MINING PLAN
(Including Mine Closure Plan)

FOR

RAJBAR 'E & D' COAL MINE

(ALLOTTED AREA - 1487 ha)
(PROJECT AREA – 1351 ha)

IN

AURANGA COALFIELD

DIST. – LATEHAR, STATE – JHARKHAND

APPLICANT

TENUGHAT VIDYUT NIGAM LIMITED

At. – Hinoo, P.O. – Doranda
Dist. – Ranchi, State – Jharkhand
PIN – 834002

Capacity – 10 MTPA

OCTOBER – 2018

(VOL.- I – TEXT & ANNEXURES)

PREPARED BY

VIJAY KUMAR SINGH

(RQP N0.34012/ (03)/ 2014- CPAM dated – 29/05/2015)
HILL TOP, MAHALLA – CHANDWE, KANKE ROAD,
RANCHI – 834008, JHARKHAND

Rajesh Ranjan

MINING PLAN
(Including Mine Closure Plan)

FOR

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(ALLOTTED AREA - 1487 ha)
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DIST. – LATEHAR, STATE – JHARKHAND

ANANDA KUMAR MANDAL
Under Secretary
Ministry of Coal
Govt. of India

APPLICANT

TENUGHAT VIDYUT NIGAM LIMITED

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Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

(VOL.- I – TEXT & ANNEXURES)

Rajesh Ranjan
TVNL, Hinoo, Ranchi-834002
27 DEC 2018

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(RQP N0.34012/ (03)/ 2014- CPAM dated – 29/05/2015)
HILL TOP, MAHALLA – CHANDWE, KANKE ROAD,
RANCHI – 834008, JHARKHAND

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Vijay Kumar Singh
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[Recognition No. ...2/(03)/2014-CPAM
Dated: 29.05.2015]

ANANDA KUMAR MANDAL
Joint Director / Under Secretary
Ministry of Coal / Govt. of India

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TVNL, Hehal, Ranchi-834002
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ABBREVIATIONS USED

agl	-	above ground level
Annex	-	Annexure
bgl	-	below ground level
Bhs	-	Boreholes
C	-	Carbon
CBD	-	Coal Body Dumper
CHP	-	Coal Handling Plant
CIMFR	-	Central Institute of Mining & Fuel Research
CMPDIL	-	Central Mine Planning & Design Institute Limited
Co.	-	Company
C.P.	-	Crushing Point
Cum	-	Cubic metre
Cum/t	-	Cubic metre per tonne
Deg	-	Degrees
DGM	-	Directorate of Geology & Mines
DGMS	-	Directorate General of Mines Safety
DMMF	-	Dry Mineral Matter Free
DVC	-	Damodar Valley Corporation
E	-	East
E.O.M	-	End of Mine
EAC	-	Environmental Appraisal Committee
EUP	-	End Use Plant
EUPs	-	End Use Plants
Ex. Band	-	Excluding Band
FBC	-	Fluidized Bed Combustion
FEL	-	Front End Loader
FT	-	Fusion Temperature
gl	-	ground level
GCV	-	Gross Calorific Value
GDEM	-	Global Digital Elevation Model
GoI	-	Government of India
Govt.	-	Government
GR	-	Geological Report
GSI	-	Geological Survey of India
H	-	Hydrogen
ha	-	Hectare

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HBH	-	Hydraulic Back Hoe
HEMM	-	Heavy Earth Moving Machinery
HGI	-	Hard Grove Grindability Index
HP	-	Horse Power
I_{100}	-	Including combustible dirt band up to 100 cm thickness
IB	-	Inter Burden
IBM	-	Indian Bureau of Mines
IDT	-	Initial Deformation Temperature
IPCC	-	Inpit Crushing and Conveying
ISP	-	Indian Standard Procedure
Kg.	-	Kilogram
Kl	-	Kilolitre
Km	-	Kilometre
KV	-	Kilovolts
Kw	-	Kilowatt
LAN	-	Local Area Network
LMV	-	Light Motor Vehicle
Lps	-	Litre per second
LS	-	Lump sum
M	-	Million
m	-	meter
M/s	-	Messer's
Max.	-	Maximum
MCR	-	Mineral Concession Rules
Mbcm	-	Million bank cubic metre
Min	-	Minutes
ML	-	Mining Leasehold
mm	-	millimetre
MoC	-	Ministry of Coal
MoEF & CC	-	Ministry of Environment, Forests & Climate Change
MSL	-	Mean Sea Level
Mtes	-	Million tonnes
MTPA	-	Million Tonnes Per Annum
MW	-	Mega Watt
N	-	North
NA	-	Not Applicable
NCB	-	Non Combustible Band
NH	-	National Highway

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OB	-	Overburden
OBR	-	Overburden Removal
OCP	-	Opencast Project
PLF	-	Plant Load Factor
ppv	-	peak particle velocity
RCC	-	Reinforced Cement Concrete
RD	-	Rear Dumper
RH	-	Relative Humidity
RL	-	Reduced Level
ROM	-	Run-off Mine
RQD	-	Rock Quality Designation
RQP	-	Recognised Qualified Person
S	-	South
Sec	-	Second
SMS	-	Site Mixed Slurry
SoI	-	Survey of India
Sp. Gr.	-	Specific Gravity
t	-	tonnes
ToR	-	Terms of Reference
T.P.	-	Transfer Point
tph	-	tonnes per hour
TPS	-	Thermal Power Station
TVNL	-	Tenughat Vidyut Nigam Limited
Ug	-	Ungraded
UHV	-	Useful Heat Value
VM	-	Volatile Matter
W	-	West
WG	-	Washery Grade
WM	-	Weathered Mantle
Yr	-	Year
Yrs	-	Years

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ESE (P&S)
TJ DEC 2024

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PROPONENT	MINING PLAN
TENUGHAT VIDYUT NIGAM LIMITED	Rajbar E & D Coal Mine

