Mining plan for Kuju OCP (1.3 / 1.5 Mty)

CHAPTER-I

INTRODUCTION

1.1 Background of the Project:

The Kuju Block is situated in the South Central part of the West Bokaro Coalfield. The four pre-nationalisation leases, called Mourpa, Kuju, Hesagora and Banwar have been re- organized in 1973, after nationalization of coal mining industry, in a single unit named Kuju colliery, which now forms the part of Kuju area of CCL.

Kuju Block is dotted by a number of pits, trenches, wells and other irregular excavations started indiscriminately without an idea of planning in pre-nationalisation period in the name of opencast mining. These excavations were supplemented by numerous inclines having limited working extent often restricted by small faults as well as due to non availability of any type of underground transport in the mine. The Kuju Block is bounded by latitude 23 ^{0} 44' 24" and 23 ^{0} 45 '17 "and longitude 85 ^{0} 29 '36" and 85 ^{0} 31' 32 ".It is covered by part of toposheet nos 73E/10 of Survey of India.

The Kuju, Mourpa and Banwar mining sections were separately operated by numerous leases, sub leases and mining contracts till nationalization of the coal company. Presently mining activities are concentrated only in Kuju and Banwar section. In Kuju section production comes from Seam X and in Banwar section production comes from multiseam quarry of seam-V, VA, VI and VII. Seasonal mining activities are restored to in the Mourpa section. Now UG mining activities are being carried out between Bander Chua nala and Mourpa nala in the seam VA, VI, VII, VIII and IX. Mining in this part is restricted by limited strike (around 350 m) and various faults. Extensive opencast as well as Underground mining activities has also taken place to the west of Bander Chua nala and extended beyond old NH 33 thereby resulting in fire and subsidence of old NH 33.A number of quarries, mainly in the incrop portion of top seams has been worked in unscientific manner and filled up with OB. Area to the north of Fault F_{12} and upto Chutua nala is being explored and a Revised Geological Report of Kuju Block incorporating this area is under preparation at CMPDI. The total annual production in 2016-17 of the mine was 5526 T. Mining activities are mainly done in Seam VII (Washery grade III) and Seam VIII (Washery grade IV). Presently, the coal produced specially from Kuju section is dispatched to Kedla Washery by road transport (contractual). However, in future the coal from Kuju OCP is proposed to be despatched through nearby New Kuju siding. Chronology of different reports prepared is given below:

Table 1.1: Chronology of Previous Approved Reports

Sl No	Year of Sanction	Name of the Report	Technology adopted	Production Capacity (Mty)	Sanction Capital (Rs.crores)
1	February1991	Scheme for Seam IX	Bord and Pillar		0.986
2	January 1995	Kuju Re Organisation	SDL	0.36	16.29 *

* - This Report envisaged Coal winning by SDL to provide gainful employment of the then existing manpower and to improve the techno-economic of the mine. Above Report has envisaged to work Seam IX, Seam VIII, Seam VII, Seam VI and Seam VA.

1.2 Present Status:

Earlier, mining activities was carried out through the inclines in the Eastern part of Bander Chua nala by Underground mining method. Area to the west of Bander Chua nala (which has been worked extensively by open cast as well as underground) upto the new NH-33 is considered for opencast mining. Presently no UG mine is operational in the proposed OC working area (as on November 2017) and it has been closed by CCL (among ten UG mines of CCL which were declared non-viable due to uneconomic reasons).

1.3 Agency wise Exploration Status :

Kuju Block - Total area of the block is 4.90 sq. km.

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Particulars	Meterage (m)	No. of Bore holes
NCDC	1474.54	3
CMPDI	8801.60	44
GSI	1021.95	3
CCL	699.90	11
	11997.99	61

Out of above 61 boreholes, 30 boreholes involving a meter age of 5424.05 meters were drilled in Kuju sector. The Kuju sector has a borehole density of 23 boreholes/sq km.

Dia of each bore hole is 4.6cm.

Persistent coal seams belonging to Barakar formation are available within the block. Incrop of all the coal seams, though dissected by faults, are available in the block. The net geological coal reserve (proved) has been estimated as 156.553 MT.

1.4 Justification of Preparation of Detailed project Report

The present report is justified in view of the following

- The report envisages improvement in mine economics. The underground mine is incurring heavy losses.
- Enhanced level of production to 1.30 MTY.
- Increased recovery or percentage of extraction due to feasibility of opencast mining.
- Increased demand of coal for power generation.
- Enhanced or Improved productivity of existing manpower.
- Extraction of opencast able coal in a systematic manner so that coal seams lying below Seam X can be extracted by Underground method in future (Seam VII and VIII are already working).
- Safety of NH-33 by leaving a barrier of 100 m from the Quarry surface.

1.5 Variants Proposed in Earlier Detailed Project Report (November 2011)

Option I- This Variant is prepared keeping in view of the following mine parameters.

- Northern Boundary: The northern surface boundary has been fixed along a safe distance 60 m from Chowtha nala.
- Southern Boundary: The surface boundary along the South has been fixed at the leasehold line of Kuju Block.
- Eastern Boundary: The surface boundary along the East has been fixed leaving a surface barrier of 60 m from Bander Chua nala.
- Western Boundary: The western boundary has been fixed at a distance of 100 m from the new diverted NH 33.

External Dump has been proposed at Pokharia Mouza (Coal Bearing, Top seam (Seam XIII) occurs at a depth of around 60m from surface & non forest land) within the lease of Kuju colliery in between Bander Chua nala and Mourpa nala. Lead to external OB dump is less than 600 m from the pit. Coal and OB removal are proposed to be excavated by departmental resources.

Option II –All parameters are same as mentioned in Option I. In this option, Coal and OB removal is proposed to be executed by outsourcing means.

Salient features of the proposed mine as per DPR

	Quarry Surface Area (Sq. Km)	Total Coal (MT)	Total OB (Mcum)	Average SR (Cum/T)	Mine Life(yrs.)	Remarks
Option- I	0.5894	9.03	31.41	3.48	8	Coal & OB both Departmental
Option- II						Coal & OB both Outsourced

1.4 Difficulties and constraints in mining with associated risk

a) Due to the steep gradient of the mine 10 ^{0} to 19 ^{0} concurrent Internal dumping is not proposed in the mine. OB is proposed to be dumped externally. Each layer of the external dump is around 30 m height and top RL of external dump is less than 90 m above from surface topography. Road width has been taken as 20 m between different tiers of dump.

b) Due to presence of irregular, old Opencast as well as Underground mining in the proposed mining area, proper care should be taken while working on the underground working, fire area and worked out small pits.

c) Hutments (180 nos.) on the proposed mining area are to be shifted elsewhere before the commencement of mining operation. Nearly 145 PAF (Project affected families) are to be rehabilitated before the commencement of mining operation as communicated by mine authorities during field visit on 20/9/2017.

d) A bridge on the Bander Chua nala is to be constructed for OB transportation to dumping place.

e) Diesel Shovels and Drills are preferred considering the existing mine profile, existing UG galleries, easy maneuverability and life of opencast mine.

f) Forest land (including 38.54 Ha Notified Forest and 72.48 Ha GMK JJ land) and 50.06 Ha Non Forest land is to be acquired for mining activities.

1.6 Technology Upgrade:

Upgrading technology is a prerequisite for more effective use of resources and thus improving environmental performance, which becomes all the more important in view of a rapidly growing demand of coal in our country. In most cases, newer technologies and processes are both more efficient and less polluting than the technology they replace, allowing increased production using less material and causing less pollution.

Considering, what has been stated in the above paragraph, the proposed mining plan suggests flexibility in the implementation stage within the scope of the proposed mining plan to respond to improvements in technology and equipment which would result in improved profitability, productivity and mitigate environmental hazards due to mining.

CHAPTER-II

PROJECT SITE INFORMATION

2.1 Location:

Kuju block is situated in the West Bokaro coalfield in the district of Ramgarh, Jharkhand. The Block covers an area of 4.90 Sq Km.to the east of Kuju Block is the Ara Block while Topa Block falls on the west. Pundi Block lies to the north of Kuju Block. The Kuju Block has metamorphic contact on the south.

2.2 Accessibility and Communication:

The National Highway No-33 passes through the western part of the Block. Due to fire, new NH-33 has been constructed and old one has been abandoned. The nearest station is Ranchi Road, on Gomoh Barkakana loop line of the railway. It is about 12 km. from the block. Coal will be transported to nearby New Kuju siding located at a distance of about 3.5 km. Two new Railway Stations namely, Kuju and Mandu are at a distance of around 2-3 km. and 3-4 km. from the mine respectively.

2.3 Climate and Rainfall Data:

Due to mining activities, the ecology of the area has been badly affected. The climate of the region is tropical. The summer (April to June) is very hot and temperature varies from 28^0C to 40^0C. The winter is also extreme. According to the rainfall data available from 'Mandu Rain Gauging Station' the maximum rainfall recorded was 480.80 mm in July 1965.The Kuju Block receives maximum rainfall of about 300 mm in the month of July, every year. Summer days are hot with dusty wind, but nights are generally pleasant. The winter (November-February) is cold and the minimum temperature recorded is 40^0C. The Rainy season is generally from June to October.

2.4 Topography with drainage pattern of area:

The topography of the Kuju Block is rugged forming hills and valleys due to numerous rivulets. The general ground slopes towards north and south-east. The drainage of the block is controlled by easterly flowing Chowtha nala. The tributary Bander Chua nala, Banwar and Mourpa nala flowing from south to north joins Chowtha nala. The highest point of elevation is around 410 m on NH -33 near the boreholes CMKJ-10, 8 and 26.The lowest elevation along the Chutua nala is around 335 m.

CHAPTER-III

GEOLOGY AND DEPOSIT APPRAISAL

1. Background/Introduction - The four pre-nationalisation leases called Mourpa, Kuju, Banwar and Hesagora have been re-organised in 1973 after nationalization of coal industry, in a single unit named as Kuju colliery. Geological report on Kuju block comprises of Mourpa, Kuju and part of Banwar leases whereas Hesagora section has been covered under a separate Geological report on Hesagora block.
2. Different GRs prepared at different period for the blocks under reference – 1) Geological report on Kuju block, West Bokaro Coalfield (CMPDI, RI-III August 1981)
3. Block Boundaries – East – Common lease hold boundary with Ara Colliery, West – Line joining boreholes CMKJ 23 & 27, North – Part of Bahera and Chowtha nala, (southern limit of lease hold of Pundi block in north) South – Metamorphic Barakar contact
4. Exploration Status-Number of boreholes and meterage drilled by the various agencies and period of drilling thereof, in the block area in tabular form is given in Table 3.1 below
   Density of boreholes in block area – 12.5 BH per Sq. Km.

