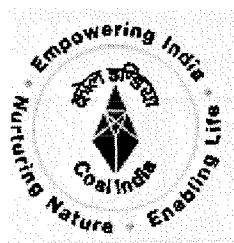


**PROJECT  
PROPOSAL**

**NORTH EASTERN COALFIELDS (NEC)**

**MINING PROPOSAL FOR  
INTRODUCTION OF NEW MINING TECHNOLOGY  
AT TIPONG MINE OF NEC, MARGHERITA,  
ASSAM, INDIA**



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## **MINING PROPOSAL FOR INTRODUCTION OF NEW MINING TECHNOLOGY AT TIPONG MINE OF NORTH EASTERN COALFIELDS, MARGHERITA, ASSAM, INDIA**

1. **PROJECT TITLE:** Introduction of New Mining technology at Tipong UG Mine of NEC, Margherita, Assam, India
2. **PROJECT OBJECTIVES:** To develop and demonstrate a suitable method of extraction of thick, steep and gassy seams (at a depth more than 300m) to achieve improved production performance and yield high percentage of extraction
3. **LOCATION OF THE MINE:** Tipong UG Mine of NEC lies in the Tipong Block in the eastern part of Makum Coalfield in Assam. The mine is bounded by latitudes 27°16'54" - 27°18'14"N and longitude 95°49'40"-95°53'00"E. It is situated at a distance of 87km from the district headquarters town Tinsukia, Assam & 27km east of Margherita, Assam, India (Refer Plate-1).

#### **4. BRIEF ABOUT NORTH EASTERN COALFIELDS (NEC):**

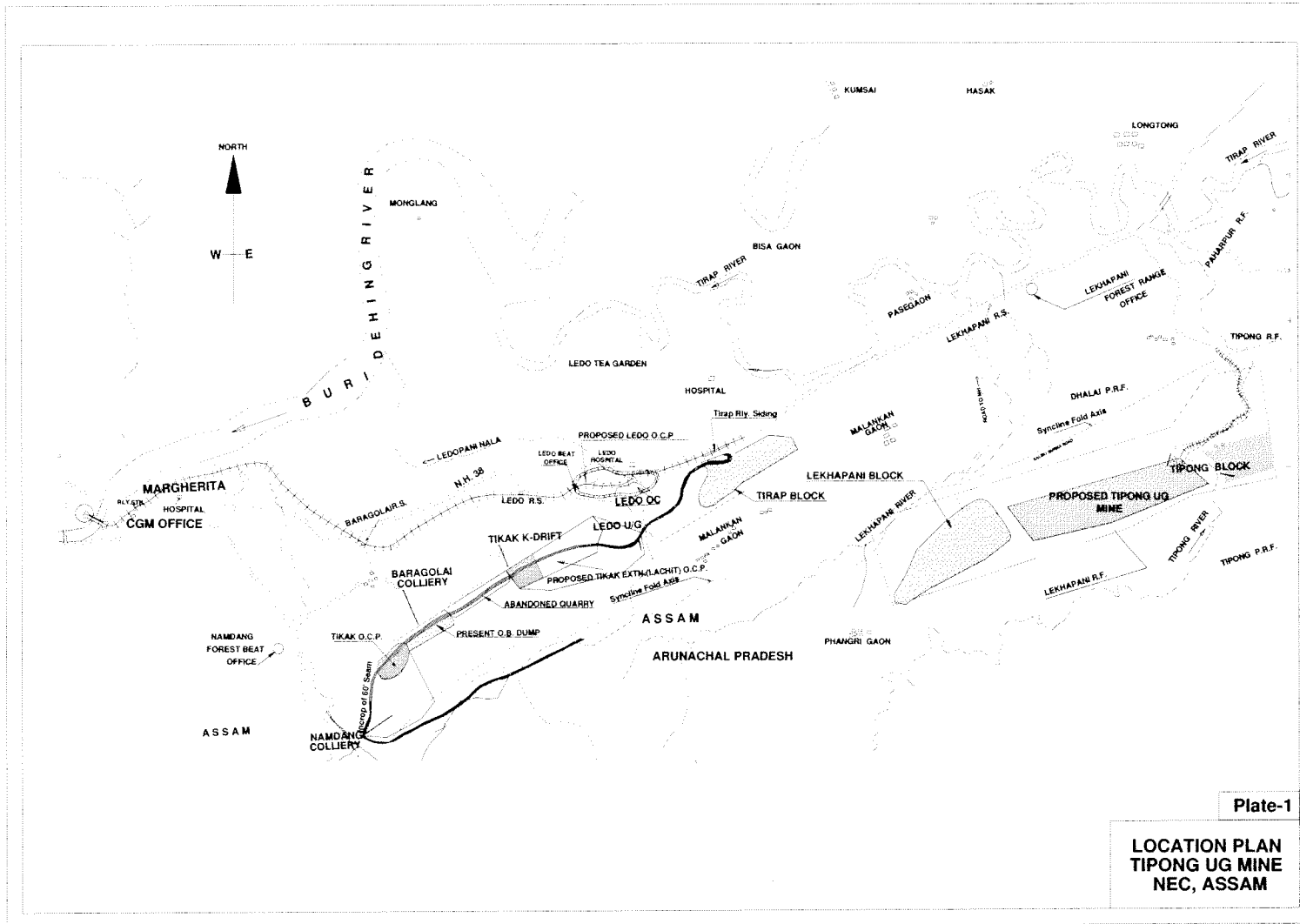
North Eastern Coalfields (NEC) is a unit of Coal India Limited (CIL), a Govt. of India undertaking company, engaged in carrying out coal mining operations in the North Eastern (NE) Region of India. Coal reserves in this region are spread in 17 coalfields out of which 9 are major coalfields of the region. These coalfields are located in hilly areas dissected by numerous rivers and streams forming deep valleys and gorges. Coal occurring in the NE region is tertiary coal and is characterized by low ash, high sulphur and caking properties.