CHECKLIST FOR MINING PLAN AND MINE CLOSURE PLAN

	Parameters	Details		Observation
1	**DETAILS OF THE BLOCK**			
a.	Name of Coal/ Lignite Block	Rajbar E & D Coal Mine		
b.	Name of the Coalfield/ Coal belt	Auranga Coalfield		
c.	Particulars of adjacent blocks: North, South, East, West	**North :** Rajbar A, B & C – CCL blocks **South:** Metamorphic rocks and then Banhardih coal block. **East:** Metamorphic rocks **West:** Coal bearing area yet to be blocked and allocated		
d.	Topo sheet No with latitude and longitude	**Vesting Order** Allotment order dated 30-06-2015 together with amendment issued as corrigendum on 21-12-2016.	**Mining Plan & Mine Closure Plan**	
	Topo sheet No	F45A9 RF 1:50000	F45A9 RF 1:50000	
	Latitudes (N):	23° 45' 27.491" N to 23° 48' 2.680" N	23° 45' 27.491" N to 23° 48' 2.680" N	
	Longitude (E):	84° 37' 38.780" E to 84° 40' 27.119" E	84° 37' 38.780" E to 84° 40' 27.119" E	
e.	Location of the Block District / State	District – Latehar State – Jharkhand		
f.	CMPDIL Certificate of the project boundary of the Mining Plan	CMPDI Letter No. CMPDI/DG/Captive/153/770 dated 20.07.2016 defining the project boundary, is enclosed as "***Annex. No. – II***" and a certificate of CMPDI vide letter no. CMPDI/BD/C(686-A)/E-220387/I-4734 dated 26.10.2018 enclosing certified plan with its observation placed in the text as "***Annex. – II A***".		
g.	Type of the Project (Operating / under Implementation)	Under Implementation		
2	**DETAILS OF THE PRESENT PROPOSAL**			
a.	**BASE DATE OF MINING PLAN/ MINE CLOSURE PLAN**	Base date for this Mining Plan is July 2018.		
b.	**Scope of The mining plan**	This mining plan is for opencastable coal layer going upto Seam III Bottom.		
3	**ALLOTTEE COMPANY DETAILS**			
a.	Name the Mine Allottee	Tenughat Vidyut Nigam Ltd. (TVNL)		
b.	Status of the Applicant Company	State Government Undertaking of Jharkhand State		
c.	Details of allotment/ vesting order	Allotment Order dated 30.06.2015 and Corrigendum No. 1 dated 21.12.2016, issued by MoC, is incorporated as "***Annex. – I & I A***".		

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	Parameters	Details		Observation
d.	Name and address of the applicant	Regd. Office Tenughat Vidyut Nigam Ltd. At. – Hinoo, P.O. – Doranda, Dist. – Ranchi, Jharkhand, PIN – 834002	Principal Place of Business Tenughat Thermal Power Station Village + P.O. – Lalpania Dist. – Bokaro, Jharkhand PIN – 829149	
e.	Relationship between the applicant and allottee company	Applicant and allottee company is Tenughat Vidyut Nigam Ltd.		
f.	Name and address of RQP with registration No	**Vijay Kumar Singh** Hill Top, Mahalla – Chandwe, Kanke Road, Ranchi – 834008, Jharkhand Mob. 08226865342 Email – vijay7143@gmail.com, **Recognition Number: 34012/ (03)/ 2014-CPAM** **dt – 29/05/2015** **Valid till 28.05.2025**		
g.	Name of the Previous allottee of the Block	Tenughat Vidyut Nigam Ltd. (TVNL)		
4.	**DETAILS OF THE PREVIOUS APPROVAL OF MINING PLAN** – There is no previously approved Mining Plan.			
a.	Date of Approval	Not Applicable		
b.	Conditions, if any	Not Applicable		
c.	Scheduled year of start of production	Not Applicable		
d.	Proposed year of achieving the targeted production	Not Applicable		
e.	Date of actual commencement of mining operations, if operations already started	Not Applicable		
f.	Likely date of mining operations, if operations not yet started & reasons for non-commencement of operations	Not Applicable		

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Hinoo, Ranchi-834002
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alified Person)
12/(03)/2014-CPAM
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	Parameters	Details	Observation

g. Planned production and actual levels achieved in last 3 years (Coal in Mte, OB in MM^3, SR in M^3/te) - **Not Applicable**

Calendar year		Planned		Actual Coal Production "Mte"				
		Coal	OB	UG	OC	Total "Mte"	OB "MM^3"	SR
Year – 1	2007-08							
Year – 2	2008-09							
Year – 3	2009-10							
Year – 4	2010-11							
Year – 5	2011-12							
Year – 6	2012-13							
Year – 7	2013-14							
Year – 8	2014-15							
Year – 9	2015-16							
Year – 10	2016-17							
	Total							

h.	Reasons for difference between the planned and actual production levels	Not Applicable	
5.	**DETAILS OF CHANGES IN THE NEW MINING PLAN COMPARED TO EARLIER APPROVAL**		
		No Previous Approved Mining Plan	**Current Mining Plan**
a.	Lease area "Ha"	Not Applicable	1351
b.	Project Area "Ha"	Not Applicable	1351
c.	Life of the Project "Yrs"	Not Applicable	48
d.	Minimum and Maximum Depth of working "m"	Not Applicable	33 (Minimum) 474 (Maximum)
e.	Geological Block "Ha"	Not Applicable	1487
f.	Production Target "MTPA"	Not Applicable	10
g.	Seams Available "As per GR"	Not Applicable	9
h.	Seams not considered for Mining with Reasons	Not Applicable	Seam I & II are envisaged for U/G Mining after 7 years of coal production in OC mine
i.	Geological Reserve "Mt"	Not Applicable	574.86 (upto Seam III)
j.	Blocked Reserve "Mt"	Not Applicable	124.67 + 7.85 = 132.52
k.	Minable Reserve "Mt"	Not Applicable	442.34
l.	Extractable Reserves "Mt"	Not Applicable	420.22
m.	% of Extraction/ recovery	Not Applicable	73
n.	Reserve Depleted (till the base date) Reserves " Mt"	Not Applicable	Not Applicable
o.	Balance Extractable reserve "Mt"	Not Applicable	Not Applicable
p.	Average Grade	Not Applicable	G – 11
q.	OB in Mm^3	Not Applicable	2119
r.	SR Mm^3/te	Not Applicable	5.04

Vijay Kumar Singh
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[Recognition No. 34012(03)/2014-CPAM
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	Parameters	Details		Observation
s.	Mining Technology	Not Applicable	Opencast with Surface miner for coal and shovel dumper for OBR	
t.	Coal Beneficiation envisaged	Not Applicable	No	
u.	Handling of Rejects	Not Applicable	Not Applicable	
v.	Land use pattern "Ha"	-	-	
1.	Excavation Area	Not Applicable	1262	
2.	Top Soil Dump	Not Applicable	Within Excavation area	
3.	External Dump	Not Applicable	NIL	
4.	Safety Zone	Not Applicable	NIL	
5.	Other Use	Not Applicable	25.2	
6.	Infrastructure area	Not Applicable	33.9	
7.	Green Belt	Not Applicable	28.9	
8.	Undisturbed Area	Not Applicable	1 ha	
	Total		**1351 ha**	
w.	**Reasons for Revision**	Not Applicable	Not Applicable	
6.	**END USE OF COAL/LIGNITE**			
a.	End Use of Coal/ Lignite as per approval by the Competent Authority	Tenughat Thermal Power Station for Power Generation		
b.	Norms adopted for calculating ROM quantity requirement based in the allotment order			

	Clinker "MTPA"		Power Plant "MW"		Blast Furnace "MTPA"	
Capacity of the end use plant	NA	NA		660x2	-	-
				Proposed		

Capacity of the Project "MTPA"				10		
Raw Coal availability from this project "MTPA"				10		
Washed coal availability "MTPA"				NA		
Reject "MTPA"				NA		

Station Heat Rate "K Cal/Kwhr				2250		
Avg Calorific Value of Coal "Kcal/Kg"				4100		
Raw coal				-		
Washed coal				-		
Rejects				-		
Specific consumption "Kg/Kwhr"						
Consumpdon Norm (Tons/MW/Annum)				4086		
Plant Load Factor/ Capacity Utilisation				85%		
Coal Requirement "MTPA"				5.39352		
Total Requirement for the End Use Plants "MTPA"	5.39352 say 5.40.					