Table 3.1: Summary of Exploratory Boreholes

Year	Agency	Block Name	Area (sq. km)	Number of BH	Meterage
	GSI	Kuju	4.08	3	1021.95
	NCDC			3	1474.54
June'76 to Feb'80	CMPDI			44	8801.60
	CCL			11	699.90
Total				61	11997.99

3.1 Geology and Structure of Block area:

The Kuju block is located in the South Central part of WBCF and lies on the southern limb of the southern synform. The Gondwana in the block is represented by rocks of Barren Measures, Barakars and Karharbari Formations. The drilling activity however, was mainly confined in Barakar Formation. The Talchir Formation and post Barren Measures sequence are absent in Kuju block.

3.2 Brief geological setting within the block:

Coal bearing formations and their general behavior –

Karharbari Formation – The only coal seam belonging to the Karharbari formation is Seam-0. Thickness of this formation in the block is about 72m. It has developed in the north eastern part of Mourpa section and gradually pinches out towards west and south portion of the block.

Barakars – The entire area is covered by the rocks of Barakar formation attaining a thickness of more than 450m in the block. This is the major coal bearing formation containing 24 co relatable coal seams. The Barakars are characterized by thick sequence of coarse to medium grained sandstones inter banded with alternating bands of sandstone and shales and coal seams.

Barren Measures - This formation is exposed in the north eastern and north western part of the block. It has a thickness of about 150m. The rock types are grey shales and carbonaceous sandy shales with sideritic bands.

Burnt outcrop – Burnt outcrop of coal seams are noticed in all the three sections of Kuju block. The entire outcrop of seam X along Banderchua Nala makes prominent upland along the burnt portion. The burning has resulted in baking of shale into buff/brown/white coloured shale. Similar phenomenon is noticed in the overlying seam XI in the same area. In Mourpa section burnt rocks are noticed where outcrop of seams VI/VII have been affected by surface burning. In Banwar section outcrop of seams V, VA & VI have been affected by surface burning.

Igneous intrusion – No igneous intrusion have been recorded in the borehole or in the mine working.

3.3 Sequence of coal seams and partings within the block area

Table 3.2: Sequence and brief description of Coal Seams in the block

Seam	Thickness range (m)	Grade range	BH intersections	Geological Reserve (MT)
Surface Cover				
XIII	1.72-3.14	D-E	11	3.815
Parting	11.06-19.06			
XII	1.36-4.72	D-F	11	5.696
Parting	45.10-64.74			
XI	6.69-14.62	E-W IV	25	25.512
Parting	1.80-13.85			
XA	0.25-1.80	C-W II	21	3.443
Parting	14.52-26.75			
X	8.45-15.65	C-W III	22	27.545
Parting	10.82-19.99			

Seam	Thickness range (m)	Grade range	BH intersections	Geological Reserve (MT)
IXA	1.04-1.68	D-W II	16	4.249
Parting	7.80-29.60			
IX	3.47-4.52	E-W III	24	11.150
Parting	2.80-12.60			
VIIIC	0.12-0.35			
Parting	4.54-24.52			
VIIIB	0.25-1.04			
Parting	7.67-19.39			
VIIIA	0.45-1.58	SG II-W II	24	1.874
Parting	6.51-21.45			
VIII	4.19-7.60	F-W IV	27	15.254
Parting	3.26-31.40			
VIIB	0.50-2.18	SG I-W I	22	4.125
Parting	11.77-29.16			
VIIA	0.30-1.35			
Parting	6.27-30.80			
VII	2.30-6.53	SG II	28	14.514
Parting	5.53-23.35			
VI	1.40-3.40	SG II	25	9.633
Parting	2.24-13.37			
VA	3.99-7.74	C-W II	25	15.101
Parting	6.22-31.95			
V	10.74-19.60	D-W III	25	53.038
Parting	6.17-26.91			
IV	2.95-5.67	W II- IV	22	14.960
Parting	2.25-7.90			
IIIA	0.50-1.95	E-W III	22	3.267
Parting	1.72-10.16			
III	3.18-8.60	F-W IV	21	31.278
Parting	1.95-13.68			
IIB	0.40-3.77	F-W III	18	6.733
Parting	5.83-26.70			
IIA	1.20-3.85	G-W IV	17	9.692
Parting	7.50-34.83			
II	1.52-6.37	W III- IV	17	10.326
Parting	2.78-42.15			
I	0.68-6.85	G-W IV	17	10.219
Parting	50.15-54.06			
0	3.08-6.76			

3.4 Structural setting of the block

The Kuju block lies on the southern limb of the southern synform. Due to presence of various strike and oblique faults the strike of the formation varies widely.

3.4.1 Dip and Strike

The strata dips toward west in the in the western part and north & north-west in the northern part. Generally the gradient of the seam is steeper in the Mourpa section as compared to Kuju and Banwar sections. The amount of dip varies from 10^{o} to 15^{o} in less disturbed area to 25^{o} to 35^{o} in more disturbed area. The strike shows a gradual change from N-S to NE-SW to almost E-W.

3.4.2 Fault

In Kuju block a total of 37 faults have been interpreted based on surface and sub-surface data. Brief description of the faults falling in and around the proposed mine/project boundary is given below.

Table 3.3: Brief Description of Faults in the block

Fault	Location	General Trend of fault trace	Amount of throw(m) & direction	1. Strike 2. Dip 3. Evidence
F5	Major fault, marks the southern boundary of the block in eastern part	E-W in eastern part and turns to WNW in western part of the block	250-400m Northerly	1. Drag effect in Quarry No.1 Q (K) of Seam-X 2. Seam-VII abutting against Qry.7C Q (K) of Seam-X NW of CMKJ-31 3. CMKJ-22 strata between Seams X and II omitted. 4. CMKJ-8 strata above Seam-V to XI omitted.
F6	Western part of the mine	N-S	30-90m Westerly	1. Field evidence, variation in dips on either side of fault.
F7	SW part of the mine	WNW-ESE	20-150m North easterly	1. Sudden termination of quarry of seam XI 7A/B Q(K) in strike 2. Part of seam IX to VIII omitted in CMKJ-8
F8	SW part of the mine	NW-SE	10-20m North easterly	1. Displacement of in crop of seam XIII in quarry No. 7Q(K) 2. CMKJ-9 faulted 3. Seam XI omitted in CMKJ-10
F9	NE part of mine	NW-SE	10m North easterly	1. Field evidence occurring in Hesagora block
F12	Major fault, NE part of mine	Low angle Curvilinear, N-S to E-W	50-250m Easterly near BH CMKJ-19 to northerly near BH CMKJ45	1. Barren Measures come in juxtaposition with seam X quarry no. 3Q(K) 2. Omission of strata observed in BH CMKJ-9,16,20,57 & WBKU-4

3.5 Description of Coal Seams

Important coal seams of the project area and their general behaviour – Seams X, XA, XI, XII & XIII have been considered for opencast mining in the present project report.

Description of Individual coal seams of the project area dealing with the following:

3.5.1 Seam – X

Stratigraphic position – Seam X is fairly consistent and thick horizon in Kuju. It has been encountered in 22 BHs. It overlies seam IXA with a parting ranging from 10.82-19.99m and underlies seam XA with a

parting range of 14.52-26.75m. The shallowest and deepest floor depths are at 55.31 and 235.92 m respectively.

Thickness - The seam ranges in thickness from 8.45 to 15.65 m. Average thickness of seam varies from 9-13m

Dirt band – Seam X is highly interbanded in nature. Number of dirt bands varies from 4 to 16 and their cumulative thickness varies from 0.64 to 3.25m.The percentage of dirt bands vary from 6.4 to 21.5

Roof and Floor – Carbonaceous shale and occasionally medium to coarse grained sandstone forms the roof of the seam while floor is generally of grey shale and intercalation of sandstone and shale.

Quality - Analytical parameters of seam-X is tabulated below

Proximate Analysis Air dried basis			**Ultimate Analysis Dmmf basis**				**Coking propensity**		
M%	**Ash% (Inb.)**	**VM%**	**C%**	**H%**	**CV (Kcal/Kg)**	**VM%**	**CI**	**CT**	**SI**
1.5-3.4	21.7-26.1	26.7-28.4	84.3-85.9	5.1-5.4	8160-8380	33.9-35.1	5/7-18/20	C-E	

Washability – The result available for borehole CMKJ-19 indicate that the yield of cleans at 1.5 sp. Gr. is about 63.2% having an ash content of 14% (the raw coal ash being 23.2%).

Grade – The coal of seam X is high volatile and weakly caking in nature. The grade varies from non coking grade C to medium coking WG-III

Reserve – The net proved reserve of the seam is 12.67 MT and indicated reserve is 14.87 MT

3.5.2 Seam-XA

Stratigraphic position – It is a thin seam encountered in 21 BHs. It overlies seam X with a parting ranging from 14.62 to 26.75m and underlies seam XI with a parting ranging from 1.80 to 13.85m. The shallowest and deepest floor depths are at 28.93 and 206.97m respectively.

Thickness – The seam ranges in thickness from 0.25 to 1.95m. Normal thickness of the seam varies from 1.12 to 1.8m.

Dirt band – The seam is generally free from dirt band.

Roof and Floor – Carbonaceous shale and occasionally medium to coarse grained sandstone forms the roof of the seam while floor is generally of carbonaceous shale.

Quality - Analytical parameters of seam-XA is tabulated below

Proximate Analysis Air dried basis			Ultimate Analysis Dmmf basis				Coking propensity		
M%	Ash% (Inb.)	VM%	C%	H%	CV Kcal/Kg	VM%	CI	CT	SI
1.5-3.6	23.4-24.4	24.7-28.0	83.8-85.3	5.1-5.5	8185-8435	33.0-37.7	9/11-24/26	C-G/G1	

Grade –. The coal of seam XA is high volatile and medium to strongly caking in nature. The grade varies from non-coking grade C to medium coking WG-II.

