary Fans with Lay-flat Flexible Ducting (simple forcing system) having diameter of 1000mm. To provide required quantity of air at the face, each heading is ventilated by Auxiliary Fan having capacity of 15m3/s at 1.2kPa pressure with approximate power of 25kW (maximum length of ducting connected to the Auxiliary Fan would be about 200m).

As there are 4 to 6 headings in the district, it is proposed to ventilate the workings with an air quantity of about 60m3/s. Discomfort in workings will arise in deeper horizons, hence, air cooling arrangements are to be provided to reduce the temperature.

The following table indicates the relationship between the size of duct, air quantity and approximate pressure requirement and power of the Auxiliary Fan:

Air Quantity	Auxiliary Fan pressure & Power (70% efficiency) for ducting length of 200m (Ducting type : Lay-flat Flexible for simple forcing)							
	Duct Ø0.9m		Duct Ø1.0m		Duct Ø1.1m		Duct Ø1.2m	
	Pressure	Fan Power	Pressure	Fan Power	Pressure	Fan Power	Pressure	Fan Power
10.0m^3/s	880Pa	13kW	520Pa	8kW	320Pa	5kW	210Pa	3kW
15.0m^3/s	1980Pa	43kW	1170Pa	25kW	720Pa	16kW	470Pa	10kW
20.0m^3/s	3510Pa	100kW	2070Pa	59kW	1290Pa	37kW	830Pa	24kW

Auxiliary Fans are to be provided with variable speed drive to facilitate operation at varied air quantity flow, i.e., during low system resistance as well as in absence of mining operations.

4.14.7. Ventilation Layout of The Mine

Two incline entries (Tunnels) connecting No.1 Seam and downcast shaft connecting No.1A Seam and No.1 Seam will serve as main intake entries of the mine. Out of two incline entries, one tunnel of 5.6m x 3.0m, 735m long, at 1 in 5 inclination will serve for coal transport with installation of conveyor and the other tunnel of 4.8m x 3.0m, 785m long, at 1 in 5 inclination will be installed with haulage. Depth of downcast shaft is 120m with Ø5.5m. An upcast shaft connecting both the seams will be sunk with Ø6.5m with a depth of 169m.

In both the seams, five trunk roadways are to be provided along the dip/level and five roadways are to be provided in development of panels. Three trunk roadways serve as intake and remaining two trunks serve as return along dip/level, three roadways serve as intake and remaining two serve as return while working of panels.

One of the trunk roadways will be used as Conveyor Roadway with separate split of ventilation. Trunk roadway with Conveyor is to be aligned adjacent to the return trunk to facilitate separate split of ventilation.

Four numbers of tunnels (4.8m x 3.0m size) are to be provided while negotiating fault planes, two tunnels will be used as intake and the remaining two tunnels will serve as return. Two numbers of staple pits are to be provided on either side of fault (F-8) with minimum cross section of 10.0m^2 as return between No.1A Seam and No.1 Seam. Return roadways between the staple pits are to be provided with minimum total cross section of 40.0m^2.

The following minimum size of roadways considered for ventilation planning:

Seam	Trunk Roadways	Galleries
No.1A Seam (Intake)	4.8m x 3.0m	4.8m x 3.0m
No.1A Seam (Return)	4.8m x 4.5m	4.8m x 3.0m
No.1A Seam (Intake)	4.8m x 2.5m	4.8m x 2.5m
No.1A Seam (Return)	4.8m x 2.5m	4.8m x 2.5m

As far as possible ascentional system of ventilation is to be planned for all the panels.

4.14.8. Ventilation Network Modeling and Capacity of Main Mechanical Ventilator

The following formulae have been used for determination of ventilation parameters:

- Formulae used for calculation of resistance of airways:

$$R = \frac{kcl}{A^3} \quad (Ns^2m^{-8})$$

- The pressure required to overcome the resistance to airflow in the roadways is determined by:

$$P = RQ^2 \quad (Nm^{-2})$$

4.14.8.1. Ventilation Network Modeling

Number of variants of ventilation network have been simulated through ventilation network simulation program for different hypothetical permutations and combinations of ventilation circuits in accordance with the proposed production phasing and layouts of the mine for optimization of ventilation system.

Network modeling has been carried out for Stage-I, representing initial operational period of 7 years with 2 Continuous Miners in No.1A Seam and 1 Continuous Miner in No.1 Seam operating in Sector-D Area. Stage-II representing the operational period of 4 years with all the 3 Continuous Miners operating in dip side area of Sector-E.

Stage-III represents the operational period of 3 years with all the 3 Continuous Miners in upper horizons of Sector-E Area. Stage-IV represents the operational period of 3 years with operation of 1 Continuous Miner in upper horizons of Sector-E Area in No.1 Seam.

The duty requirements of the Main Mechanical Ventilators during Stage-I, Stage-II, Stage-III and Stage-IV of mining operations have been devised through optimization of ventilation system through ventilation network modeling.

4.14.8.2. Results of Ventilation Network Modeling and Operating parameters of Main Mechanical Ventilators

The following table shows the operating parameters of Main Mechanical Ventilators during Stage-I, Stage-II, Stage-III and Stage-IV period of mine workings.