Source of Coal Requirement

Coal from this project "MTPA"	10
Linkages/ E-auction from CIL "MTPA"	NIL
Other block of the Company "MTPA"	NIL
Total availability "MTPA"	10

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Vijay Kumar Singh
(Recognised Competent Person)
[Recognition No. 3401(E)(3)/2014-CPAM]

ANANDA KUMAR MANDAL
(Under Secretary)

	Parameters	Details	Observation
c.	Percentage of end use requirement to be met from this mine	100%, Any balance coal will be delivered to CIL or other users as per the then governmental norms.	
d.	If washing/ beneficiation of the coal/ lignite is planned to be conducted on site or adjacent to the extraction area, briefly describe the nature of the beneficiation and recovery rate, consumption of water etc.	No Beneficiation Planned	
e.	Proposed Use of Rejects/ Middling's	Not Applicable	
f.	Distance of End use plant from the pit head of the project in "km"	160 Km.	
g.	Mode of Coal Transport	Indian Railways	
7.	**EXPLORATION AND GEOLOGY**		
a.	Geological Block Area "Ha"	1487 ha	
b.	Status of Exploration of the block	Detailed Exploration done.	
c.	Area covered by 'detailed' exploration within the block (sq. km)	14.87 Sq. Km.	
d.	Whether entire block area has been covered by 'detailed' exploration.	Yes	
e.	No. of boreholes drilled within the block	97 borehole	
f.	Whether any further exploration/study is required or suggested and time frame in which it is to be completed	Not Required	
g.	Overall borehole density within the block (no./ sq. km) approx	6.5 Bh/sq. Km. in 1487 ha.	
h.	No of Seams available as per GR	7 seams–I to VII in Barakar Formation and 2 Seams – R1 & R2 in Raniganj Formation.	
i.	Seams not considered for Mining with Reasons	All seams have been considered for mining.	
j.	Dip of the Seam	Average over working area 1 in 7.5 (7.6°)	
k.	Seam wise Thickness and Depth with Reserve assessment (Given on next pages)		

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[Recognition No. 34012(03)/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
Chief Manager
TVNL, Winsa, Ranchi-834002

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PROPONENT	MINING PLAN
TENUGHAT VIDYUT NIGAM LIMITED	Rajbar E & D Coal Mine

7 (k) A – Seam wise Thickness and Depth with Reserve assessment

Seam	Thickness Range 'm'	Depth Range 'm'	Net Geological Res 'Mt'	Blocked Reserve below					Mineable Reserve 'Mt'		Mining Loss (5%)
				Highwall/ Batter	Nala/ River/ Road	Barrier	Un-economic	Total Blocked	UG	OC	
R2	0.80-5.73	16.90-112.75	9.36	1.49		0.06	-	1.55		7.81	0.39
Parting	1.05-17.95										
R1	2.49-6.54	24.70-122.86	14.47	2.28		0.09	-	2.37		12.11	0.61
Parting	97.49-151.85										
VII Top	0.36-6.12	6.00-243.25	12.72	4.08		0.07	-	4.15		8.57	0.43
Parting	0.71-12.30										
VII Middle	0.60-22.10	5.20-246.67	127.27	13.94		0.20	-	14.14		113.12	5.66
Parting	2.45-16.29										
VII Bottom	0.18-3.10	30.66-266.26	6.57	3.08		0.09	-	3.17		3.40	0.17
Parting	6.12-61.42										
VI Top	0.30-13.19	13.81-310.65	22.85	3.82		0.05	0.05	3.92		18.95	0.95
Parting	0.81-11.15										
VI Middle	0.35-14.94	13.60-321.98	38.67	11.86		0.20	0.41	12.47		26.22	1.31
Parting	.21-16.47										
VI Bottom	0.09-15.70	25.94-337.30	30.92	7.56		0.40	0.48	8.44		22.54	1.13
Parting	9.77-83.80										
V	0.24-7.47	18.02-396.88	12.67	5.22		0.32	1.29	6.83		6.05	0.30
Parting	8.72-38.09										
IV Top	0.17-9.68	13.00-426.83	37.17	9.42		0.39	1.67	11.48		26.03	1.30

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Seam	Thickness Range 'm'	Depth Range 'm'	Net Geological Res 'Mt'	Blocked Reserve below					Mineable Reserve 'Mt'		Mining Loss (5%)
				Highwall/ Batter	Nala/ River/ Road	Barrier	Un-economic	Total Blocked	UG	OC	
Parting	0.73-22.12										
IV Middle	0.16-13.05	22.50-447.08	25.81	10.50		0.21	0.40	11.11		14.56	0.73
Parting	1.44-21.86										
IV Bottom	0.18-13.24	10.60-457.59	67.35	14.60		0.44	1.34	16.38		51.27	2.56
Parting	6.32-70.04										
III Top	0.25-8.59	18.84-515.16	27.70	6.82		0.25	1.03	8.10		19.76	0.99
Parting	1.44-40.50										
III Middle	0.24-10.39	9.50-415.90	19.83	2.30		0.18	0.80	3.28		16.45	0.82
Parting	3.95-37.52										
III Bottom	0.10-25.11	9.45-543.72	121.49	24.46		0.29	.38	25.13		95.51	4.78
Parting	12.44-72.19										
II Top	0.18-9.90	16.16-595.47	28.30	-		-	Nil	-		-	-
Parting	0.47-50.37										
II Bottom	0.17-7.54	24.24-607.15	33.45	-		-	Nil	-		-	-
Parting	4.24-45.20										
I Top	0.25-8.31	47.73-619.51	37.17	-		-	Nil	-		-	-
Parting	0.25-21.38										
I Bottom	0.15-11.80	48.50-630.50	32.24	-		-	Nil	-		-	-
Total			**706.03**	**121.43**		**3.24**	**7.85**	**132.52**		**442.34**	**22.12**

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7 (k) B – Seam wise Thickness and Depth with Reserve assessment

Seam	Extractable Reserve 'Mt'			As on base date 'Mt'							Reason not considered for mining
				Depletion of Reserve			Balance Reserve				
	UG	OC	Highwall	UG	OC	Highwall	UG	OC	Highwall	Total	
R2		7.42									
Parting											
R1		11.50									
Parting											
VII Top		8.14									
Parting											
VII Middle		107.46									
Parting											
VII Bottom		3.23									
Parting											
VI Top		18.00									7.85 Mt reserve of Seam III Bottom to VI Top has high stripping ratio and is uneconomic. This reserve is over 150 ha with thick population of 800 persons as such it would not be pragmatic to take out coal from these 150 ha.
Parting											
VI Middle		24.91									
Parting											
VI Bottom		21.41									
Parting											
V		5.75									
Parting											
IV Top		24.73									
Parting											

Vijay Kumar Singh
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[Recognition No. 2412(2/03)/2014-CPAM - 29.05.2015]

PROPONENT TENUGHAT VIDYUT NIGAM LIMITED	MINING PLAN Rajbar E & D Coal Mine

Seam	Extractable Reserve 'Mt'			As on base date 'Mt'							Reason not considered for mining
				Depletion of Reserve			Balance Reserve				
	UG	OC	Highwall	UG	OC	Highwall	UG	OC	Highwall	Total	
IV Middle		13.82									
Parting											
IV Bottom		48.71									
Parting											
III Top		18.77									
Parting											
III Middle		15.63									
Parting											
III Bottom		90.73									
Parting											
II Top	8.49	-									Reserve of 1.18 Mt of Seam I & II falls within Sukri River bed over 17 ha as such it cannot be mined.
Parting											
II Bottom	10.04	-									
Parting											
I Top	11.15	-									
Parting											
I Bottom	9.67	-									
Total	**39.35***	**420.22**									

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. [illegible]/(03)/2014-CPAM
Dated- 29.05.2015]

* - Precise estimation of extractable reserve for UG Mining would be made at the time of preparation of mining plan after 6 years of start of OC Mine.