Reserve - The net proved reserve of the seam is 1.44 MT and indicated reserve is 2.01 MT

3.5.3 Seam-XI

Stratigraphic position – It is the youngest thick and persistent horizon encountered in 25 BHs. It serves as a marker horizon. It overlies seam XA with a parting ranging from 1.80 to 13.85m and underlies seam XII with a parting ranging from 45.10 to 64.74m. The shallowest and deepest floor depths are at 25.55 and 203.34m respectively. The seam has been partly quarried in the in crop region.

Thickness – It ranges from 6.69 to 14.62m. However, the normal and consistent thickness is 10.0 to 13.0m

Dirt band – Seam XI is highly interbanded in nature. Number of dirt bands varies from 7 to 23 and their cumulative thickness varies from 1.52 to 3.91m.The percentage of dirt bands vary from 14.4 to 31.25%

Roof and Floor – Carbonaceous shale and occasionally medium to coarse grained sandstone forms the roof of the seam while floor is generally of grey shale.

Quality - Analytical parameters of seam-XI is tabulated below

Proximate Analysis Air dried basis			Ultimate Analysis Dmmf basis				Coking propensity		
M%	Ash% (Inb.)	VM%	C%	H%	CV Kcal/Kg	VM%	CI	CT	SI
1.6-3.3	30.8-35.7	25.6-27.5	84.2-86.2	5.2-5.5	8205-8435	36.2-38.8	4/6-19/21	B-E/F	

Washability – The result available for borehole CMKJ-19 & CMKJ-44 indicate that the yield of cleans at 1.5 sp. Gr. is about 41% having an ash content of 16-18%.

Grade – The coal of seam XI is high volatile weakly caking in nature. The grade varies from non-coking grade E to medium coking WG-IV.

Reserve - The net proved reserve of the seam is 12.81 MT and indicated reserve is 12.70 MT

3.5.4 Seam-XII

Stratigraphic position - It has been encountered in 11 BHs. It overlies seam XI with a parting ranging from 45.10 to 64.74m and underlies seam XIII with a parting ranging from 11.06 to 19.07m. The shallowest and deepest floor depths are at 14.90 and 138.27m respectively. The seam has been partly quarried in the incrop region.

Thickness – It ranges from 1.36 to 4.72m. Generally thickness of the seam varies from 2.5 to 3m.

Dirt band – Seam XII is interbanded in nature. Number of dirt bands varies from 2 to 8 and their cumulative thickness varies from 0.28 to 1.18m.The percentage of dirt bands vary from 11.4 to 32.4%

Roof and Floor - grey shale and occasionally medium to coarse grained sandstone forms the roof of the seam while floor is generally of carbonaceous shale.

Quality - Analytical parameters of seam-XII is tabulated below

Proximate Analysis Air dried basis			Ultimate Analysis Dmmf basis				Coking propensity		
M%	Ash% (Inb.)	VM%	C%	H%	CV Kcal/Kg	VM%	CI	CT	SI
1.8-4.1	30.0-42.2	21.8-26.2	83.4	5.4	8160	36.6	5/7	C	

Ash Fusion Range (^{o}C) – IDT- 1110-1150, HT- >1290-1350

Grade – The coal of seam XII is non caking in nature. The grade varies from non-coking grade D to F

Reserve - The net proved reserve of the seam is 1.55 MT and indicated reserve is 4.15 MT

3.5.5 Seam-XIII

Stratigraphic position – This is the youngest seam encountered in 11 BHs. It overlies seam XII with a parting ranging from 11.06 to 19.07m and underlies about 10.0-13.0m below the Barren Measures-Barakar contact. The shallowest and deepest floor depths are at 12.36 and 150.00m respectively.

Thickness – The seam ranges in thickness from 1.72 to 3.14m. However, the normal thickness of the seam is 2 to 2.25m. The seam has been partly worked by open cast method in in crop region.

Dirt band – Seam XIII is interbanded in nature. Number of dirt bands varies from 1 to 5 and their cumulative thickness varies from 0.10 to 0.60m.The percentage of dirt bands vary from 4.8 to 16.7%.

Roof and Floor - Carbonaceous shale and occasionally medium to coarse grained sandstone forms the roof of the seam while floor is generally of grey shale and intercalation of sandstone and shale.

Quality - Analytical parameters of seam-XIII is tabulated below

Proximate Analysis Air dried basis			Ultimate Analysis Dmmf basis				Coking propensity		
M%	Ash% (Inb.)	VM%	C%	H%	CV Kcal/Kg	VM%	CI	CT	SI
1.9-4.3	25.6-32.1	23.7-27.0	83.3-84.4	5.0-5.5	8140-8200	33.9-35.7	5-9/11	A/B-D	

Ash Fusion Range (^oC) – IDT-1180- 1240, HT - >1400, FT - >1400

Grade – The coal of seam XIII is non caking in nature. The grade varies from non-coking grade D to E
Reserve - The net proved reserve of the seam is 0.9 MT and indicated reserve is 2.92 MT

3.6 Geo-technical information

Details of Physico-mechanical properties determined for various litho units in core of Borehole no. CMKJ-6 & 19 of Kuju block are tabulated below

Sl. No.	Litho-unit description	Comp.- Strength Kg/cm^2	Split Tension Kg/cm^2
1	Conglomerate	275-769	66.86
2	C.Gr. Sandstone, gritty sandstone including pebbly sandstone	152-546	19.07-45.67
3	Medium grained sandstone	265-986	51.22-107.92
4	Fine grained sandstone	320-1210	35.30-43.43
5	Shaly sandstone & intercalated sandstone and shale	288-1084	31.45-124.63
6	Grey shale	276-735	25.26-79.92
7	Carbonaceous sandy shale	358-467	42.45-68.22
8	Carbonaceous shale	160-645	15.69-27.05
9	Carbonaceous shale with siliceous streak	301-350	38.36-43.97

3.7 Geological Reserves

3.7.1 Brief methodology adopted for reserve estimation

Isochore and isograde of individual seams have been drawn. The area of the inter-play of isochore and isograde of individual seam has been measured with the help of planimeter. The reserve below isochore of 0.90m for various seams has been excluded from estimation.

The area thus measured has been multiplied with average thickness of the enclosing isochore so as to arrive at the volume of coal.

Heave zone of the fault on the floor of the individual seam and 40m barrier along nalas and 60m barrier on both sides of the National High way have been excluded from reserve estimation.

The specific gravity of the individual seam has been considered separately for different grades. A mathematical average of ash % of individual grade have been considered and 1% of the average ash

thus calculated, has been added to 1.29 & 1.28 (respectively for coking and non-coking coal) to arrive at the Sp. Gr. for individual grade. Grade wise Sp. Gr. considered for estimation of reserve are given below

Grade	Av. Ash %	Sp. Gr.
Coking coal		
SG-I	<15.0	1.44
SG-II	16.5	1.46
W-I	19.5	1.49
W-II	22.5	1.52
W-III	26	1.55
W-IV	31.5	1.61
Non coking coal		
Grade D	28	1.56
Grade E	34	1.62
Grade F	40	1.68
Grade G	51	1.79

Volume of the coal has been multiplied by the Sp. Gr. of the coal falling in the particular grade to obtain the gross in situ reserve. A deduction of 10% of the gross reserve has been made in order to obtain the net in situ reserve of the coal.

3.7.2 Seam-wise and category wise net Geological Reserves within the block area is given below

Table 3.5: Seam-wise and category wise Geological Reserve of Kuju

Seam	Category			Total
	Proved	Indicated	Inferred	
XIII	0.897	2.918		3.815
XII	1.547	4.149		5.696
XI	12.811	12.701		25.512
XA	1.437	2.006		3.443
X	12.673	14.872		27.545
IXA	2.144	2.105		4.249
IX	6.081	5.069		11.150
VIIIA	0.832	1.042		1.874
VIII	8.666	6.588		15.254
VIIB	1.578	2.547		4.125
VII	8.969	5.545		14.514
VI	6.786	2.847		9.633
VA	8.556	6.545		15.101
Seam	**Category**			**Total**
	Proved	**Indicated**	**Inferred**	

V	35.211	17.827		53.038
IV	9.360	5.6		14.96
IIIA	1.504	1.763		3.267
III	13.199	18.079		31.278
IIB	4.421	2.143	0.169	6.733
IIA	6.109	3.153	0.070	9.692
II	6.928	3.118	0.280	10.326
I	6.844	3.131	0.244	10.219
Total	**156.553**	**124.108**	**0.763**	**281.424**

Coal type wise and category wise reserve in Kuju block is summarized below

Coal type	**Category**			**Total**
	Proved	**Indicated**	**Inferred**	
Medium coking (SG-I to W-IV)	107.2	94.3	0.8	202.3
Medium coking (Ungraded)	15.9	14.9	-	30.8
Semi coking (Grade –I & II)	2.4	0.3	-	2.7
Semi coking (Ungraded)	19.3	4.7	-	24.0
Non coking	11.7	9.9	-	21.6
Total	**156.5**	**124.1**	**0.8**	**281.4**

CHAPTER-IV

MINE BOUNDARY, RESERVES AND MINE LIFE

4.1 Introduction

Mining activities, both opencast and underground has taken place earlier in this block. Now all mining activities are suspended in the proposed mining area due to fire and proximity to old NH-33. Balance Coal and OB quantity (as on 31/3/2017) of the quarry has been estimated after deducting all mined out quarries , UG workings and production figures reported by mine officials.

Quarry Area(Sq. km)	Coal(MT)	OB(Mcum)	SR(cum/T)	Life(yrs.)	Av.Grade
0.5894	9.03	31.41	3.48	8	G6

It is proposed to exploit the coal seams in the Quarry from Seam XIII to Seam X. The proposed quarriable block is based on the "Geological Report of Kuju Block, West Bokaro Coalfield" prepared in August 1981. The parameters of the opencast minefield and the technical condition of its development make it feasible to produce 1.30 MT of ROM coal per annum with normal technical indices i.e., deployment of equipment, strike length of the quarry, annual advances of the faces, etc.

Five (5) numbers of coal horizons, namely Seams XIII, XII, XI, X A and X are occurring within this mining block. Seam X is the base seam of the proposed quarry.

4.2 Mine Boundaries:

Mine boundary optimization is considered keeping in view of the following parameters:

- Northern Boundary: The northern surface boundary has been fixed along a safe distance of 60 m from Chowtha nala.
- Southern Boundary: The surface boundary along the South has been fixed at the leasehold line of Kuju Block (metamorphic line).
- Eastern Boundary: The surface boundary along the East has been fixed leaving a surface barrier of 60 m from Banderchua nala.
- Western Boundary: The western boundary has been fixed at a distance of 100 m from the new diverted NH 33.