NEC operates through its area at Margherita looking after the coal mining activities in the state of Assam. Active mining in the Makum Coalfield has been going on since 1882. At present the coal seams of the coalfield are worked by one underground coal mine (viz. Tipong UG Mine) and three opencast mines (viz. Tirap OC, Ledo OC and Tikak OC) (refer Plate-1).

There are five prominent seams in Makum Coalfield viz. 8ft, 5ft, 20ft, 7ft & 60ft seams in descending order - out of which, two mineable coal seams are 20ft-seam and 60ft-seam.

General topography of the coalfield consists of hills with altitude 300-500m above MSL (Mean Sea Level). The general strike of the seam is along NE-SW. Coal seams are in the form of asymmetrical syncline known as 'Namdang Syncline' located between 'Margherita Thrust' in north and 'Haflong Disang Thrust' in south. The southern limb of 'Namdang Syncline' is steeply inclined (45°-90°), whereas the northern limb is moderately inclined (25°-40°). The anticline is known as 'Ledo Anticline'.

The methods of coal extraction in underground collieries of Margherita are Tipong method (a modified Bhaska method) in Baragolai colliery and Tipong colliery (gradient 40° to 75°) and Scraper Assisted Chamber method (a modified Tipong method) in Ledo colliery (gradient 25° to 40°). To improve upon the percentage of coal extraction and also coal production, various other methods such as Descending Shield method and Flexible roofing method have also been tried with limited success and later discontinued.



The mines were initially worked by 'Bhaska method'. Due to lack of safety in this method where miners had to work under unsupported roof, the method was modified and named as 'Tipong method'. 'Tipong method' provides more safety and yields higher percentage of extraction as compared to 'Bhaska method'. At Ledo underground colliery due to low gradient of seam, the 'Tipong method' has been modified by using a scraper to assist coal flow.

Both the existing methods presently have low production of the order of 150 tonnes per day (TPD) per district in 'Tipong method' and 175 TPD per district in 'Scraper assisted chamber method' with low percentage of extraction of about 20 – 30%.

Performance details of various methods (existing & past) of mining tried in NEC are given below:

Particulars	Existing Method		Method Tried and Discontinued		
	Tipong	Scraper Assisted Chamber	Flexible Roofing	Descending Shield	
				Sectional Shield	CK Shield
Seam Thickness (m)	3 to 11	6 to 9	6 to 9	5 to 6	4 to 4.5
Seam Gradient	Above 38 <sup>o</sup>	25 <sup>o</sup> to 35 <sup>o</sup>	40 <sup>o</sup> to 50 <sup>o</sup>	Above 60 <sup>o</sup>	45 <sup>o</sup> to 55 <sup>o</sup>
Avg. Production per district (TPD)	150	175	220	210	135
% of extraction within panel	35	50	66	77	78
Overall %of extraction	20 to 30	-	-	-	-