Rajeev Ranjan
ESE (P & S)
Hinoo, Ranchi-834002
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	Parameters	Details	Observation
7.	**EXPLORATION AND GEOLOGY**		
l.	Average GCV	4276 Kcal/Kg	
m.	Gross Geological Reserve of the block "Mte"	784.48 Mte	
n.	Net Geological Reserve of the block "Mte"	706.03 Mte (R2 to III Bottom – 574.86 Mte and II Top to I Bottom – 131.17 Mte).	
o.	Blocked Reserve "Mte	124.67 Mte + 7.85 Mte = 132.52 Mte	
p.	Minable Reserve of the block "Mte"	442.34 Mte (Quarriable Seam R2 to III Bottom)	
q.	Corresponding extractable reserve of the block "Mte"	420.22 Mte	
r.	Percentage of Extraction	73%	
s.	Reserve already Depleted (Base date of Mining Plan)	Not Applicable	
t.	Balance Reserve (As on Base Date)	706.03 Mte	
8.	**MINING**		
a.	Existing method of mining if the mine is under operation	Not Applicable	
b.	Proposed method of mining with justification on suitability of method of mining	Opencast mining upto Seam III Bottom and Underground mining for remaining Seam I & II. The mining plan being submitted is for Opencast mine only. Mining plan for Underground mining would be submitted after 6 years of Opencast mining. Justification for these have been given in detail in Chapter – V on pages 7, 8 & 9.	
c.	Coal production capacity proposed "MTPA"	10 MTPA	
d.	Justification for optimization Coal production capacity	Extractable Reserve of 420.22 Mt over a mine life of 48 years excluding construction period of two years.	
e.	Calendar year from which the production will start	From the year 2019.	
f.	Year of Achieving rated production	In 8th year i.e. year 2025–26.	

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	Parameters	Details	Observation

g. Coal production Plan "MT"

Production Stage Years		Coal Production		OB "Mm³"	Cum SR
		UG	OC		
Y-1	2018-19		1	5.5	5.50
Y-2	2019-20		2	11	5.50
Y-3	2020-21		4	22	5.50
Y-4	2021-22		7	38.5	5.50
Y-5	2022-23		8	44	5.50
Y-6	2023-24		8	44	5.50
Y-7	2024-25		9	50	5.51
Y-8	2025-26		10	55	5.51
Y-9	2026-27		10	55	5.51
Y-10	2027-28		10	54	5.49
Y-11	2028-29		10	52	5.46
Y-12	2029-30		10	52	5.43
Y-13	2030-31		10	52	5.40
Y-14	2031-32		10	52	5.39
Y-15	2032-33		10	52	5.37
Y-16	2033-34		10	52	5.36
Y-17	2034-35		10	52	5.35
Y-18	2035-36		10	52	5.34
Y-19	2036-37		10	52	5.33
Y-20	2037-38		10	52	5.32
Y-21	2038-39		10	50	5.30
Y-22	2039-40		10	50	5.29
Y-23	2040-41		10	50	5.27
Y-24	2041-42		10	50	5.26
Y-25	2042-43		10	50	5.25
Y-26	2043-44		10	50	5.24
Y-27	2044-45		10	50	5.23
Y-28	2045-46		10	50	5.22
Y-29	2046-47		10	50	5.21
Y-30	2047-48		10	50	5.20
Y-31	2048-49		10	50	5.19
Y-32	2049-50		10	50	5.19
Y-33	2050-51		10	50	5.18
Y-34	2051-52		10	50	5.17
Y-35	2052-53		10	50	5.17
Y-36	2053-54		10	50	5.16
Y-37	2054-55		10	50	5.16
Y-38	2055-56		10	50	5.15
Y-39	2056-57		10	47	5.14
Y-40	2057-58		10	47	5.13
Y-41	2058-59		8	47	5.15

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	Parameters		Details				Observation
	Y-42	2059-60	8	45	5.16		
	Y-43	2060-61	7	40	5.17		
	Y-44	2061-62	7	40	5.18		
	Y-45	2062-63	7	26	5.15		
	Y-46	2063-64	5	16	5.13		
	Y-47	2064-65	5	10	5.09		
	Y-48	2065-66	4.22	2	5.04		
			420.22	**2119**			

h.	**Peak/Rated Capacity**	10 MTPA	
	- By OC	10 MTPA	
	- By UG	U/G Mining is envisaged by 8 – 9 years	
	- Overall	Not Applicable	
i.	**Life of the mine :**	48 years	
	- By OC	48 years	
	- By UG	UG mine yet to be planned but is envisaged to be completed before 48 years of OC production	
	- Overall	48 years	
j.	Whether the proposed external OB dump site is coal/ lignite bearing: If so, whether coal/lignite below waste disposal area is extractable.	There is no external dump.	
k.	Whether negative proving for coal/ lignite in the proposed site for OB dump/ infrastructure has been done.	No external O.B. dumping. Infra area is certified as non coal area by CMPDI.	
l.	Whether the mining operations to be carried out through departmental equipment/ MDO/ outsourcing.	MDO	
m.	Operations that are proposed to be outsourced	To be operated through MDO.	
n.	Proposed configuration of HEMM for OC (Coal & OB) & Major Equipment for UG.	Given on next page for opencast mine.	