4.3 Mineable Reserves:

The quarry boundary has been optimized to the extent that the extractable reserve has been maximized to produce coal @ 1.30 MTY within the proposed boundary.

4.4 Quarry Floor consideration:

Quarriable reserve has been considered upto Seam X only. Seam IX A of average thickness of 1.1 m occurs at parting of 17.0 m (avg.) from Seam X.

4.5 Seam wise details of Balance Mineable Reserves (as on 31/3/2017):

Name of seam	Thickness variation (m)	Net insitu Geological Reserve in Kuju Block(MT)	Mineable Reserve (MT)
XIII	2.05-3.09	3.815	0.24
XII	2.83-4.38	5.696	0.38
XI	6.32-12.75	25.512	4.84
X A	0.50-1.66	3.443	0.45
X	9.92-12.39	27.545	3.12
Total		**66.011**	**9.03**

4.6 Reason for difference in Mineable Reserve and Net insitu Geological Reserve:

- Geological Block area is- 4.90Sqkm whereas Quarry Area is-0.5894 Sqkm.(it is within the Geological Block)
- Remaining area consists of Mourpa sector (annexed in revised GR), Banwar sector (no mining activity) and area bounded by block boundary in the east and Bander chuan nala in the west (Kuju underground mine in operation).
- Reserves extracted by underground as well as opencast have been deducted from geological reserve to estimate the mineable reserve (in the proposed quarry).
- Quarry area is reduced considerably while keeping a safe barrier from Chutua nala Banderchua nala and NH-33 thereby decreasing the mineable reserve within the Quarry.
- Coal lost due to fire near NH-33 is deducted to attain mine able reserve.

4.7 Target Output & Mine Life:

The mine has been planned for a nominal production capacity of 1.30 MT per annum of coal and peak production 1.50 MTY. The target has been assessed based on geological constraints, optimization of mining operations, size of the quarry, rate of advance, type of mining system adopted , existing developed workings and old worked out quarries Etc.

Mine Life:The project will sustain a quarry life of eight years. The break-up of total period is as follows:

- Production build-up period – Two years
- Targeted production period - Five years

CHAPTER-V

METHOD OF MINING

5.1 General

Considering the geo mining characteristics of the mining block i.e. thin seams, steep gradient of the seams within the quarry, occurrence of geological disturbances, abandoned old opencast mines, developed galleries and presence of fire, mining with shovel-dumper combination is proposed to work in Kuju Opencast mine.

5.2 Geo-Mining Characteristics

The Geo-Mining characteristics of the proposed Kuju OCP (1.30 MTY) are given in the table below. A total no. of five coal horizons is occurring within the quarriable area.

5.2.1 Seam Gradient

The dip of the formation varies from 10^{o} - 19^{0} in the proposed quarry towards east west.

5.2.2 Assessment of Quarriable Potentiality

A study was carried out in this report to find out the possibility of opencast working upto seam X. Average grade of coal produced from this quarry is expected to be Grade C (long flame).Feasibility of extracting coal upto 140 m depth including developed area of underground workings by opencast method is studied and it is found technically feasible to convert the underground mine to opencast mine upto seam X.

Following points are considered while preparing this quarry:

- Seam X has been considered as base seam.
- Coal seam roof and floor surface as generated in the MINEX model has been used for the quarry planning purposes and estimation of coal reserve.
- Topography, fault position etc. has been considered as provided in the Geological Report of Kuju Block and plan supplied by the project.
- Based on the MINEX model an estimate of the gross insitu geological reserve falling within the proposed quarry has been estimated.
- The net geological reserve in the quarry has been estimated by deducting coal reserve already quarried or depillared and coal already extracted in developed/standing pillars with the following consideration

- Reserve already quarried or depillared-Insitu coal reserve falling within the vertical limits (at a slope of 70 degree) of top edge of the mined out quarries have been completely deducted for seams worked earlier. In case of underground B&P depillared pillars, coal reserves falling within the depillared panel area have been completely deducted.
- Percentage of extraction of coal for opencast in remaining developed pillars has been estimated by deducting a fixed percentage of 40% for coal extracted during underground B&P development.

5.2.3 Details of sequence of coal seam and parting

Name of Parting/Seam	Thickness of parting /coal (m) with range	
	Min	Max
Top OB above Seam XIII	5.70	39.12
Seam XIII	1.72	3.14
Parting between XIII & XII	11.03	13.46
Seam XII	2.63	2.93
Parting between XII& XI	48.03	52.46
Seam XI	10.86	11.46
Parting between XI & X A	2.20	4.82
Seam X A	1.12	1.32
Parting between X A & X	15.02	16.43
Seam X	10.82	11.18

5.3 Mine parameters

Particulars	Minimum(m)	Maximum(m)
Strike length	614	952
Depth of quarry	35	145
Dip rise length (on floor)	472	787
Final Quarry Floor area (in Sq km)	0.40	
Final Quarry Surface area (in Sq km)	0.59	
Balance Mineable reserves (Mt)	9.03	
Balance Total OB (M cum)	31.41	
Average Stripping Ratio (Cum/Tonne)	3.48	
Seam gradient (Avg. gradient of the quarry floor)	10 - 19 deg	

5.4 Choice of Technology:

Considering the geo-mining conditions shovel-dumper combination with drilling and blasting has been proposed for mining the quarry. Other technologies like Dragline, Bucket Wheel Excavator, Surface miners are ruled out for this quarry.

Shovel Dumper Combination

The equipment selection process is the most critical part of the project planning. The following selection criteria have been considered for selecting the size and type of the equipment:

1. The strike length of the mine
2. Annual rate of advance
3. Total volume of overburden and coal to be handled annually
4. The individual thickness of coal seam and partings
5. The geo-mining condition of the mine.
6. The type of mining system to be used like Inclined Slicing or Horizontal Slicing.
7. The intuitive economics of the mine
8. Presence of geological disturbances like faults, intrusions etc.

Keeping in view of the Geological and Mining parameters of Kuju OCP mining area i.e. steep gradient of the seam (10^0-19^0), rated output of 1.30 MTY, Shovel-dumper mining system with horizontal slicing has been envisaged for the quarry.

5.4 Equipment Selection

- Coal and OB both Departmental and external dump is on Pokharia Mouza(Coal bearing and non-forest land) at a distance of around 600 m from mine.

  Considering the average strike length of the quarry, gradient and thickness of the seam, annual load of excavation, lead of HEMM, presence of developed UG mines and abandoned quarries the following equipment have been selected.

Coal Winning:

Coal will be mined by 6.0 cum diesel hydraulic shovel with back hoe attachment in combination with 60T rear dumpers. This attachment will be useful tools in handling faulted area operation, coal wedge removal, working over developed area and temporary sump formation in horizontal slicing method. For the estimation of the dumpers population in coal, the lead for coal transportation has been considered for each year and for each seam. Coal will be transported through batters. Ramp is provided (1 in 10 gradient) to facilitate HEMM movement in between different horizon. Possibility of haul road on floor is ruled out due to steep gradient of coal seam. A hydraulic shovel with backhoe is proposed in common to deal with developed workings from upper bench. While working developed seams by opencast method, further occurrence of fire cannot be ruled out, so adequate precautions are required to deal with fire as soon as it appears. 1.2 Cum Back hoe, F E loader and water sprinkler have been for common mining activities. Productivity of these FE loader and backhoe has not been considered while calculation the requirement of HEMM for the mine. The coal will be transported right from the coal face to the feeder breaker through the haul roads made along the batters of the quarry.

Overburden Removal:

OB / partings are envisaged to be removed by 6.0 cum diesel hydraulic shovel in combination with 60T rear dumpers. OB will be transported through batters like Coal transportation. Ramp is provided (1 in 10 gradient) to facilitate HEMM movement in between different horizon to the external dump site as shown in the dump plan.

Drilling and Blasting:

Drilling and blasting operations for loosening the coal and OB are necessary before excavation by shovels. For the purpose of drilling in coal and OB benches 160mm Diesel RBH drills have been provided. One wagon drill of 100mm-120mm has been provided to deal with thin coal seam/partings and wedge formation. Controlled or muffled blasting will be practiced near the important surface infrastructures.

Mining system & system parameters:

As the seams are steeply dipping the mine will follow horizontal slicing method. The mining system has been depicted in the cross section of the mine.

The following mining parameters have been considered in the project.

Sl. No.	Particular	Unit	Value
1	OB Bench Height for 6.0 cum Diesel Hydraulic shovels	m	10
2	Coal Bench Height for 6.0 cum Back Hoe	m	10
3	Working bench width	m	40
4	Non - Working bench width	m	20
5	Width of Permanent haul road	m	20
6	Usual height of the spoil dump bench	m	30
7	Maximum height of spoil dump	m	87
8	Bench Slope for OB and coal	Deg	70
9	Bench Slope for dump	Deg	37
10	Overall pit slope for Quarry	Deg	43
11	Blast Hole dia for OB and Coal for Quarry	mm	160
13	Blast Hole depth in OB and Coal bench	m	12-14
14	Powder Factor for OB	Kg/cum	0.3-0.4
15	Powder Factor for Coal	Kg/Te	0.2-0.3

5.5 Precautions to be taken during mining operation due to existing UG workings, abandoned old quarry and probable break out of fire:

a) Quarry shall be worked by Heavy Earth Moving Machinery only. No manual operation in the quarry will be done.

b) HEMMs, except drilling machines shall not be deployed on the bench where thickness of coal or overburden above the UG galleries, as proved by advance boreholes or other suitable methods, is less than 6m.

c) Exposed coal faces (including UG galleries) shall be kept covered with fine grained incombustible OB material to prevent breathing of air and control fire to dip side working. This cover shall be removed only at the time of coal extraction.

d) Overburden containing carbonaceous material shall not be dumped within 30m of the exposed side of the coal benches. Hot overburden shall be quenched and cooled at dump sites.

e) No person shall be allowed at any place in the opencast working where the thickness of overburden and/or coal over any gallery is less than 1.5m.

f) Except for the purpose of inspection and support work no person shall be allowed in the underground mine beneath and within 200 m of the opencast excavation. The person visiting UG will take all safety precautions for safe working.

g) Movement of active coal face should be faster and stagnation of coal face should be avoided.

h) **Blasting in fire area**

i) No explosive other than slurry and emulsion explosive shall be used.

ii) Blasting shall be done with detonating fuse down the hole. Fresh drill holes should be tightly plugged at the mouth.

iii) Temperature inside the hole shall be measured by Bi-Metallic thermocouple heat sensor (before filling with water) and if the temperature exceeds 80^{o}C in any hole the hole will not be charged.

iv) All blast holes shall be kept filled with water. When any hole is traversed by cracks or fissures the hole shall not be charged unless it is lined with an asbestos pipe and the hole filled with water. In addition, bentonite should be used for sealing any cracks at the bottom of the hole.

v) Detonating fuse shall not be laid on hot ground without taking suitable precautions.

vi) Charging and firing of holes in any one round shall be expeditiously completed and in any case within 2 hours.

vii) A parting of at least 2m between the bottom of a short hole and roof of underground gallery shall be left intact.

viii) Effective muffling of hot shot holes with old wire rope screens shall be done for prevention of flying hot fragments.

ix) No blasting shall be done in crushed or broken ground.

x) No person shall be employed within 150m when blasting the heated material.

xi) The spacing of hole in the coal/OB benches lying immediately above the galleries shall be so adjusted that the holes do not lie immediately above the galleries in order to ensure that blast holes do not directly fire into the underground working.

xii) All holes in the coal/OB benches lying immediately above the galleries shall be charged with water impulses or with moist sand of at least 0.6m in length at the bottom of the hole.

xiii) No person including a shot firer shall take shelter within 100m of the quarry opening. Such shelter shall be of an approved design.