Variant No.	Description	Air Quantity (m^3/s)	Fan Pressure (mmwg)	Fan input power (kW) #
1	Stage-I operational period (3 CM's in Sector-D)	310	128	558
2	Stage-II operational period (3 CM's in Sector-E)	280	93	365
3	Stage-III operational period (3 CM's in upper horizons of Sector-E)	250	71	249
4	Stage-IV operational period (1 CM in upper horizons of No.1 Seam of Sector-E)	120	36	60

Efficiency of Fan system considered as 70%

4.14.8.3. Capacity and type of the Main Mechanical Ventilators

1) Main Mechanical Ventilator to be installed at Up cast Shaft shall be of 310-250m3/s capacity at 1300-1000Pa. Capacity of Prime Mover would be about 600kW.
2) The above capacity is to be provided by operating two fans of 160-130m3/s at 1300-1000Pa (each about 300kW) operating in parallel mode. One fan of similar capacity is to be installed as standby.
3) Axial-flow direct-driven type of fan with facility of changing the angle of impeller blades along with variable speed drive is envisaged.
4) It is recommended to install Axial-flow Fan with direct drive having efficiency more than 85%. Energy Efficient type Prime Mover is to be selected and which should be of not less than 94% efficiency at full load.

4.14.9. Fan Drifts

Fan drifts of required cross section and profile are to be constructed for installation of Main Mechanical Ventilators. Profile of the main drift at connecting portion of the shaft shall be of aerodynamic design to minimize the pressure losses.

As it is planned to operate two fans in parallel mode, these two fans may be installed in two separate drifts. A third drift is to be constructed, where standby fan will be installed. All the three drifts are to be constructed by branching off from the main drift.

The main part and branching off drifts should have such cross sectional area so that the velocity of air should not exceed 12m/s (to minimise pressure losses in the Drift).

The proposed dimensions of the Main-drift:

Width	:	6.0m
Height	:	5.0m
Length	:	5m max. (horizontal portion)

The proposed dimensions of all the Branching-off drifts (three drifts):

Width	:	4.5m
Height	:	5.0m
Length	:	10m max.

4.14.10. Virgin Rock Temperature (VRT):

V R T = 28.258 + 2.254 + (H – 20)/50
Where, H = Depth of workings,
Hence, virgin rock temperature at 550 m depth = 41.1 0C

From the above, it can be inferred that high temperatures will prevail in the working places due to the high virgin rock temperature at 550m depth if special measures such as artificial air-cooling is not adopted.

Exact requirements of capacity of air cooling system may be worked out at later stage however, about 1500 TR cooling system may be required for cooling of air in Continuous Miner workings. Power consumption for the cooling system would be about 2.0 MW.

4.14.11. Preventive Measures for Spontaneous Heating

Keeping in view of the chances of occurrences of spontaneous heating, it is suggested to take up the following precautions:

- The size and shape of pillars in trunk headings are to be adequately designed and supported to resist any crushing.
- While forming return roadways near Downcast Shafts, return airways are to be positioned such that, minimum of 3 roadways are to be left around the

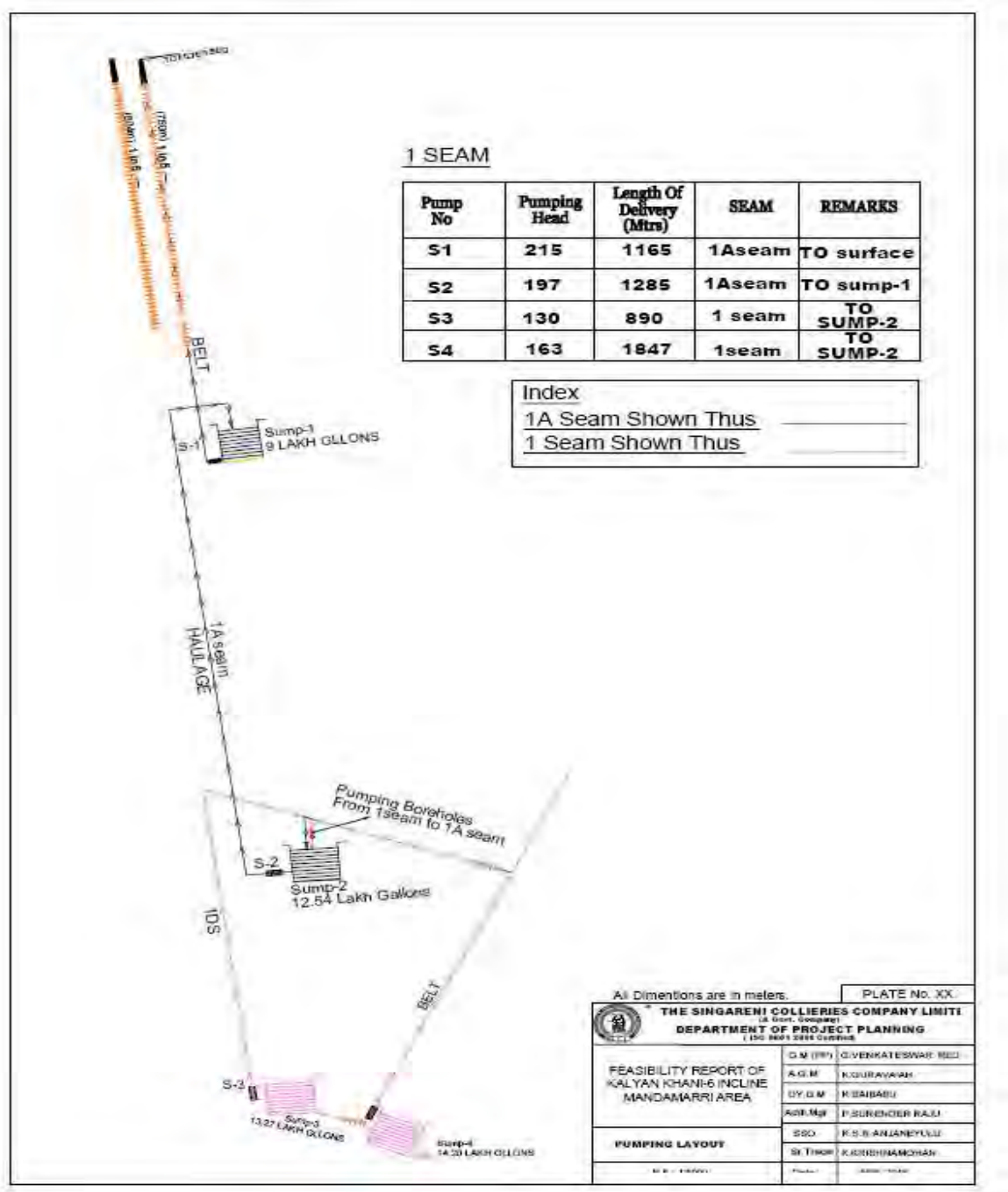
shaft as intake airways lying in any direction of Downcast Shaft in all the seams.