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List of HEMM

Operation	Item	Mining Equipment	Equipment Capacity	Total No. of Eqpt.
Waste Removal	i. Drilling	Blast Hole Drill	383 mm	3
		Blast Hole Drill	250 mm	6
	ii. Loading	Hydraulic Backhoe	40 Cum	3
		Hydraulic Backhoe	12 Cum	6
	iii. Transport	Rear Dumper	360 t	20
		Rear Dumper	120 t	34
Coal Production	i. Drilling	Blast Hole Drill	250 mm	*
	ii. Coal Cutting	Surface Miner	3.8 m drum	4
	iii. Loading	Front End Loader	18 Cum	4
	iv. Transport	Coal Body Dumper	100 t	20
		Trunk Belt	2000 tph	2 sets
		Mobile Belt	2000 tph	10 sets
		Mobile Hopper & Apron Feeder	2000 tph	5 sets
Road , Drain & Culvert	i.	Wheel Dozer	350 Kw (45 t class)	1
	ii	Track Dozer with Ripper	300 Kw	4
	iii	Motor Grader	16 Ft Blade (200 Kw)	4
	iv	Vibratory Compactor	25 t	4
	v	Water Sprinkler	40-45 Kl	4
	v	FE Loader	5 Cum	1
	vi	FE Loader	2 Cum	1
	vii	Diesel Back hoe (20 t class)	1 Cum	1
Maintenance & Safety Equipment	i	Crane	100 t	1
	ii	Crane	40 t	1
	iii	Crane	8 t	1
	iv	Boom Truck		4
	v	Heavy Duty Toe Truck		2
	vi	Tyre Handler		2
	vii	Mobile Maint. Van		4
	viii	Fire Tender		2

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/ Kumar Singh
ised Qualified Person)

ANANDA KUMAR MAHATO
Under Secretary
Ministry of Coal

Operation	Item	Mining Equipment	Equipment Capacity	Total No. of Eqpt.
Supplies & Transport	i	Diesel Bowser		4
	ii	Fork Lift	8 t	2
	iii	Line Truck	20 t	2
	iv	Tipping Truck	8 t	6
Reclamation & Envt. Mgt	i	Motor Grader	16 Ft Blade 200 Kw	2
	ii	Dozer	300 Kw	4
	iii	Water Sprinkler	40-45 Kl	4
	iv	Farm Tractor		4

* - It is envisaged that surface miner would not have sufficient exposed coal layer during the 1st year stage. One of the 250 mm drills provided for OBR, would be temporarily diverted to drill hole over exposed coal bench to prepare coal by blasting. Coal would be loaded by 18 cum wheel loader into 100 t CBD to meet the target of 1 Mt production of coal during 1st year stage. From 2nd year onwards surface miner would take over preparation of coal as alternative to drilling blasting in coal for the entire balance life of the mine.

Vijay Kumar Singh
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	Parameters	Details	Observation
8.	**MINING**		
o.	Mode of entry for underground mines (shaft, incline, adit,):	Not Applicable for this Mining Plan.	
p.	Results of any investigation carried out for scientific mining, conservation of minerals and protection of environment; future proposals.	Scientific investigation would be undertaken in future, if required.	
9.	**IMPORTANT SAFETY ASPECTS –** Major Risks and uncertainties to the project viz. Proximity to river, adjacent working, geo-mining disturbances, slope stability and remedial measures suggested. It should also include proposed overall slope of the quarry and OB dump, dump height, strata control, fire and spontaneous heating, gas monitoring, disaster management, danger from inrush of water etc	The only mining danger is Sukri River on the North boundary of the proposed opencast mine. There is no history of flooding of its banks where at present villages exist. However, an embankment is proposed with a 7.5 m road at its top with height of 1.5 m over highest flood level as required by Coal Mines Regulations 1957. The project area would be fenced to guard against inadvertent entry of any unauthorized person. Length of fencing would be about 18 Km. Proposed overall slope of waste dump bench is 24.8° which is considered well within mining practice of a maximum of 28°. Total dump height, with three benches, has been kept limited to 90 m above ground level. Deployment of surface miner would be able to separate clean coal from waste floor. Therefore, chances of coal going into waste have been minimized reducing the possibility of spontaneous heating. Rajbar being an opencast mine, would have no problem of gas. No water lagoon or other reservoir etc. are there to cause inrush of water.	
10.	**STATUS OF LEASE**		
a.	Status of Lease	Applied for	
b.	Existing Lease Area "Ha"	Not Applicable	
c.	Period for which Mining Lease has been granted/is to be renewed/ is to be applied for.	Not Applicable	
d.	Date of expiry of earlier Mining Lease, if any	Not Applicable	
e.	Whether the lease boundary/ required boundary	The proposed Project/ Lease area covers 1351 ha. Out of which, 1320 ha is within allotted coal block & 31 ha is	

Rajesh Ranjan
ESE
RVNL, Hindpi, Ranchi-834002
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umar Singh
Qualified Person)
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	is same as demarcated by CMPDI/ SCCL/ NLC for delineating block/sub- block	outside.	
f.	Lease Area (applied/ required) as per the Mining Plan under consideration (Ha)	Lease Area Required – 1351 ha	
g.	Whether the applied lease area falls within the allotted block	Out of 1351 ha of proposed Project/ Lease area, 31 ha falls on non coal bearing area outside the allotted block.	
h.	Area (Ha) of lease which falls outside the block/sub-block delineated by CMPDI/SCCL/NLC.	31 ha	
i.	**Details of outside area:**		
	– Whether forms part of any other coal block.	No	
	– Whether it contains any coal/lignite reserves.	No	
	– Purpose for which it is required, e.g. roads/ OB dumps/ service buildings/ colony/ safety zone/ others (specify).	For Infrastructure, township & office etc.	
j.	**Whether some part(s) of the allotted block has not been applied for mining lease.**	Yes. Only 1320 ha has been considered for mining out of total block area of 1487 ha.	
	– Total area in Ha of such part(s).	150 ha + 17 ha = 167 ha not required as mining is not feasible in the area.	
	– Total reserves in such part(s). (Mt)	7.85 + 1.18 = 9.03 Mt	
	– Brief reasoning for leaving such part(s)	17 ha is beneath river bed and its meander and has been left out, as mining this coal is not feasible. 150 ha is in metamorphic high area with missing seams, resulting in very poor coal intensity and making it uneconomical to work coal underneath. Further, a population of 800 persons residing over these 150 ha, makes its workability further unfeasible. Workability over only 1320 ha is found feasible. This has been discussed at item 5.4.1 & 5.4.3.	
11.	**ENVIRONMENTAL MANANGEMENT**		
a.	Land use pattern in Ha Pre Mining , During Mining and Post Closure Land Use and Post Closure Management of the Land should be provided in the following table (Given on next page)		

Land use pattern in Ha Pre Mining, During Mining and Post Closure Land use and Post Closure Management of the Land should be provided in the following table