5.6 Mining Strategy to work the balance reserves beyond the present opencast proposal

Considering the steep dip nature of the property dip side extension of the proposed quarry through opencast operation appears to be a difficult proposition. Majority of the seams to the dip side of the proposed quarry have underground potentiality. These seams may be worked in future by underground mining methods. The High wall of the proposed quarry may be regraded and utilised to mine the balance coal reserves through underground means.

While working above underground workings and fire, suitable precautions as laid down by DGMS vide its various Circulars should be strictly observed.

LIST OF HEMM
COAL & OB BOTH DEPARTMENTAL

Particulars	Size / Capacity	YEARS							
		1	2	3	4	5	6	7	8
OB									
Diesel Hyd. Shovel	6.0 Cum	1	2	2	3	3	3	3	3
Rear Dumper	60 T	9	12	17	18	22	24	24	24
RBH Drill (Diesel)	160 mm	1	2	2	3	3	3	3	2
Dozer	410HP	2	3	3	4	4	4	4	3
Coal and Mixed benches									
Diesel Hyd. Backhoe Shovel	6.0 Cum	1	1	1	1	1	1	1	1
Rear Dumper	60 T	2	2	2	2	2	2	3	3
RBH Drill (Diesel)	160 mm	1	1	1	1	1	1	1	1
Dozer with Ripper Attachment	410HP	1	1	1	1	1	1	1	1
Common									
Hyd. Shovel (with backhoe)	1.2 Cum	1	1	1	1	1	1	1	1
Dump Truck	10T	1	1	1	1	1	1	1	1
Grader	280HP	1	1	1	1	1	1	1	1
RT crane	50T	1	1	1	1	1	1	1	1
RT crane	20T	1	1	1	1	1	1	1	1
FE Loader	5-6 Cum	1	1	1	1	1	1	1	1
Wagon Drill	100-120mm	1	1	1	1	1	1	1	1
Tyre Handler	35kN	1	1	1	1	1	1	1	1
Water Sprinkler	28KL	1	2	2	2	2	2	2	2
Wheel Dozer	460 HP	1	1	1	1	1	1	1	1
Vibratory Compactor	30T	1	1	1	1	1	1	1	1
Fuel Truck	16KL	1	1	1	1	1	1	1	1
Fire Truck		1	1	1	1	1	1	1	1
Reclamation									
F E Loader	5-6Cum				1	1	1	1	1
Water Sprinkler (wide spray system)	28 KL				1	1	1	1	1
Dozer	410 HP				1	1	1	1	1
Rear Dumper	60T				2	2	2	2	2

CHAPTER-VI

MINING & DUMPING STRATEGY

6.1 Constraints on Mine Development

1 **Underground Workings and old quarried area:** The proposed mining area contains old underground workings in Seam XII, X A and X (other Seam like Seam VIII and Seam VII also worked by UG). Suitable statutory precautions need to be taken during the extraction of these seams.

2 **Fire:** Mine is to be worked with suitable precaution while working near the fire in Seam XII.

3 **Built-up:** An extensive built up area is located within the proposed quarry(around 180 hutments).Villages known as Lohagate and Lakri gate is located on the proposed mine area. These needs to be shifted and rehabilitated.

4 **OB Dumping site:** Within the leasehold area of the mine, non-coal bearing area is not available upto a lead of 5 km. So it is proposed to dump the OB on coal bearing area and to re handle it later.

5 **Approach to Dump:** A bridge over Banderchua nala is to be constructed for HEMM movement from the quarry to external dump site.

6 **Land Acquisition:** Notified Forest Land of 38.54 Ha, GMK JJ-72.48 ha and 50.06 Ha non-forest land is to be acquired for mining operation within the quarry **as communicated by mine officials on 21/11/2017.**

7 **Water Logged area-**Proper care is to be taken while working in/near water logged area.

The above constraints have been considered while formulating mining/dumping strategy.

6.2 Mining Strategy / Mining Sequence

The quarry is proposed to be worked by horizontal slicing method by shovel-dumper combination (considering the steep seams). Batter roads along with ramps are designed to evacuate coal and OB from this mine.

6.3 Dumping Strategy

Spoil Dump

Total volume of overburden of the proposed OCP has been estimated as 31.41 Mcum(balance as on 31/3/2017).

All the OB is proposed to be dumped externally on the Mourpa Sector (within the leasehold of the project) at a distance of about 600m.It is further proposed to rehandle this dump to fill up the void created by worked out quarry. Maximum dump RL is 440 m which is 84m (average) above the surface topography. However nearly 1.0Mcum of OB is dumped within the quarry area towards east of worked out quarry on coal bearing area. It is to be re handled to excavate seam X.

Final Stage Dump Plan

Particulars are given below;

Sl No	Particulars	Value
1	Quarry Area (Sq. km)	0.5894
2	Maximum Quarry Depth(m)	145
3	External Dump area (Sq. Km)	0.6802
4	Total Dump capacity(Mcum-solid)	31.41

Dump Management Plan for final stage is given below

Year	Dump Progressive(Mcum)	External with RL
1	2.55	+380
2	5.75	+380
3	9.90	+380,+410
4	14.05	+410,+440
5	18.44	+410,+440
6	23.28	+410,+440
7	28.12	+410,+440
8	31.41	+410,+440

RL wise Dump Capacity

Dump RL	Total External(Mcum) Dump
+380	13.88
+410	10.26
+440	7.27
Total	31.41

Top Soil Management

The salvaging, stockpiling and re-application of topsoil to be used as growth medium in the reclamation of Internal & external overburden dumps within the mining area is a major environment protection programme. Soil management in opencast mine is necessary to re-establish the stability & productivity of lands disturbed due to mining activity. Accordingly top soil storage area is mentioned on the plan.

Dumping Arrangements

The void left at the end of mine life is 0.397 Sqkm which is 61 % of the total quarry area. The void is proposed to be filled by rehandling of external OB dump (after completion of mine) or Initial OB dump of Hesagora mine (adjacent to Kuju mine) whichever occurs earlier.

CHAPTER-VII

MINING SCHEDULE & EQUIPMENT PHASING

7.1 Design criteria:

The following design criterion has been adopted for the mining operations as per prevalent norms of mine design considered in CIL mine.

No. of annual working days	-	330
No. of daily shifts	-	3
Duration of each shift	-	8 hrs.

The opencast mine would be worked on the above 3 shift/day basis and 7 days/week schedule and the number of working days /year are adopted as 330 considering annual public holidays, unscheduled delays and bad weather effect particularly in rainy season.

Excavation Category:

a) Coal	-	Cat-III
b) OB	-	50% Cat.III+50% Cat.IV
c) Alluvium	-	Cat.I/II

Insitu Volume Weight:

For Coal	-	1.60
For OB	-	2.40

The material having compressive strength between 125 to 250 kg/cm^2 is classified as Cat III and between 250 to 1250 kg/cm^2 as Cat IV.

7.2 Annual productivity of HEMM

Productivity of Excavators

Equipment	Annual Productivity (Mcum)
6.0Cum Diesel Hydraulic Shovel + 60T RD in OB	1.63
6.0Cum Diesel Hydraulic Shovel + 60T RD in Coal	1.77

Productivity of Rear Dumpers (Mcum)

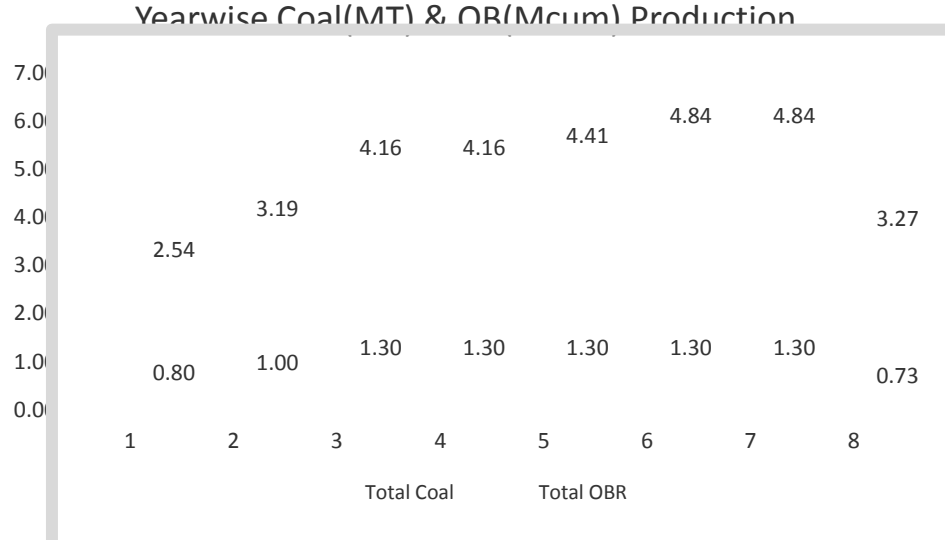
Annual Productivity of 60T Rear Dumper with 6.0 Cum Diesel Hydraulic Shovel

Lead (Km)	In OB	In Coal
0.5	0.3368	0.4022
1.0	0.2622	0.3159
1.5	0.2199	0.2665
2.0	0.1948	0.2368
2.5	0.1783	0.2170
3.0	0.1612	0.1968
3.5	0.1482	0.1812
4.0	0.1381	0.1689
4.5	0.1298	0.1590
5.0	0.1231	0.1509
5.5	0.1173	0.1440
6.0	0.1125	0.1381
6.5	0.1083	0.1331
7.0	0.1047	0.1286

7.3 Calendar Programme of Excavation

The mining schedule has been formulated based on the adopted sequence of opencast mine development at optimum conditions of mining operations for the entire life of Kuju OCP. Seam wise parting wise calendar plan is enclosed. Balance mineable Coal and OB(as on 31/3/2017) has been estimated after deducting all worked out areas (Underground development and opencast workings both).Due to existing site condition and nature of coal deposit below seam X it is proposed to take the entire extractable coal by opencast method within an optimum time frame of eight years.