- While forming intake roadways near Upcast Shaft, intake airways are to be positioned such that, minimum of 3 roadways are to be left around the shaft as return airways lying in any direction of the Upcast Shaft in all the seams.
- Roof and Sides of roadways particularly near the dyke / fault planes are to be treated by guniting upto a distance of 5m on either side by using compressed air operated guniting machines, cement injection and stabilization is to be taken up.
- Loose coal if any is to be removed from the workings, unused workings are to be kept sectionalised.
- Continuous monitoring of CO, CH4, O2 and other gases are to be done by tele-monitoring system with provision of sensors at strategic locations in mine workings. The information from the face is to be communicated to the out station, which does digital/analog conversion and multiplexing for onward transmission to the central computer on surface for processing, analysis and storage of data.
- Continuous monitoring system is to be incorporated with warning system (audio-visual) to indicate impending danger of spontaneous heating.
- Stone dust barriers are to be provided at required places to prevent propagation in event of explosions.
- Trunk Conveyors are to be installed in roadway adjacent to return roadway with independent ventilation split to facilitate tapping of heat and dust to the return roadway.
- Operating pressure of Main Mechanical Ventilators are to be kept to the minimum possible by maintaining highest possible volumetric efficiency (VEQ) and lowest mine resistance.
- Subsidence is likely to occur over the extracted panels hence, the surface cracks over the extraction panels shall be effectively blanketed.

4.15. PUMPING

Adequate pumping arrangements will be made to deal with make of water when the mine is in full operation. The seepage of water from faces and other places will be collected at the dip of the panel and from there it will be pumped to Main sump. From the main sump the water will be pumped out to the surface. Filter bed will be constructed on surface which provides drinking water for the mine and nearby colonies. Water for underground spraying will be taken through pipelines laid from the filter bed, as it is a permanent source of water with sufficient head and excess water will be let out into open drain to join with the main drainage system of the area.

Pumping Layout of No.1A seam and No.1 seam.



Sump-1 and Sump-2 will be established at No.1A seam of Sector-E during the trunk galleries development of No.1 and No.1A seam.Sump-1 will be the main sump as it pumps out water to surface.

In No.1A seam of Sector-D, development of trunk galleries and depillaring of the panels (i.e.P1, P1A and P2) would commence before opening up of No.1 seam at Sector-D.

To deal with make of water generated during course of development of trunk galleries and depillaring of P1, P1A and P2 panels of No.1A seam of Sector-D, sump-3 will be established at dip side of mine boundary in No.1 seam of Sector-E to facilitate drainage of water from goaf of No.1A seam of sector-D. No.1 seam water will come to sump-3 after commencement of depillaring activities in 1 seam of Sector-D.

Thus sump-4 will not be much useful after commissioning of Sump-3. However, auxiliary pumps will be serving at panels to feed the water to the nearest sump.

Detailed Pumping layout is presented in plate No-XX.