Pre Mining Land Use "Ha"			Land use "Ha" (During Mining)							Land Use "Ha" (Post Closure)								
			Type (Land Use)	Stages of Mining					Land use "Ha" (End of Life)	Agricultural land	Plantation	Water Body	Public/ Company Use	Water Harvesting	Dismantled area	Forest Land (Returned)	Undisturbed	Total
				5th Year	10th Year	20th Year	30th Year	40th Year	45th Year									
Tenancy	Agricultural	553.68	Excavation Area	153.0	439.0	617.0	816.0	1138.5	1262.0									
	Township		Backfilled Area	39.0	117.0	322.0	496.0	689.0	562.0	497.48	159.00					325.52		982.00
	Grazing		Excavated Void	114.0	322.0	295.0	320.5	470.0	280.0		5.76	135.81				138.43		280.00
	Barren	20.84	Without Plantation & Agriculture (Part of Backfilled Area)	30.0	75.0	175.0	82.0	36.0	253.0									
	Water Bodies	0.14	Top Soil Dump	Within Excavation Area														Nil
	Road		External Dump	No External Dump														
	Community		Safety Zone Rationalisation	Safety Zone is part of Peripheral road area as it creates at least 20 m barrier from mine excavation to other surface features.														
	Inhabitant	6.76																
	Village		Diversion/relocation Revo/Nala/Canal	Not Required														
Govt Non Forest	Agricultural	108.40	**Infrastructure Area** • Electrical Sub Station • Workshop • Store • CHP & Coal Storage	2.0 2.9 1.9 12.7	2.0 2.9 1.9 12.7	2.0 2.9 1.9 12.7	2.9 2.9 1.9 12.7	2.0 2.9 1.9 12.7	3.0 2.9 1.9 12.7						2.90 2.90 1.90	12.70		2.90 2.90 1.90 12.70
	Township		Garland Drains	4.3	4.5	4.5	4.3	4.3	4.3				3.26			2.04		4.30
	Grazing/Other		Embankment	9.5	9.5	9.0	9.5	9.5	9.5				5.75			3.75		9.50
	Road	10.20	Water Reservoir near Pit/ Water Body	0.6	0.6	0.6	0.6	0.6	0.6				0.60					0.60
	Water Bodies	51.16	**Infrastructure Sub Total**	**33.9**	**33.9**	**33.9**	**33.9**	**33.9**	**33.9**									
	Barren	88.22	Green belt	28.9	28.9	28.9	28.9	28.9	28.9		22.04					6.88		28.90
	Other (Institue, School, Play ground etc	5.56																
Forest	Reserve		Pit head power plant	Not Required														
	Protected	485.20	Resettlement	Outside Project Area														
	C-U-B-J	2.08	Undisturbed/Mining right for UG	1.0	1.0	1.0	1.0	1.0	1.0							1.00		1.00
Pvt Land	Area		**Others** • Road Diversion (Peripheral Rd) • Township • Office • ETP • Magazine	11.0 10.1 1.0 1.2 1.0	11.0 10.1 1.9 1.7 1.9	11.0 10.1 1.9 1.2 1.9	11.0 10.1 1.9 1.2 1.0	11.0 10.1 1.9 1.2 1.9	11.0 10.1 1.9 1.2 1.9				5.72 10.10 1.90			5.88 0.80 0.50		11.60 10.10 1.90 1.20 1.50
			Others Sub Total	**25.2**	**25.2**	**25.2**	**25.2**	**25.2**	**25.2**									
Total		**1351.80**		**343.6**	**528.0**	**786.0**	**1085.5**	**1227.5**	**1351.5**	**497.48**	**186.80**	**135.81**	**35.73**	**0.00**	**7.90**	**497.26**	**0.00**	**1351.00**

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(Recommended / Approved)
[Designation]
Date:

	Parameters	Details		Observation
11.	**ENVIRONMENTAL MANANGEMENT**			
b.	Surface features over the block area	Project topography is basically a plateau. It is bounded by Sukri River on the North. Project area of 1351 ha is covered by forest over 37%. The balance has agricultural land, waste land, water body, habitation & Village roads.		
c.	No. of villages/ Houses to be shifted	There are 6 villages. Only 4 villages out of 6 villages would require resettlement. About 550 families would have to be shifted.		
d.	Population to be affected by the project	About 3000 population would be affected by the project.		
e.	Monitoring schedules for different environmental components after the commencement of mining and other related activities.	Air Quality	Twice in a month	
		Water & effluent quality	Once in a month	
		Ground water level monitoring	Pre monsoon, Post monsoon & Pre summer	
		Noise level	Once in a month	
		Study of Flora and Fauna	Once in 5 years	
		Soil Quality	Once in 5 years	
12.	**PROGRESSIVE & FINAL MINE CLOSURE PLAN**			
12.1	**Parameters of Mining Plan vis-a-vis Mine Closure Plan (When only Mine Closure Plan is being placed for approval details of approved mining plan must be provided)**			
		No Approved Mining Plan	**Mining Plan & Mine Closure Plan**	
a.	Lease area "Ha"	Not Applicable	1351	
b.	Project Area "Ha"	Not Applicable	1351	
c.	Life of the Project in Years	Not Applicable	48	
d.	Minimum and Maximum Depth of working "m"	Not Applicable	33 (Minimum) 474 (Maximum)	
e.	Geological Block "Ha"	Not Applicable	1487	
f.	Production Target "MTPA"	Not Applicable	10	
g.	Seams Available "as per GR"	Not Applicable	9	
h.	Seams not considered for mining with reasons	Not Applicable	Seam I & II are envisaged for U/G Mining after 7 years of coal production in OC mine	
i.	Geological Reserve "Mte"	Not Applicable	574.86 (upto Seam III)	
j.	Blocked Reserve "Mte"	Not Applicable	124.67 + 7.85 = 132.52	
k.	Minable Reserve "Mte"	Not Applicable	442.34	
l.	Extractable Reserves "Mte"	Not Applicable	420.22	
m.	% of recovery	Not Applicable	73	
	Reserve Depleted (till base date) in Mt	Not Applicable	Not Applicable	
	Balance Extractable Reserve in Mt	Not Applicable	Not Applicable	

	Parameters	Details		Observation
	Avg. Grade	Not Applicable	G – 11	
n.	OB MM3	Not Applicable	2119	
o.	SR MM3/te	Not Applicable	5.04	
p.	Mining Technology	Not Applicable	Opencast with Surface miner for coal and shovel & dumper for OBR	
q.	Coal Beneficiation envisaged	Not Applicable	No	
r.	Handling of Rejects	Not Applicable	Not Applicable	
s.	Land use pattern "Ha"	Not Applicable		
1.	Excavation Area	Not Applicable	1262	
2.	Top Soil Dump area	Not Applicable	Within Excavation area	
3.	External Dump	Not Applicable	NIL	
4.	Safety Zone	Not Applicable	NIL	
5.	Other Use	Not Applicable	25.2	
6.	Infrastructure area	Not Applicable	33.9	
7.	Green Belt	Not Applicable	28.9	
8.	Undisturbed Area	Not Applicable	1 ha	
	Total		**1351 ha**	
12.2	**Statutory obligations**	Statutory obligations have been deliberated in the text in Chapter-XV at para 15.1.2. However, at present no approval exists, as mining plan is the first approval for subsequent approvals. Hence no statutory obligations have arisen.		