## 5. TIPONG UG MINE DETAILS

### 5.1. HISTORY AND BRIEF DESCRIPTION OF TIPONG UG MINE

- **Mining History:** Tipong Colliery (i.e. Tipong UG Mine) was started in 1924 by the-then ATR Company. The mine came under the administrative and operational control of NEC/ CIL after nationalization of coal mines in the year 1972-73.
- **Topography:** Topography of the area is hilly undulating with forest cover. Hilly rugged terrain having steep slopes with elevations ranging from 360m -500m above MSL.
- **Climate:** The maximum and minimum temperatures recorded by Tipong Mine are 35<sup>o</sup>C and 6<sup>o</sup>C respectively. The average annual rainfall varies from 3000 to 4250mm. Humid but short summer, prolonged rainy season and fairly cold winter are basic climatic characterization.
- **Vegetation:** Evergreen tropical forest
- **Mine Entries:**
  - Pragati Khani Adit : Cross measure
  - Main Dip Incline (Dip mine) : 60ft-seam bottom section
  - Companion Dip Incline : 60ft-seam top section
  - Coal Dip Incline : 20ft-seam
  - Agragati Khani Adit : Cross measure
- **Leasehold Area:** 3.8 sq. km extended over a strike length of 5.7km;
- **Method of exploitation:** Tipong Method, a modified manual sub-level caving method
- **Mine workings:** North limb of the syncline does not exist in the mine property; hence, only south limb is being exploited in the mine. Coal seams, locally known as 10ft,

8ft, 5ft, 20ft and 60ft seams, occur from hangwall (H/W) to footwall (F/W) respectively. Out of these, only 20ft and 60ft seams are persistent. The 60ft-seam is further bifurcated in two sections, viz. Top section (7.5-11.0m thick) and Bottom section (4.5-6.0m thick). The intervening parting consists of mud stone of 3-11m thickness. 20ft-seam lies on H/W of 60ft-seam with parting of 55-100m thickness. Both coal seams as well as immediate strata are generally weak in nature with folds, synclines and thrusts common in this area. Coal is highly friable with the presence of shale bands and plastic clay.

The mine property is divided into two parts i.e. East section (Coal dip) and West section (Dip mine) by the Tipong River. In both the section mine property above 0-level (i.e. drainage level) has been exhausted and at present workings are below 0-level.

Property on the eastern and western side of Tipong River had been extracted above drainage level in Agragati Khani and Pragati Khani respectively. On the eastern side of the river, Agragati Khani (Coal Dip) workings are confined between -1L (RL 167.05m) and -5L (RL 100.57m) in middle section of 60ft seam. Workings in 20ft seam were discontinued as the seam thinned out and became inconsistent beyond 7th Cross-measure of -5L. On the western side of the river Udit Khani (Dip Mine) workings are confined between 0L ('Zero' level) (R.L 189.63m) and -7L (RL 78.70m) in top and bottom sections of 60ft seam. Top coal workings are being kept ahead of Bottom coal workings by a distance 110m.

Since the 60 ft seam was divided into two parts, both the sections known as top and bottom section are being worked independently. As 20ft-seam is in the H/W side, it is being depillared first followed by Top section and Bottom section of 60ft-seam respectively. Due to the steepness of the seams ( $55^{\circ}$  to  $75^{\circ}$ ), these are at present being worked manually by modified Sub-level Caving method (commonly known as 'Tipong method').

- **Special method tried:** Earlier the coal seams were worked by 'Bhaska Method' (a type of manual sub-level caving method). 'Descending shield Method', 'C.K. Shield Method' and 'Flexible Roofing Method' were tried in Tipong Mine in technical collaboration with erstwhile USSR during 1984 to 1990 with varied degree of success, and were discontinued. Presently, 'Tipong Method', a modified 'Bhaska Method', is being followed in the mine. Chronology of different methods being worked in Tipong UG Mine are given in the table below:

SN	Methods	Mine	Seams	Start date	Finish date
1	Tipong Method	Pragati khani	60ft & 20ft seams	1977	1986
2	Descending Shield Method	Pragati khani	Bottom section of 60ft seam and 20ft seam	1986	1990
3	Flexible Roofing Method	Pragati khani	Top section, 60ft seam	1985	1989
4	Tipong Method of Mining	Agragati khani & Udit khani	60ft and 20ft seams	1989	Till date

## 5.2. GENERAL FEATURE OF TIPONG COAL BLOCK:

- **Block Geology:**
  - **Stratigraphy:** The general geological succession of the rock type in the block is given below:

Age	Group	Lithology
Recent	-	Alluvium comprising clay and sand with pebbles
Miocene	Tipan	Fine to coarse grained greenish to brownish feldspathic and micaceous sand stones, ferruginous grit, ferruginous pebble beds, mottled sand stone, clays and sub-ordinate greenish shales.
Oligocene	Barail	<p><u>Tikak Parbat formation:</u> Hard, massive and compact grey to black silty mud stone, grey to black shales and carbonaceous shales, at places pyritiferous grey shales with white coarse calcite vein-lets, grey silt stone, grayish-white medium to coarse grained quartzose sand, grey to greyish white sticky clay and dolomite, dolomite. Lime stone bends and coal.</p> <p><u>Baragolai formation:</u> Well bedded micaceous sandstone alternating with mottled sand clays, grey shales and mud stone. Multi-directional splitting and coalescence of the 60ft and 20ft seams are very common.</p>

- **Structure:** The coal bearing strata of Tikak Parbat formation in the Tipong UG Mine area constitute of southern limb of the main Namdang syncline and are deposited in conformity with the structural frame work of the main syncline. The dominant trend of the strata is NE-SW with steep north-westerly dips of 55° to 75° in Tipong East and 40° to 55° in Tipong West. Except for a minor fault of about 15m throw; the area is free from any fault.
- **Major Geological constraints:**
  - The coal is comparatively of recent origin belonging to the Eocene and Oligocene ages. The coal as well as the strata is generally weak in nature and Folds, Synclines, and Thrusts are common.
  - The coal seams in the main belt have drained into syncline (fold) plunging NE with the fold running more or less SW. The folded limbs dip from 15° to almost vertical.
  - Tipong River passing through the middle of the property in north-south direction.
- **Coal seams:**
  - Two mineable coal seams (viz. 20ft and 60ft seams) with reserves of 4.96 million tonnes (Mt) (out of which 20ft seam having 1.27Mt & 60ft seam 3.69Mt)
  - Steeply dipping at inclination varying from 46° in the western part to 49° in the eastern part.
  - The seams are not regular in thickness.

Seam	20ft seam	60ft seam
True Thickness	4.92m	16.14m
Gradient	46° in western part to 49° in eastern part	
In-crop depth	15m to 50m	
Explored depth	446.92m	519.33m
Reserve	1.27 Mt	3.69 Mt
NOTE: 60ft-seam is further bifurcated in two sections, viz. Top section (7.5-11.0m thick) and Bottom section (4.5-6.0m thick).		

- **Nature of Coal:**
  - Soft, powdery and friable with presence of shale bands and plastic clay
  - Prone to spontaneous heating (incubation period 3-4 months only)
  - Low ash of about 4% but due to mixing with bands, ash content goes up.

- Superior quality, low ash (5.8%-18.2%), volatile matter (44%-49%), high sulphur (2.3%-3.9%), high calorific value (6480-7620 kcal/kg) and strongly caking (caking index 17-22).

- **Nature of Immediate Roof & Floor:**

Seam-wise nature of immediate roof and floor are as follows:

Name of seam	Roof & floor
20ft-seam	Carbonaceous shale, gray shale, mudstone, and sandy shale
60ft-seam	Grey shale, mudstone, and sandy shale
<i>NOTE: The roof and floor contain mud stone or argillaceous shale, which is fairly weak of compressive strength of 70 kg/cm<sup>2</sup> and prone to moisture softening and swelling.</i>	

- **Highly acidic mine water due to presence of sulphur**
- **Degree of Gassiness:** All seams of Tipong UG Mine are of Degree III gassiness (i.e. CH<sub>4</sub> emission rate – more than 10m<sup>3</sup> per tonne of coal produced).
- **Crossing Point and Ignition Point:**

Parameter	20ft-seam	Top Section (60ft-seam)	Bottom Section (60ft-seam)
Crossing Point temperature	140 °C	165 °C	140 °C
Ignition Point temperature	165 °C	175 °C	175 °C
<i>NOTE: Seams are highly prone to spontaneous heating.</i>			

- **Geo-engineering parameters:**

- **Compressive strength:**
  - a) 60ft-seam coal : 113 kg/sq. cm
  - b) 20ft-seam coal : 84 kg/sq. cm
  - c) Stone of footwall : 175 kg/sq.cm
- **Rock Mass Rating (RMR):**  
The results of RMR study carried out at Tipong UG Mine in 60ft & 20ft seam are as follows:

Seam	60ft seam	20ft seam	Stone of Footwall
RMR	35.8	24.75	43.9
Category of Roof	Poor	Poor	Fair
Rock load (Immediate roof)	1.9 t/Sq.m	3.56 t/Sq.m	3.4 t/Sq.m