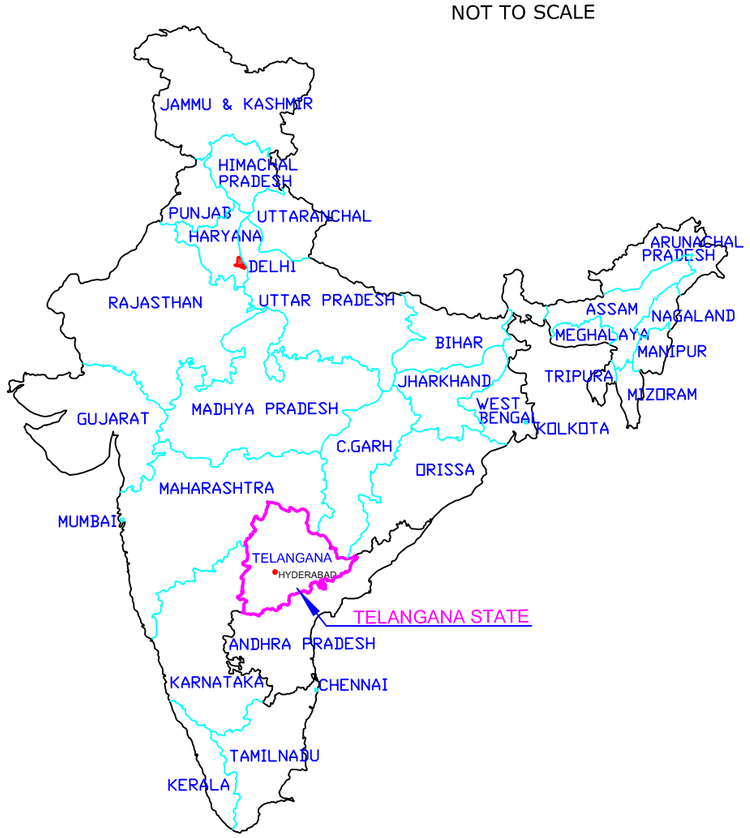
TABLE: DETAILS OF PUMPS

S.No	Description	Capacity and Head
1)	Main Pumps (7 Nos.at sump-1&2)	750 GPM,300m Head ,350 HP
2)	Pumps (5 Nos.at sump-3&4)	750 GPM,200m Head ,240 HP
3)	Auxiliary Pumps (4 Nos.)	500 GPM,95m Head ,75 HP
4)	Auxiliary pumps (6Nos)	250 GPM,75m Head ,40 HP
5)	Bucket Pumps/Face pumps(6 Nos)	7.5 Hp

*****

INDIA

NOT TO SCALE



TELANGANA STATE

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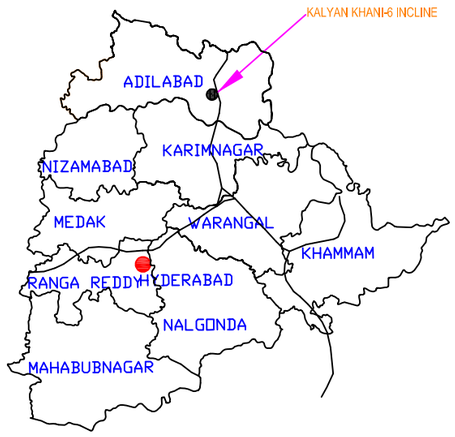
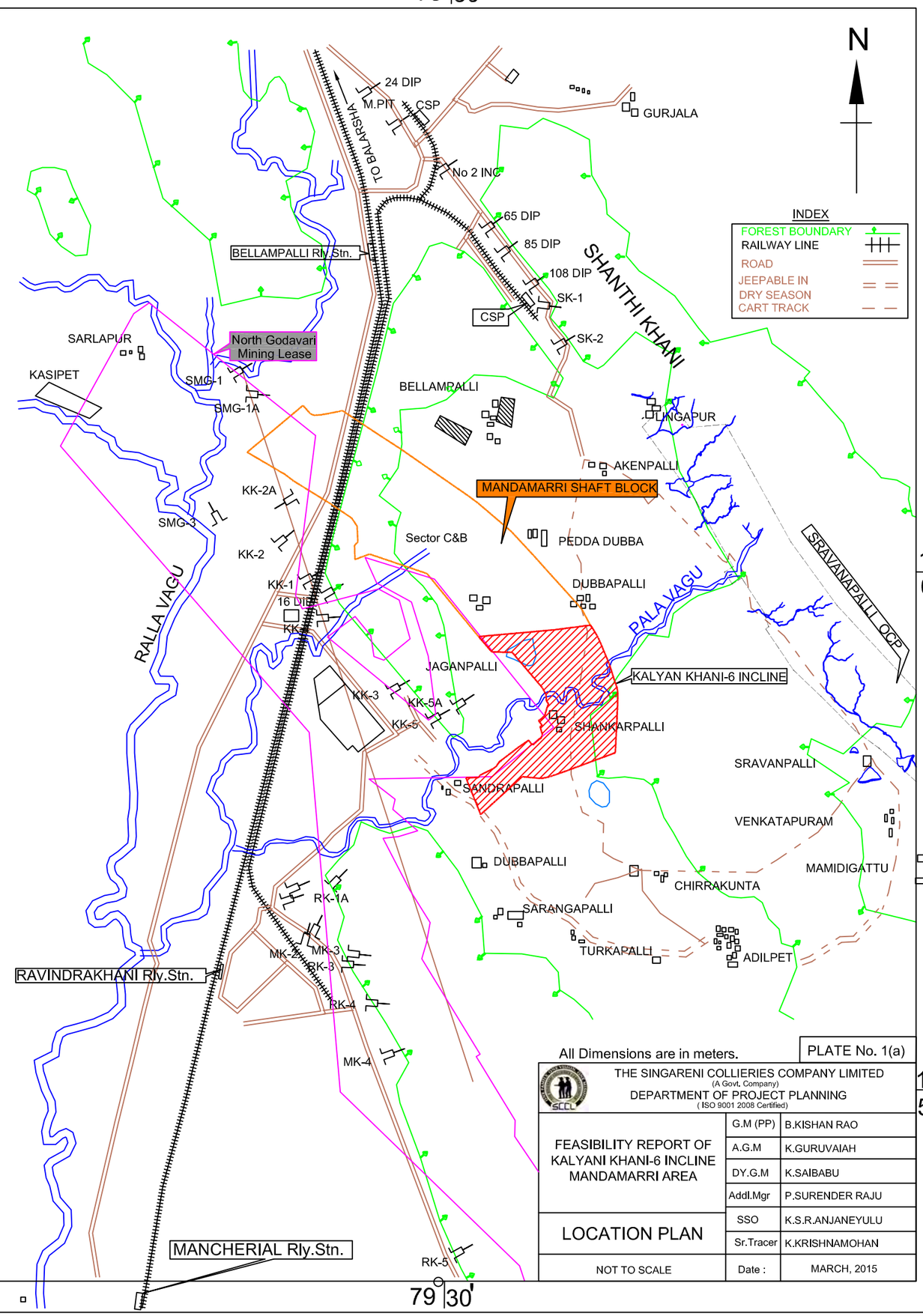