12.3 Waste Management (Figures in Mm³)

Year/ Stage	Cumulative OB Removal			Temporary Dump (Cumulative)		Internal Dump/ Backfilling (Cumulative)		Embankment & Green Belt (Cumulative)	
	Top Soil	OB	Total Waste	OB	Top Soil	OB	Top Soil	OB	Top Soil
1st Year	0.1	5.4	5.5	5.0	–	–	–	0.4	0.05
3rd Year	0.4	38.1	38.5	38.15	0.25	–	–	–	0.10
5th Year	0.6	120.4	121	96	0.45	25	–	–	–
10th Year	1.8	377.2	379	146	1.45	232.8	0.2	–	–
15th Year	2.1	636.9	639	181	1.58	457.5	0.5		
20th Year	2.5	896.5	899	214	1.70	684.2	0.8	–	–
25th Year	3.1	1145.9	1149	207	1.85	940.8	1.2		
30th Year	3.7	1395.3	1399	84	2.00	1252.3	1.7	–	–
35th Year	4.1	1644.9	1649	61	1.95	1585.8	2.2		
40th Year	4.6	1888.4	1893	–	1.90	1890.0	2.7	–	–
45th year	4.8	2086.2	2091	–	1.45	2087.7	3.3		
48th Year	5.0	2114.0	2119	–	1.00	2114.0	4.0	–	–

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	Parameters	Details	Observation

12.4 Land likely to be degraded and Technically and Biologically reclaimed

Land Degraded & Technically Reclaimed Area

Area in ha

Production Stage Years		Land Degraded				Technically Reclaimed Area				
		Excv	Dump (Extn + Top Soil)	Infra/ others	Total	Back-filled	Dump (Extn + Top Soil)	Infra & Others	Green Belting	Total
1	2	3	4	5	6	7	8	9	10	11
Y-1	2018-19	20	No external dumping of Waste Rock or Top soil is proposed.	88	108		Not required as explained in Column 3	59.1		59.1
Y-3	2020-21	96		88	184			59.1		59.1
Y-5	2022-23	153		88	241	48		59.1	28.9 ha	136.0
Y-10	2027-28	439		88	527	137		59.1	28.9 ha	205.0
Y-15	2032-33	535		88	623	174		59.1	28.9 ha	262.0
Y-20	2037-38	617		88	705	222		59.1	28.9 ha	310.0
Y-25	2042-43	772		88	860	318		59.1	28.9 ha	406.0
Y-30	2047-48	916		88	1004	406		59.1	28.9 ha	494.0
Y-35	2052-53	1034		88	1122	525		59.1	28.9 ha	613.0
Y-40	2057-58	1138		88	1226	639		59.1	28.9 ha	727.0
Y-45	2062-63	1195		88	1283	795		59.1	28.9 ha	883.0
Y-48	2065-66	1262		88	1350	982		59.1	28.9 ha	1070.0
Post Closure Y-51	2068-69					982		59.1 + 280 = 339.1 ha	28.9 ha	1353.0 *
Undisturbed					1					1
					1351					1351

- Infrastructure to be retained – 37.4 ha
- Infra Others to be dismantled – 21.7 ha

} 59.1 ha + Green Belt – 28.9 ha = 59.1 + 28.9 = 88 ha

- Backfilled – 982 ha
- Void – 280 ha
  - Water Body – 269 ha
  - Slant Plantation – 11 ha
- Infra & Others – 88 ha
  - Infra & Others – 59.1 ha
  - Green Belting – 28.9 ha

Total – 1350 ha
Undisturbed – 01 ha
Total Project Area – 1351 ha

Stage wise Biological Reclamation

Area in ha

Production Stage Years		Biologically Reclaimed Area					Forest Land (Returned)	Un Disturbed	Total
		Agriculture	Plantation	Water Body	Public/ Company (Infra Retained)	Total			
Y-1	2018-19								
Y-3	2020-21								
Y-5	2022-23								
Y-10	2027-28	3	43			46			
Y-15	2032-33	16	81			97		1	
Y-20	2037-38	30	114			144		1	
Y-25	2042-43	85	152			237		1	
Y-30	2047-48	141	190			331		1	
Y-35	2052-53	177	245			422		1	
Y-40	2057-58	213	300			513		1	
Y-45	2062-63	330	311			641		1	
Y-48	2065-66	447.6	322 #			769		1	
Post Closure									
Y-51	2068-69	008.48	537.12	269	37.4	1350	497.28	1.0	
	Undisturbed				1	1351			

- After the end of 48th year, 59.48 ha of agricultural land and 215.12 ha of plantation to be done during post mining reclamation.

12.5 Water Quality Management : (Existing water bodies available in the lease hold area; Measures to be taken for protection of the same including control of erosion, sedimentation, siltation, water treatment, diversion of

These items of surface water regime have been discussed at point no. 14.3.2.1 under head Surface Water on page XIV-3. No diversion of water courses is called. It is only guiding the water flow coming from outside, into the garland drain around mine area. The impact on surface water has been discussed at point 14.4.2.1.

Rajesh Ranjan
ESE (P & S)
TVNL, Hinoo, Ranchi-834002
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Vijay ... gh
(Recogn... Person)
[Recognition No. ...014-CPAM ...5]
Dated- ...

	Parameters	Details	Observation
	water course if any; Measures for protection of contamination of ground water from leaching etc; Quality of surface water bodies and measures proposed to meet the water quality; Report of hydrological study of the area; Water Balance Chart etc)	The subject of ground water has been covered at point 14.3.2.2 and at point 14.4.2.2. The water quality management details are given at item 14.5.2. Some of the suggested water quality management actions are reproduced: • Construction of garland drains of suitable size around mine area, with proper gradient, to prevent rain water from entering into excavation area. • Construction of settling and sedimentation pond of adequate size to collect the mine discharge water to allow settlement of suspended solids and its storage after necessary treatment. The treated water will be used for dust suppression, green belt development and other needs of project. • Construction of garland drain around coal stock yard/coal bunker. • Effluents from workshop, garage or wash areas will be treated through grease / oil traps and then in sedimentation pond and recycled for use again in the workshop/ wash area. • Separate sewage system and treatment plant for domestic sewage & office sewage etc. will be set up for proper treatment of these and for reuse of recovered water in green belt, etc. The solid waste from sewerage plant of the colony & office will be used as manure over the plantation areas. However, detailed Hydrological and Hydrogeological studies would be carried out at the time of preparation of EIA/EMP to understand the implication of activities on the water regime of the area. The water balance chart has been prepared and is covered at item no. 14.3.2.4 under Chapter-XIV dealing Environment Management Plan. It shows a positive flow of water from mine to natural drainage.	

Vijay Kumar Singh
(Recognised Qualified Person)
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Rajesh Ranjan
ESE (P&S)
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	Parameters	Details	Observation

12.6 Top Soil Management – (Including Action plan for Top Soil management)

Year/ Stage	Top Soil Removal "Mm³" (Cumulative)	Top Soil Used "Mm³"								Total utilized Top Soil (Cumulative)
		Embankment		Spreading over the Backfilling Area in Sq. Km. (Cumulative)		Spreading over the OB Dump Area in Sq. Km.		Using for Green Belt Area (Cumulative)		
		Area (Sq. Km.)	Top Soil (Mm³)	Area (Sq. Km.)	Top Soil (Mm³)	Area (Sq. Km.)	Top Soil (Mm³)	Area (Sq. Km.)	Top Soil (Mm³)	
1st Year	0.08	0.065	0.020					0.10	0.030	0.050
3rd Year	0.384							0.317	0.0951	0.1151
5th Year	0.812									0.1151
10th Year	1.756			0.42	0.1768					0.7919
15th Year	2.112			0.93	0.4248					0.5399
20th Year	2.466			1.44	0.6728					0.7679
25th Year	3.056			1.8056	1.1571					1.2722
30th Year	3.664			2.171	1.6414					1.7585
35th Year	4.106			3.5956	2.0879					2.2027
40th Year	4.552			5.02	2.5338					2.6489
45th Year	4.408			6.21	3.2486					3.3636
48th Year	5.048			7.40	3.9632					4.0783
Post Mining			0.020	9.93	4.7878			0.417	0.1251	5.0460

12.7 Coal beneficiation and management of Coal Rejects, proposal regarding future maintenance and dismantling of structures, slurry pond and rejects

Not Applicable

12.8 Infrastructure to be retained and to be dismantled and measures to be taken for their physical stability and maintenance for the retained infrastructure facilities;

Infrastructure/ others in tabular form is given hereafter.