- **Qualitative analysis of coal**

- **Proximate Analysis of 60ft-seam coal**
  - Moisture % = 3.2 – 4.1 (in-band) & 1.6 – 4.0 (ex-band)
  - Ash % = 5.8 – 18.2 (in-band) & 3.5 – 13.2 (ex-band)
  - Volatile Matter % = 36.7 – 46.0
  - Total Sulphur = 2.3 – 3.9
- Caking Index = 17 – 22
- Calorific value = 6480 – 7620 kcal/kg
- Coke type = F to G1
- HGI = 46 – 73
- Swelling Index = 3½ & 5

### 5.3. PANELS PROPOSED FOR INTRODUCTION OF NEW MINING TECHNOLOGY

- Proposed Panels:** An opencast mine has been planned to be operative on the incrop zone of Tipong UG Mine extending upto a maximum depth of around 300m from surface both in eastern and western sections (NOTE: The project has been principally agreed by the Empowered Sub-Committee of CIL for its administrative approval). In the western section, opencast mining has been planned upto +160m reduced level (RL). The proposed new mining technology can be implemented at depth below the opencastable limit in the western section. For introduction of new UG mining technology at Tipong UG Mine of NEC, panels at a depth beyond +100m RL are being proposed, which will be below the proposed opencast project.
- Exploration status of the panel:** No borehole exists in the proposed panel area. Additional boreholes will be needed to prove the extent/ nature of the seams at depth beyond 350m from surface. However, Borehole No. 7841/53/004 (which lies in the eastern part and down dip of the proposed block intersecting both 60ft and 20ft seams) has been considered for this proposal.

Borehole No.	Seam	True Thickness	Remarks
7841/53/004	20ft-seam	4.92 m	Composite seam
	Parting	77.26m	-
	60ft-seam	16.14m	Seam splitted into 3 sections with inter-section parting of 0.58m of grey shale, 1.00m & 0.87m shale with a total drilled seam thickness of 18.12m.

- Nature of seams in the panel:** The coal seams are not regular in thickness and shows pinching and swelling characteristics at places. The coal is friable in nature. The immediate roof and floor of 60ft seam consists of grey shale, mudstone, sandy shale etc and that of 20ft seam are carbonaceous shale, grey shale, mudstone, sandy shale etc. The intervening stratum between 60ft and 20ft-seams consists of shale, mudstone, fine to medium grained sandstone, laminated sandstone and shale etc., and the thickness of parting between seams also varies to some extent along dip and strike.

Due to inadequate consolidation and poor diagenesis which is typical of Tertiary sediments, rocks of the area are in general poor in nature. Due to poor core recovery and induced fragmentation of cores no physico-mechanical properties from samples of boreholes drilled at Tipong Mine could be determined.

Coal seams are of Degree III gassiness. The mine water is acidic. Strata pressure is very high. The roadways require skin to skin supports due to soft roof and floor conditions.

- Statutory permissions:** For introduction of new mining technology in Tipong UG Mine of NEC, necessary statutory permissions need to be taken by the project proponent from DGMS (Directorate General of Mines Safety), MoEF (Ministry of Environment & Forest), State/Central Pollution Control Board, etc.
- Mine infra-structure:** Existing mine infrastructures namely, land, incline mouth complex inclusive of office/ service buildings, surface & UG mining machinery, electrical installations at the surface, approach road, culverts and colonies, etc. existing in Tipong U/G mine will be made available for the implementation of new mining technology in Tipong UG Mine, NEC. However, with due consideration to proposed opencast mining in the incrop zone of Tipong Mine, suitable infrastructure may need to be developed for the same.



#### 5.4. CONSTRAINTS/ DIFFICULTIES BEING FACED:

- Seams are steeply dipping and highly gassy
- Soft and friable nature of coal in the seams
- Weak and incompetent roof and floor rocks
- Seams prone to spontaneous heating
- Requires special method
- Low production and productivity

#### 6. AREAS OF INTEREST

- To achieve improved production performance and extraction percentage from steep seams by utilizing improved mining technology.
- Explore alternative mining methods amenable to the unique characteristics of the coal bearing strata of the North Eastern Region.

#### 7. ACTION POINTS

- Case studies and field visits to gather first hand knowledge about the method proposed;
- Preparation of feasibility report for Tipong Mine for introduction of new method of mining;
- Implementation of the report and technology transfer; and
- Training and workshop for adaptation of the technology.

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