All Dimensions are in meters.

PLATE No. 1(a)

THE SINGARENI COLLIERIES COMPANY LIMITED
(A Govt. Company)
DEPARTMENT OF PROJECT PLANNING
(ISO 9001 2008 Certified)

FEASIBILITY REPORT OF KALYANI KHANI-6 INCLINE MANDAMARRI AREA

LOCATION PLAN

NOT TO SCALE

G.M (PP)	B.KISHAN RAO
A.G.M	K.GURUVAIAH
DY.G.M	K.SAIBABU
Addl.Mgr	P.SURENDER RAJU
SSO	K.S.R.ANJANEYULU
Sr.Tracer	K.KRISHNAMOHAN
Date :	MARCH, 2015

967500 968500 969500 970500 971500 972500 973500 974500

3050000 3051000 3052000 3053000 3054000 3055000

N 68° 00' 00" E
FULL DIP 1 IN 5.8

KALI NAGAR
TRINITY SCHOOL
ROAD
KK5 BUNGLOWS AREA
PRANAHITHA COLONY
LEATHER PARK
Govt.Jr COLLEGE
MVTC
GIRLS Z.P HS
CARMEL SCHOOL
ROAD TO BELLAMPALLI
OVER BRIDGE
WORK SHOP
STORES
KK1 C.S.P.
POWER LINE
KK 3A INCLINE
KK 3 INCLINE
KK 5 INC MINE BOUNDARY
KK 5 INCLINE
KK 5A INCLINE
PALA VAGU
SANDRAPALLI
ROAD TO SARANGAPALLY
Proposed Inclines
(750m) i in 5
(804m) i in 5
PROPOSED AIR SHAFT-1
PROPOSED AIR SHAFT-2
KUCTHA ROAD TO SANKARPALLI
SANKARAPALLI
Kalyan khani-6 (Sector "D"&"E")
KK-I MINE BOUNDARY
GEOLOGICAL BLOCK BOUNDARY
SECTOR-A
SECTOR-B
SECTOR-C
SECTOR-D
SECTOR-E
F1 F2 F4 F5 F6 F7 F8 F9
1000m+
150m
20m
7m
30m
120m
70m
90m
60m
20M
100
FOREST LAND
MINE BOUNDARY
N.T.P.C POWER LINE

INDEX
- BOREHOLE
- VILLAGE
- ROAD
- FAULT
- BLOCK BOUNDARY
- FOREST BOUNDARY
- POWER LINE
- VAGU

All Dimensions are in meters.

PLATE No. I (b)