PARTICULARS	UNIT	REVISED CALEDAR PLAN								
		1	2	3	4	5	6	7	8	Total
Seam 13	MTe	0.01	0.01	0.02	0.02	0.03	0.06	0.06	0.03	**0.24**
Seam 12	MTe	0.01	0.02	0.02	0.02	0.05	0.11	0.11	0.04	**0.38**
Seam 11	MTe	0.52	0.65	0.84	0.84	0.75	0.57	0.57	0.10	**4.84**
Seam 10A	MTe	0.05	0.06	0.08	0.08	0.06	0.04	0.04	0.04	**0.45**
Seam 10	MTe	0.21	0.26	0.34	0.34	0.41	0.52	0.52	0.52	**3.12**
Total Coal		0.80	1.00	1.30	1.30	1.30	1.30	1.30	0.73	9.03
Top OB	Mcum	0.37	0.47	0.61	0.61	0.65	0.70	0.70	0.40	**4.51**
Part Bet 13 &12	Mcum	0.08	0.10	0.14	0.14	0.22	0.38	0.38	0.29	**1.73**
Part Bet 12 &11	Mcum	1.42	1.77	2.31	2.31	2.54	2.98	2.98	1.80	**18.11**
Part Bet 11 &10A	Mcum	0.11	0.14	0.18	0.18	0.17	0.13	0.13	0.13	**1.17**
Part Bet 10A &10	Mcum	0.56	0.71	0.92	0.92	0.83	0.65	0.65	0.65	**5.89**
Total OBR		2.54	3.19	4.16	4.16	4.41	4.84	4.84	3.27	31.41
S.R	**Cum / Te**	**3.18**	**3.19**	**3.20**	**3.20**	**3.39**	**3.72**	**3.72**	**4.48**	**3.48**



7.4 Drilling & Blasting Operation:

Elements of Drilling and Blasting:

Drilling of top OB, Partings and Coal envisages to be done by 160mm drills. It is suggested to use slurry explosive in cartridge/site mixed slurry for better result and enhance safety with proper stemming material. Secondary blasting is not suggested in any circumstances. Mine is already having explosive storage capacity to cater daily explosive requirement to meet underground mining needs.

Powder Factor

- For OB -0.3 Kg/Cum of OB
- For Coal-0.2 Kg/Te of Coal

7.5 Year wise Weighted Average lead (in Km):

YEAR-WISE AVERAGE LEAD									
PARTICULARS	**UNIT**	**YEARS**							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
COAL	Km	0.58	0.73	0.89	1.04	1.20	1.31	1.41	1.51
OBR	Km	1.14	1.55	1.97	2.39	2.81	2.94	3.07	3.20

CHAPTER-VIII

COAL QUALITY

Quality parameters of seams considered for the present report are given below:

Seam-X

Proximate Analysis Air dried basis			Ultimate Analysis Dmmf basis				Coking propensity		
M%	Ash% (Inb.)	VM%	C%	H%	CV Kcal/Kg	VM%	CI	CT	SI
1.5-3.4	21.7-26.1	26.7-28.4	84.3-85.9	5.1-5.4	8160-8380	33.9-35.1	5/7-18/20	C-E	

Seam- XA

Proximate Analysis Air dried basis			Ultimate Analysis Dmmf basis				Coking propensity		
M%	Ash% (Inb.)	VM%	C%	H%	CV Kcal/Kg	VM%	CI	CT	SI
1.5-3.6	23.4-24.4	24.7-28.0	83.8-85.3	5.1-5.5	8185-8435	33.0-37.7	9/11-24/26	C-G/G1	

Seam- XI

Proximate Analysis Air dried basis			Ultimate Analysis Dmmf basis				Coking propensity		
M%	Ash% (Inb.)	VM%	C%	H%	CV Kcal/Kg	VM%	CI	CT	SI
1.6-3.3	30.8-35.7	25.6-27.5	84.2-86.2	5.2-5.5	8205-8435	36.2-38.8	4/6-19/21	B-E/F	

Seam-XII

Proximate Analysis Air dried basis			Ultimate Analysis Dmmf basis				Coking propensity		
M%	Ash% (Inb.)	VM%	C%	H%	CV Kcal/Kg	VM%	CI	CT	SI
1.8-4.1	30.0-42.2	21.8-26.2	83.4	5.4	8160	36.6	5/7	C	

Seam-XIII

Proximate Analysis Air dried basis			Ultimate Analysis Dmmf basis				Coking propensity		
M%	Ash% (Inb.)	VM%	C%	H%	CV Kcal/Kg	VM%	CI	CT	SI
1.9-4.3	25.6-32.1	23.7-27.0	83.3-84.4	5.0-5.5	8140-8200	33.9-35.7	5-9/11	A/B-D	

The coals of seam X, XA & XI are high volatile and weakly caking in nature. Though the coal of seam X A has better caking property, their general grade varies from non-coking grade C- E long flame to medium coking WG-II-IV. The coals of seam XII & XIII are non-caking in nature. Their general grade varies from non-coking grade D to F.

CHAPTER - IX

PUMPING AND DRAINAGE

It is proposed to make garland drains around the quarries and divert the surface water including rainwater from catchments area to nearby natural course of water / nallah.

The main pumps will handle the quantity of water inflow during a day of peak rainfall in monsoon.

During the heavy monsoon period, the work in lower most bench may have to be stopped as it will not be possible to pump out the entire make of water on the wettest day. Therefore, it is proposed to draw a part of the lower-most bench which would then act as sump.

Water accumulated in the sump will be pumped out to the surface and discharged into the nallah flowing outside the quarry. It is proposed to create a sedimentation lagoon by constructing a series of check dams across the nallah. The lagoon will help to separate the suspended solids from the mine water.

9.1 Calculations and Assessment of volume of water to be pumped:

The calculation has been done taking into consideration the entire area of the quarry of the proposed mine. Pumping system has been designed for the volume of water accumulated in the mine at the final stage of production considering probable maximum daily rainfall as 152mm. Pumping capacity worked out as under (considering water to be pumped out in 120 hrs. @ 20 hrs. pumping per day). The volume of maximum precipitation of water in the mine taking 10% for seepage and underground precipitation due to nearby nallah / Choutha river on the day of maximum rainfall has been as under:

QUARRY

At the end of	Catchment's area in km^2				Depth of mine (m)	Max. ^{m} probable rainfall in a day (mm)	Volume of water ('000 Cum/day)
	Total quarry area	Mined-out area	Internal dump area	Area beyond excavation			
5th year	0.50	0.50	0.00	0.025	65	152	58.938
8th year	0.589	0.589	0.00	0.0325	145	152	76.619

9.2 Pumping Capacity

PUMPING CAPACITY REQUIRED :

Probable water accumulation on the day of maximum rainfall taking 10% for seepage and underground precipitation = 76619Cum.

Pumping capacity/hr = 638 cum/hr (177 lps).

SELECTION OF PUMPS AND DELIVERY RANGES:

On the basis of the calculation and providing standby pumping capacity, the main pumps have been provided for each quarry.

Main Pumps

Three nos. of 300 Cum./hr.x 170 m head pumps and three nos. 300Cum /hrx90 m head pumps have been provided for the mine.

Low Head Pumps

Besides the above main pumps three nos. of 150 Cum./hr.x 60 m head pumps have also been provided to dewater the quarry for their initial years of operation when depth of quarries will be less.

Diesel Pumps

One number of 300 Cum. /hr. x 170 m head diesel pump has been provided for emergency requirement.

Face Pumps and Slurry Pumps

Three nos. of Face Pumps of 50 Cum./hr. x 60 m head and three nos. of Slurry Pumps of 80 Cum./hr. x 45 m head capacities have been provided to pump out the water & slurry respectively accumulated near the working faces.

CHAPTER-X

COAL HANDLING & DESPATCH ARRANGEMENTS

10.1 Introduction

Coal handling plant has been proposed to handle 1.3 MT of coal per annum. ROM coal from mine will be transported to receiving pit of CHP through Rear discharge dumper. At receiving pit, coal will be crushed down to (-) 100 mm for onward transportation to siding. Coal from the sizer will be transported to nearby New Kuju siding located at a distance of about 3.5 km. The coal handling plant has also been provided with suitable repair, communication and other auxiliary facilities to meet the day to day requirement in the plant operation. Crushing and conveying will be done in three shifts per day and seven days a week. The design capacity of CHP has been fixed as 500 tph.

10.2 Design parameters

10.2.1 Basic Data

Description	Considered data
Production capacity in MTY	1.3
No. of working days / annum	330
No. of working shifts / day	3
Duration of each shift (hours)	8
Effective working hours/day	15
Feed size of R.O.M coal in mm	1200
Product size of coal in mm	(-) 100
Loading /despatch hours	Round the clock.
Average Grade of coal	G6
Consumer	Basket linkage
Mode of Despatch	By tipping truck

10.3 System description

ROM coal of (-) 1200 mm size transported in 60 te rear discharge dumpers will be fed into receiving pit hopper. The coal from the receiving pit hopper will be fed into the Primary sizer through apron feeder provided below the receiving hopper. Crushed coal (-) 100 mm will be transported by tipping truck to nearby New Kuju siding, that is located at a distance of about 3.5 km

10.4 Plant description

The Run-Off-Mine coal from the open cast Project shall be received into receiving pit by means of rear discharge dumpers. Receiving pit has been provided with sufficient capacity hopper. The ROM coal will be unloaded into the receiving hopper of twin shaft sizer. The coal will be reclaimed by apron feeder and fed to twin shaft sizer for crushing to specified size of (-) 200 mm. Crushed coal of (-) 100 mm will be collected by the conveyor(C1) of 1200 mm wide and 500 tph, installed underneath the twin shaft sizer and to carry up to truck loading hopper.

Dust control, Noise control, Fire fighting arrangements and Plant cleaning system are provided as per standard provision. The coal produced from this mine has been proposed to feed to nearby New Kuju Siding.

CHAPTER-XI

WORKSHOP

COAL & OB DEPARTMENTAL

11.1 Introduction

A new unit workshop has been proposed. Any major repair of equipment and manufacturing of spares on large scale are beyond the scope of this workshop. These works will be carried out in Regional Repair Shop or Central Workshop, Barkakana.

CHAPTER-XII

POWER SUPPLY, ILLUMINATION AND COMMUNICATION

12.1 Power Supply

12.1.1 Source of Power & Supply Voltage

Kuju substation cum switching station (installed capacity 2 x 10 MVA, 33 /11 kV) is the source of power for the Mines in Kuju area. This sub-station is located at Mourpa which is about 5 km from Kuju Project. This Sub-station receives power at 33kV by means of 2 nos. 33 kV OHTL feeders from DVC's S/S at Naisarai.

12.1.2 Proposed Scheme of Power supply & Distribution

It is proposed to install a 33/6.6 kV, 2x2MVA sub-station for distribution of power to cater power demand of surface and quarry loads of the Project. This proposed sub-station will receive power at 33 kV through double circuit 33 kV OHTL to be erected from Mourpa Switching cum sub-station.

Provision for 5 Km. length of 33 kV double circuits OHTL with "WOLF" conductor and other accessories have been made for this purpose.

CHAPTER – XIII

CIVIL CONSTRUCTION

13.1 Buildings

13.1.1 Residential buildings

For residential buildings 55% housing satisfaction has been provided. The maximum manpower provision for this project is 659. Maximum number of quarters required is 362 at 55% housing satisfaction. There are 702 no. of quarters existing, so provision has not been made for construction of residential building.

13.1.2 Service buildings

It is proposed to utilize existing facilities of service and welfare buildings. Provision has been made in this report for construction of Site office, workshops, Store, substation, first aid center, canteen & rest shelter etc.

13.2 Roads & culverts

13.2.1 Approach road to project and Haul road

It has been proposed to construct 0.5 km. long approach road to the project. The maximum length of haul road has been estimated as 0.5 km.

13.2.2 Diversion of NH 33

Within the proposed area of quarry, NH 33 had collapsed due to fire in the abandoned UG mine. The diverted road has been constructed by NH Authority at the cost of Rs. 1277.50 lakh. This amount has to be paid by CCL to NH Authority before starting mining operations. Provision has been made for this in the report.

13.2.3 Source of water

Source of water for industrial use will be mine water.

CHAPTER- XIV

SAFETY & CONSERVATION

Deploying HEMM or any equipment in the mine for winning of coal shall be planned in confirmation with the prevailing statutory provisions as per Mines Act 1952 and CMR 1957 applicable for safety in opencast mines. However, all statutory rules, regulations, applicable laws etc. and statutory requirement related to Govt. licenses, workers compensation, Insurance, etc., including minimum wage act for workers employed in the mine shall have to be adhered to. Rules, if any imposed by local/State/Central authorities are to be complied by the mine authorities. Mine authorities shall have to supply various protective equipment viz. helmet, shoes etc. to the workmen at their cost.
All the regulations & schedules of Coal Mines Regulations 1957 relating to opencast mining have to be adhered to and implemented in order to maintain day to day safety precautions as per stature.

Safety aspects for deployment of Dept. equipment, outsourcing/hiring of HEMM/equipment

Special precaution should be taken while deploying workers in the mine. Before employing any labour to the mine proper vocation training should be imparted and recommendations of VIII Safety Conference should be strictly followed. Management for deployment of labours by outside agency shall fix terms and conditions. Some of the major aspects are as follows: -

A) **For persons**:

i) No persons shall be deployed unless he is trained at VTC

ii) Records in Form-B & Form-D shall be maintained.

iii) Records of Vocational training Certificate and driving license of operators shall be kept at the mine and shall be made readily available for inspection by management.

iv) No person shall be employed unless the person holds VTC certificate and Management is informed. A record of it shall be maintained.

v) Qualified competent persons shall maintain adequate supervision.

vi) Outside agency (if any deployed in mine) shall follow safety guidelines and safety instructions from Project Authorities.

B) <u>For Machineries as recommended by DGMS Cir. (Tech.) 1 of 1999:</u>

i) All the machineries to be deployed in mines should be checked before deployment by competent authority.

ii) Regular checking of m/c deployed by outside agency shall be done. No unfit machine shall be deployed before the defect is rectified.

iii) A proper record of repair and maintenance along with inspection done by management and defect pointed out shall be maintained and signed by authorized person.

iv) The trucks deployed outside agency shall be provided with Audio visual alarms, proper light for use at night and period when natural light is not sufficient. Also audio-visual alarms for reversing on trucks shall be provided.

Other Precautions for machines

i) RTO certificate photo copies of all vehicles shall be submitted to management

ii) Daily welding, monitoring, inspection shall be done by the agency's mechanic as directed by management.

iii) Machine manufacturers should be asked to give risk analysis details in respect machines deployed by outside agencies.

iv) Suitable type of the fire extinguishers shall be provided in every machine.

C) **General**

i) No person/vehicle shall be deployed at any place other than authorized place.

ii) All workers should obey lawful instruction of mine management.

iii) Risk Management Plan of tipper/pay loader shall be made and implemented.

iv) All drivers shall obey systematic traffics rules prepared by management

v) Before deploying workers they must be trained and briefed about safety aspects in opencast mine. However during course of execution of the work, if any accident occurs whether major or minor, the matter shall have to be immediately informed to mine management i.e. Colliery Manager/Agent/owner so that Notices of accidents in a accordance of (Reg.9 of CMR 1957) and Section 23 of Mines Act 1952 may be given and other necessary steps may be taken in accordance with the Mines Act 1952.

vi) Mine shall be operated in such a way so as to minimize pollution in the mine.

Stability of Benches, Quarry High walls and Spoil Dumps:

During quarry operations, it is necessary to adopt required mining parameters for the stability of benches, high walls and spoil dumps. It is also mandatory to examine systematically the fencing of mine workings, landslides and cracks between benches. It is required to maintain well-graded and wide roads on benches keeping the width of working areas sufficient for spreading of blasted rock and movement of the mining and transport equipment.

During actual mining operation, systematic observations of the condition of benches, high wall slopes and spoil dumps should be carried out and the dimensions be modified if necessary to suit the local conditions.

Precautions against Danger from Surface Water

1) A careful assessment is to be made against the danger from surface water before the onset of rainy season. The necessary precautions should be clearly laid down and implemented. A garland drain needs to be provided to drain away the surface rainwater from coming into the mine.

2) Inspections for any accumulation of rainwater, obstruction in normal drainage and weakening in embankment.

3) Standing order; for withdrawal of working persons in case of apprehended danger.

4) During heavy rain inspection of vulnerable points is essential. In case of any danger persons are to be withdrawn to safer places.

5) Nallah or water inlets may be diverted or isolated by embankments if so required.

Prevention of Flooding of Equipment Deployed at Bottom Horizons

During the heavy monsoon period, the mining operation in the lower-most bench may have to be stopped. Therefore, it is proposed to drown the lower-most bench, which would work as a sump. The water will be pumped out and discharged into the nearby Chowtha nala. For ensuring safety of the equipment while working out bottom horizons with no access to surface profile, the following measures should be taken:

1) Drivage of initial trenches and coal cutting on bottom benches should be done during the dry period of the year.

2)Ramps should be made for quick shifting of equipment from bottom horizons, liable to be flooded during monsoon period, to the top horizons.

Prevention of Electric Shocks

During mining operations, all the statutory provisions of the Indian Electricity Rules 1956, and Indian Standards for installation and maintenance of electrical equipment etc. should be observed.

1)For protection from electric shocks to persons, from electrical equipment with voltage up to 1000V Earth Leakage Relay should be provided which will automatically disconnect electrical circuits.

2)Closed mobile substations and switchgears should be mechanically interlocked which exclude the possibility of opening the door when oil switch and air circuit breakers are in operation.

3)All metal parts of electrical equipment should be properly earthed to avoid failure of insulation.

4)All H.T lines and cables located within the blasting zones should be disconnected during blasting operations.

Dust Suppression & Dilution of Exhaust Fumes

The following measures should be adopted for dust suppression at all quarry working places, dumps, haul roads, CHP and near other auxiliary mining operations.

1)Spraying with water on all working faces & haul roads, by special spraying machines or water-sprinkler.

2)While drilling holes, it is necessary to use dust extraction devices.

3)Installation of local dust suppression and air conditioning devices in cabins of excavators and drilling rigs may be considered.

4)Leveling of spoil dump surface.

5)Separate dust suppression arrangement should be provided for CHP.

To prevent collection of harmful mixtures in the atmosphere, from the different sections of quarry workings, it is recommended: -

1)To spread out the sources of dust formation and omission of harmful gases throughout the working area of the quarry.

2)Drilling & blasting operations should be timed for periods of maximum wind activity during the day.

3)Dumpers may be provided with purifiers for exhaust gases.

Measures to be taken for Fire Fighting and Fire Prevention

In addition to statutory provisions, the measures for firefighting and prevention of fires are as follows:

1)Organization of special cell for systematic observations to examine and prevent fire.

2)Removal of spillage of coal on benches and cleaning of coal horizons to prevent cases of coal heating.

3)Storage of lubricants and cotton waste in enclosed fireproof containers in working places.

4)Provision of fire extinguishers

Measures to be taken while Drilling Blasting

Following measures should be taken while drilling and blasting operations in the quarry:

1)Drilling and Blasting in quarry should be done in accordance with the provisions of Mines Safety Act, rules and regulations. While working above underground workings DGMS Circulars should be strictly adhered to.

2)Adequate safety measures have to be taken during blasting operation in the quarry so that men/machine is not affected.

Conservation

Conservation of coal enjoins maximum recovery of in-situ reserves of coal and its proper utilization.