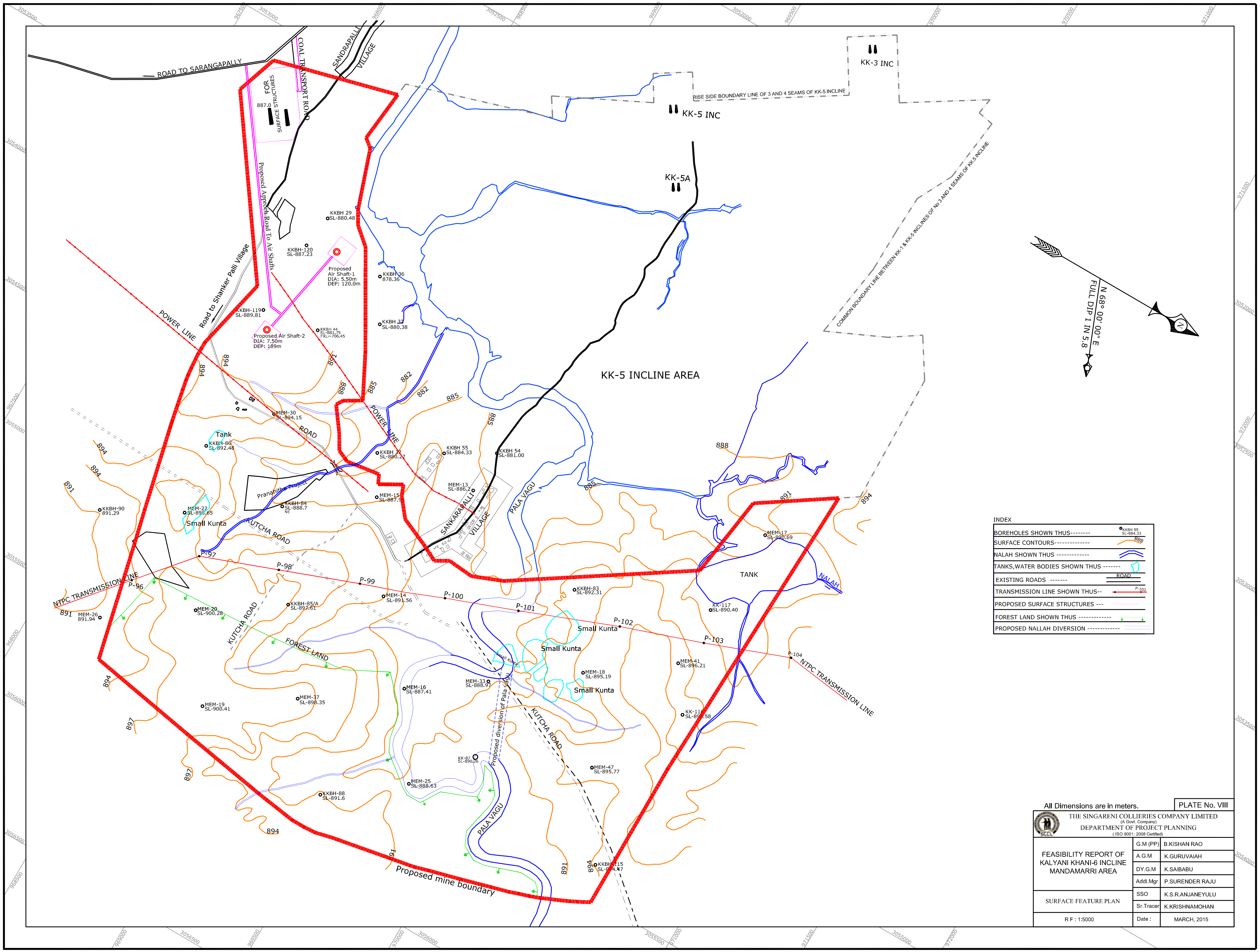
THE SINGARENI COLLIERIES COMPANY LIMITED
(A Govt. Company)
DEPARTMENT OF PROJECT PLANNING
(ISO 9001: 2008 Certified)

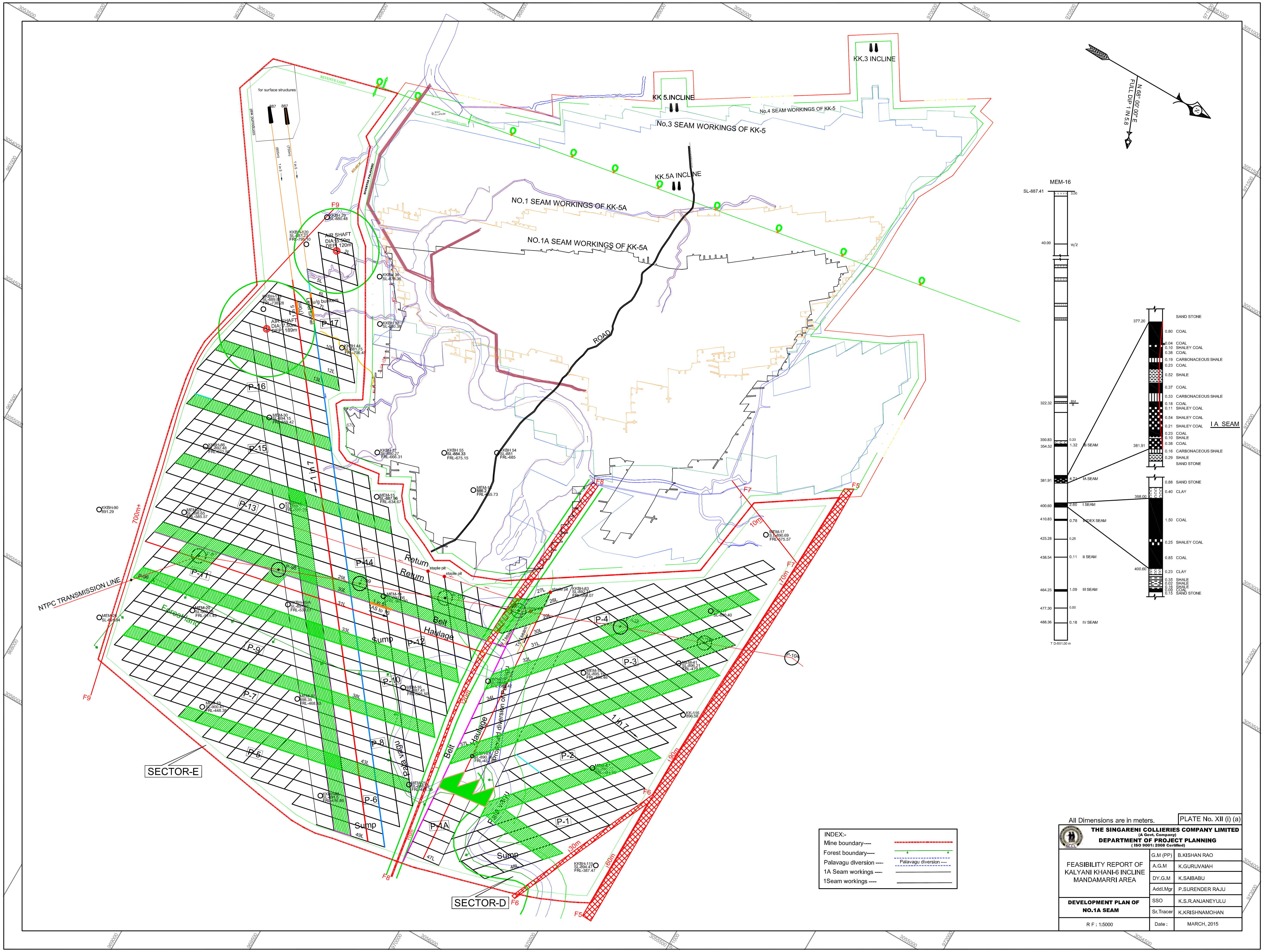
FEASIBILITY REPORT OF KALYANI KHANI-6 INCLINE MANDAMARRI AREA

KEY PLAN

MOT TO SCALE

G.M (PP)	B.KISHAN RAO
A.G.M	K.GURUVAIAH
DY.G.M	K.SAIBABU
Addl.Mgr	P.SURENDER RAJU
SSO	K.S.R.ANJANEYULU
Sr.Tracer	K.KRISHNAMOHAN
Date :	Feb, 2015


ROAD TO SARANGAPALLY
COAL TRANSPORT ROAD
SANDRAPALLI VILLAGE
FOR SURFACE STRUCTURES
887.0
Proposed Approch Road To Air Shafts
KK-3 INC
KK-5 INC
RISE SIDE BOUNDARY LINE OF 3 AND 4 SEAMS OF KK-5 INCLINE
KK-5A
COMMON BOUNDARY LINE BETWEEN KK-1 & KK-5 INCLINES OF No.3 AND 4 SEAMS OF KK-5 INCLINE
N 68° 00' 00" E
FULL DIP 1 IN 5.8
KK-5 INCLINE AREA
KKBH 29 SL-880.48
KKBH-120 SL-887.23
Proposed Air Shaft-1 DIA: 5.50m DEP: 120.0m
KKBH 36 878.36
KKBH-119 SL-889.81
Proposed Air Shaft-2 DIA: 7.50m DEP: 189m
KKBH 37 SL-880.38
Road to Shanker Palli Village
POWER LINE
MEM-30 SL-894.15
ROAD
Tank
KKBH-86 SL-892.48
KKBH 55 SL-884.33
KKBH 54 SL-881.00
MEM-13 SL-886.2
MEM-15 SL-887.9
Pranahitha Project
KKBH-84 SL-888.7
MEM-22 SL-895.65
Small Kunta
KKBH-90 891.29
KUTCHA ROAD
SANKARAPALLI VILLAGE
PALA VAGU
888
MEM-17 SL-890.69
TANK
NALAH
KKBH-83 SL-892.31
KK-117 SL-890.40
NTPC TRANSMISSION LINE
P-96
P-97
P-98
P-99
P-100
P-101
P-102
P-103
P-104
MEM-14 SL-891.56
KKBH-85/A SL-897.61
MEM-20 SL-900.28
MEM-26 891.94
FOREST LAND
Small Kunta
MEM-41 SL-896.21
MEM-18 SL-895.19
MEM-33 SL-888.97
MEM-16 SL-887.41
MEM-37 SL-898.35
MEM-19 SL-900.41
Proposed diversion of Pala Vagu
KK-87
MEM-47 SL-895.77
MEM-25 SL-888.63
KKBH-88 SL-891.6
Proposed mine boundary
KKBH 115
INDEX
BOREHOLES SHOWN THUS-------- KKBH 55 SL-884.33
SURFACE CONTOURS-------------- 888
NALAH SHOWN THUS -------------
TANKS,WATER BODIES SHOWN THUS -------
EXISTING ROADS ------- ROAD
TRANSMISSION LINE SHOWN THUS-- P-103
PROPOSED SURFACE STRUCTURES ---
FOREST LAND SHOWN THUS -------------
PROPOSED NALLAH DIVERSION -------------
All Dimensions are in meters.
PLATE No. VIII
THE SINGARENI COLLIERIES COMPANY LIMITED
(A Govt. Company)
DEPARTMENT OF PROJECT PLANNING
(ISO 9001: 2008 Certified)
FEASIBILITY REPORT OF KALYANI KHANI-6 INCLINE MANDAMARRI AREA
SURFACE FEATURE PLAN
G.M (PP) B.KISHAN RAO
A.G.M K.GURUVAIAH
DY.G.M K.SAIBABU
Addl.Mgr P.SURENDER RAJU
SSO K.S.R.ANJANEYULU
Sr.Tracer K.KRISHNAMOHAN
R F : 1:5000
Date : MARCH, 2015



INDEX:-

Mine boundary----

Forest boundary----

Palavagu diversion ----

1A Seam workings ----

1Seam workings ----

All Dimensions are in meters.