Coal deposits in Kuju OCP mining block upto Seam X are potential seams for opencast mining, both qualitatively and quantitatively. These aspects are taken into account during mine planning and operation in ensuring maximum recovery.

Opencast mining using shovel dumper system is one of the very important technology of coal production of thick or even thin seams from shallow depth upto economic stripping ratio (cubic metre of overburden required to be removed to raise one tonne of coal). The coal production from opencast method in Indian mining is more than 75% of total production. This trend is likely to continue in near future.

CHAPTER – XV

ENVIRONMENTAL MANAGEMENT

The Environment Management Plan is one of the most important subjects to deal with after the preparation of the Project Report. During mining operation, degradation of land, air, water, soil, noise, flora and fauna etc. occurs. Socio economic, hydro-geological strata are also affected and these are taken into consideration at the time of preparation of EMP.

15.1 Existing Environment Quality

Pre-mining observation is to be done in the above mentioned field. A base line data in environmental study is to be done and accordingly Environmental Impact is assessed. These basic data are taken from Pre-feasibility report, PR, Terms of Reference (TOR) etc. It covers the core zone of the project as well as Buffer zone, which is 10 km away from periphery of the core zone.

All the parameters related with environment will be studied for preparation of Environment Management Plan.

15.2 Environmental Impact Assessment

The mining operation in Kuju OCP will generate a series of activities, which will produce air pollutions, waste water and effluent. It generates high noise level, degrade land and also will have impact on flora fauna. The project activities would also have impact on socio-economic profile of the area.

It is proposed to assess the likely impact of the mining in and around the surrounding of the project.

15.3 Environmental Control Measures

Mitigation measures are broadly divided into preventive measure and suppression measure. Stress is given on mitigation measure, which is well effective and economical and are discussed in detail in EMP report.

15.4 Environment Management Plan

For effective implementation, mid-term corrective measures, monitoring and control measure of environmental management plan depends on time bound action programme. The success of environmental management plan depends on the well set-up organization with dedicated persons. The objectives for preparation of Environmental Management Plan are:

To implement environmental control and protection measures;

Subsequent environmental monitoring of the efficacy of various control measures;

Plantation / Green Belt Development;

Land restoration;

Keeping in view of the above, details of the organizational structure responsible for the implementation of environmental control and mitigation measures as well as monitoring of such implementation will be discussed in the EMP.

15.5 Cost Estimate

All the above activities in EMP accrue some cost. The estimated capital for capital outlay in mines and capital expenditure on environmental protection measures are provided in the Detailed Project Report of Kuju OCP.

15.6 Company Social Responsibility

Company also performs some social works such as opening of primary schools and higher secondary schools for providing the education to local people, establishment of dispensaries and hospitals, medical camps for providing better health facilities, vocational training to unemployed youth for better employment digging of wells and bore wells for drinking water facilities etc. for welfare of the local people. These works are done with the fund generated @ 2% of retained earnings under the head of company social responsibility scheme.

15.7 Rehabilitation and Resettlement

Rehabilitation site is yet to be proposed for about 145 PAFs (as informed by mine officials).

Resettlement and rehabilitation will be done according to R&R Policy of Coal India Limited.

CHAPTER-XVI

LAND

16.1 Total leasehold area for Kuju opencast

The total requirement of land for Kuju Opencast Project has been estimated as 173.89 Ha. (As documentary evidences furnished by mine officials). It includes 38.54 Ha. of Notified forest land, 72.48 Ha of GMK JJ and 62.87 Ha. of non-forest land. The break-up of land on different heads are shown in the following tables.

Table 16.1

As per Inputs supplied by Project

Sl. no	Particulars	Notified Forest(Ha)	GMK JJ(Ha)	Non- Forest land(Ha)	Total (Ha)
1	Quarry	35.31	8.14	15.49	58.94
2	External OB dump	0	46.83	21.19	68.02
3	Infrastructures(W/S, CHP, S/S)	0	0	3.98	3.98
4	Others-Vacant land / Proposed Green Belt	2.1	14.06	20.91	37.07
5	Safety zone	1.13	3.45	1.3	5.88
6	**Total land required for Project**	**38.54**	**72.48**	**62.87**	173.89
7	Land already in physical possession	0	0	12.81	12.81
8	**Balance Land to be acquired**	**38.54**	**72.48**	**50.06**	161.08

CHAPTER-XVII

MINE CLOSURE PLANNING

Mine closure encompasses rehabilitation process as an ongoing programme designed to restore physical, chemical and biological quality disturbed by the mining to a level acceptable to all concerned. It aims at leaving the area in such a way that rehabilitation does not become a burden to the society after mining operation is over. It must also aim to create as self-sustained ecosystem.

Mine closure operation is a continuous series of activities starting from day one of the initiation of mining project. As progressive mine closure is a continuous series of activities, it is obvious that the proposals of scientific mining have included most of the activities in the progressive mine closure plan.

Final mine closure plan as per statute, shall be considered to have its approval at least nine months before the date of proposed closure of mine. This period of nine months is reckoned as preparatory period for final mine closure operations.

Kuju Mine shall have mine closure plan, which shall of two types:

a) Progressive Mine Closure Plan; and
b) Final mine closure plan

17.1 Mine Closure Plan Corpus

Particulars	Formula Used
Escrow amount per Ha for OC project as on April, 2012 (in Rs Lakhs)	Escrow amount per Ha for OC project as on April, 2009 (in Rs Lakhs)x (WPI as on April, 2004 / WPI as on Aug, 2009)x baseline conversion factor 1.561
Corpus Value based on April, 2012 rate (in Rs. Lakhs)	Project Area (Ha) x Escrow amount per Ha for OC project as on Aug, 2012 (in Rs Lakhs)
Current value of Corpus as on 01.04.17 (in Rs. Lakh)	Corpus Value based on Aug, 2012 rate (in Rs. Lakhs) x WPI as on April, 2017 / WPI as on Aug, 2012
Balance Corpus for which provision is to be made as on 01.04.17 (in Rs. Lakh)	Current value of Corpus (in Rs. Lakh) - Amount deposited (excluding interest) till 01.04.17 (in Rs. Lakh)
Annual corpus (Balance corpus / Balance life, in Rs. Lakh)	Balance Corpus for which provision is to be made as on 01.04.14 (in Rs. Lakh) / Balance Life of mine as on 01.04.14 (in years)
The annual corpus amount is to be deposited in escrow account every year with 5% escalation.	

Corpus Calculation

Project Area (Ha)	173.89
Area outside overlapping (Ha)	65.72
Escrow amount per Ha for OC project as on April, 2012 (in Rs Lakhs) @ Rs 6 lakh / Ha*(100/129.60)*1.561	7.23
Area overlapping between Kuju UG & OC (Ha)	108.17
Escrow amount per Ha for overlapping area as on April, 2012 (in Rs Lakhs). This calculation has been done @ Rs 6 Lakh per Ha for OC- Rs 1 Lakh per Ha for UG as per August, 2009 base. = Rs 5 lakh / Ha* (100/129.60)*1.561	6.04
Corpus Value based on April, 2012 rate (in Rs. Lakhs)	1128.5024
WPI as on April, 2012	100
WPI as on April, 2017	113.2
Current value of Corpus (in Rs. Lakh)	1277.46
Provision made till year 2016-17 (in Rs. Lakh)	790.1
Balance Corpus for which provision is to be made(in Rs. Lakh)	487.36
Balance Life of mine as on 1.4.17 (in years)	8
Annual corpus (Balance corpus / Balance life, in Rs. Lakh)	60.92
Year	**Amount in Lakh (Rs.)**
1	60.92
2	63.97
3	67.17
4	70.53
5	74.06
6	77.76
7	81.65
8	85.73
Total	**581.79**
Total Amount in Escrow Account (in Rs Lakhs)	**1371.89**

PROGRESSIVE AND FINAL MINE CLOSURE COST DISTRIBUTION				
	Total Amount in Escrow A/c (in Rs Lakhs)	**1371.89**		
SL. NO.	**ACTIVITY**	**% OF TOTAL MINE CLOSURE COST**	**AMOUNT IN LAKH (RS.)**	**Remarks**
A	**PROGRESSIVE CLOSURE ACTIVITIES**			
1	**OB Dump Reclamation**			
	Handling/ Dozing of OB Dump and back filling	71	974.04	Throughout the life of the mine
	Bio-reclamation including soil spreading, plantation and post care	0.4	5.49	Throughout the life of the mine
2	**Landscaping**		0.00	
	Landscaping of the open space in lease hold area for improving its esthetic	0.3	4.12	Throughout the life of the mine
3	**Plantation**		0.00	
	Plantation around the quarry area and in safety zone	0.2	2.74	Throughout the life of the mine
	Plantation over the external OB Dump	0.02	0.27	Throughout the life of the mine
	Entrepreneurship Development (Vocational/ skill development training for sustainable income of affected people	0.26	3.57	Throughout the life of the mine
	Miscellaneous and other mitigative measures	2	27.44	Throughout the life of the mine
	TOTAL (1)	**74.18**	**1017.67**	
B	**FINAL CLOSURE ACTIVITIES**			
1	**Dismantling of Structures**			To be included in final mine closure plan
	Service Buildings	0.2	2.74	
	Residential Buildings	2.67	36.63	
	Industrial structures like CHP, Workshop, field sub-station etc.	0.3	4.12	
2	**Permanent Fencing of mine void and other dangerous area**		0.00	To be included in final mine closure plan
	Random rubble masonry of height 1.2 metre including levelling up in cement concrete 1:6:12 in mud mortar	1.5	20.58	
3	**Grading of highwall slopes**		0.00	To be included in final mine closure plan
	Levelling and grading of highwall slopes	1.77	24.28	
4	**OB Dump Reclamation**		0.00	
	Handling/ Dozing of OB Dump and back filling	17.66	242.28	17.66% for final mine closure
5	**Plantation**		0.00	

	Plantation over cleared area obtained after dismantling	0.5	6.86	To be included in final mine closure plan
6	**Post Closure Env Monitoring/ testing of parameters for three years**			For three years after mine closure
	Air Quality	0.22	3.02	
	Water Quality	0.2	2.74	
7	**Post Closure Manpower cost for supervision**	0.8	10.98	To be included in final mine closure plan
	TOTAL (2)	**25.82**	**354.22**	
	GRAND TOTAL (1+2)	**100**	**1371.89**	