PLATE No. XII (i) (a)

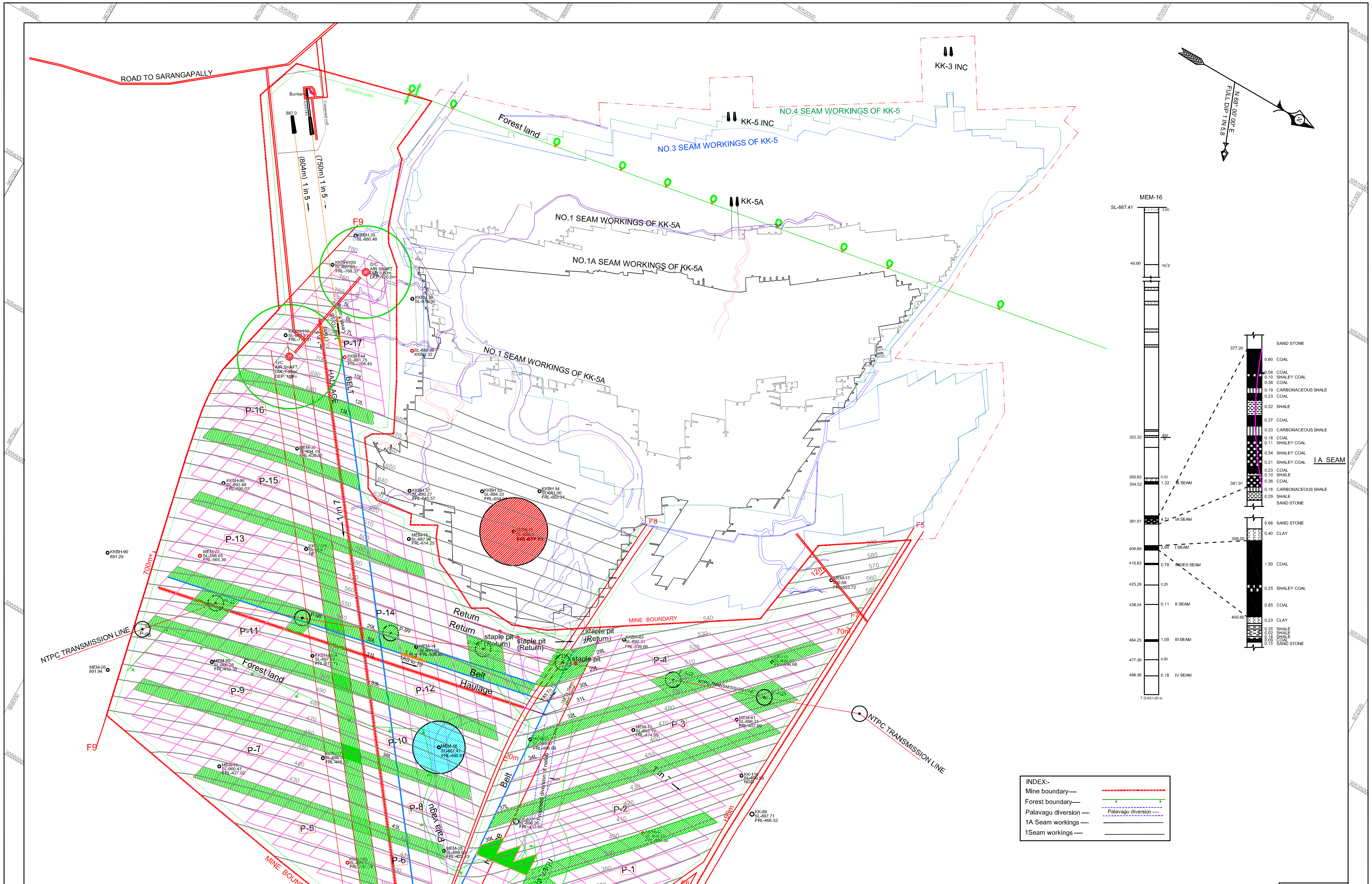
THE SINGARENI COLLIERIES COMPANY LIMITED
(A Govt. Company)
DEPARTMENT OF PROJECT PLANNING
(ISO 9001: 2008 Certified)

FEASIBILITY REPORT OF KALYANI KHANI-6 INCLINE MANDAMARRI AREA

DEVELOPMENT PLAN OF NO.1A SEAM

R F : 1:5000

G.M (PP)	B.KISHAN RAO
A.G.M	K.GURUVAIAH
DY.G.M	K.SAIBABU
Addl.Mgr	P.SURENDER RAJU
SSO	K.S.R.ANJANEYULU
Sr.Tracer	K.KRISHNAMOHAN
Date :	MARCH, 2015



All Dimensions are in meters.

PLATE No. XII (i) (b)

THE SINGARENI COLLIERIES COMPANY LIMITED
(A Govt. Company)
DEPARTMENT OF PROJECT PLANNING
(ISO 9001: 2008 Certified)

FEASIBILITY REPORT OF KALYANI KHANI-6 INCLINE MANDAMARRI AREA	G.M (PP)	B.KISHAN RAO
	A.G.M	K.GURUVAIAH
	DY.G.M	K.SAIBABU
	Addl.Mgr	P.SURENDER RAJU
DEVELOPMENT PLAN OF NO.1 SEAM	SSO	K.S.R.ANJANEYULU
	Sr.Tracer	K.KRISHNAMOHAN
R F : 1:5000	Date :	MARCH, 2015