A. Infrastructure to be dismantled and retained in shown below in tabular form.

Infrastructure to be Dismantled		Non Forest	Forest	Infrastructure to be retained		Non Forest	Forest
Workshop	2.9	2.9	0	Garland Drain	4.3	2.26	2.04
Store	1.9	1.9	0	Embankment with Road at its top	9.5	5.75	3.75
Electrical Sub Station	2.0	2	0	Sedimentation Tank	0.6	0.6	0
CHP & Coal Storage	12.7	0	12.7				
Total	**19.5 ha**	**6.8 ha**	**12.7 ha**	**Total**	**14.4 ha**	**8.61 ha**	**5.79 ha**

B. Others

To be Dismantled		Non Forest	Forest	To be retained		Non Forest	Forest
ETP	1.2	0.6	0.6	Road	11.0	5.12	5.88
Magazine	1.0	0.5	0.5	Township (Colony)	10.1	10.1	0
				Office Building	1.9	1.9	0
Total	**2.2 ha**	**1.1 ha**	**1.1 ha**	**Total**	**23.0 ha**	**17.12 ha**	**5.88 ha**

Garland Drain, Embankment with Road as its top, Sedimentation Tank, Road, Township (Colony) & Office Building would not be dismantled. A fixed deposit would be made out of Escrow Amount, Interest of which would be used by State Govt./ Local Bodies for maintenance of public utility items.

Rajesh Ranjan
EE (P & S) TVNL, Hindo, Ranchi-834002
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STATE STATUS ... AMLUDA KUMAR MANJ... Under Secy. / Minister ... Govt. of Jhk...

	Parameters	Details	Observation
12.9	Decommissioning of mining equipment and their possible post mining use	MDO route is proposed for operating the mine. MDO would own mining equipment. MDO would either move the equipment to similar project in hand or sell these equipment.	
12.10	Safety measures to be implemented to prevent access to surface opening for underground working, excavation etc (fencing to be carried out by barbed wires	Void area would be fenced off with masonary wall to prevent inadvertent access.	
12.11	Economic Repercussions of closure of mine - Manpower retrenchment, compensation to be given, socio-economic repercussions and remedial measures consequent to closure	Retired employees would get pension under Coal Mine Pension Scheme. Prematurely separated employees would get financial benefits out of "Separation Scheme" offered by the mine owners.	
12.12	**Time scheduling for abandonment with bar chart for the life of the project plus 3 years**	Time scheduling for abandonment with bar chart for the life of the project plus 3 years has been given in Table hereafter:	

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(Reco[illegible]erson)
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Rajesh Ranjan
ESE (P&C)
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Time Scheduling & Envisaged Resources to Execute the Progressive & Final Closure Activities

Sl. No.	Activity	Schedule	Manpower	Expenditure ₹ in Crores
PROGRESSIVE CLOSURE ACTIVITIES				
1	Water quality management		Job Outsourced	1.19
2	Air quality management		Job Outsourced	1.19
3	Waste management		Routine Activity	
4	Barbed wire fencing around temporary dump		Job Outsourced	3.66
5	Barbed wire fencing around the Project area		Job Outsourced	10.97
6	Filling of Void – Rebunding of Crown Dump	Void filling is included as a routine mining operation. Crown rebunding is not proposed.		
7	Top Soil Management (Rehandling)		Job Outsourced	0.82
8 A.	Agro Reclamation of Mined out land		Job Outsourced	48.07
8 B.	Biological Reclamation of Mined out land		Job Outsourced	26.72
9	Plantation over virgin area including green belt		Job Outsourced	8.31
10	Manpower Cost and supervision		12 Persons	71.07
11	Toe Wall around the temporary dump	Raising toe wall around the temporary dump is a routine mining operation		
12 A.	Garland drain around Mined Project Area		Job Outsourced	8.23
12 B.	Peripheral road, gates & View point		Job Outsourced	89.22
13	Grassing of temporary dumps		Job Outsourced	29.28
			Sub Head Total	**297.73**
FINAL CLOSURE ACTIVITIES				
A.	**Dismantling of Infrastructure & Disposal/ rehabilitation of Mining Machinery**			
1	Dismantling of CHP, workshop, admin. store, magazine, ETP		Job Outsourced	0.55
2	Rehabilitation of the dismantled facilities			
a.	Rehabilitation of the infra areas covering 9 ha as agriculture land at ₹ 3.60 lakh/ ha		Job Outsourced	0.70
b.	Rehabilitation of 12.2 ha of CHP area as plantation area at ₹ 2.00 lakh/ ha		Job Outsourced	0.68
3	Dismantling of pumps and pipes/ other facilities		Job Outsourced	0.29
4	Dismantling of existing bunker, revisioning of pumps for borewell pumping arrangement	Not Applicable for OC Mine		
5	Dismantling of UG equipment	Not Applicable for OC Mine		
6	Relaunching water pipelines to dump for plants/ agriculture land		Job Outsourced	1.44
7	Dismantling of Power line		Job Outsourced	0.29
			Sub Head Total	**4.64**
B.	**Safety and Security**			
1	Barbed wire fencing around dump	Covered in Progressive Closure at Item 4.		
2	Barbed wire fencing around the pit	Already done in Progressive Closure at Item 5.		
3	Barbed wire fencing with reasonably pillars	Not Applicable for OC Mine		
4	Concrete wall with reasonably pillars around the pit	Not Applicable for OC Mine		

Sl. No.	Activity	Schedule	Manpower	Expenditure ₹ in Crores
6	Securing air shaft and installation of loosened pump	Not Applicable for OC Mine		
C	Securing of facilities	Not Applicable for OC Mine		
7	Brick wall fencing around the water body		Job Outsourced	14.12
8	Secondary wall around the water body	Same at 7 above.		
9	Deterioration (viz. leaching, pitting etc.) of side walls of the water body		Job Outsourced	2.86
10	Toe wall around the dump	Dealt in Progressive Closure at Item 11.		
11	Garland drain	Dealt in Progressive Closure at Item 12.		
12	Garland drain around the dump	No External Dump.		
13	Drainage Channel from main OB dump	Not Applicable – No External O.B. Dump. Backfilled dumps drain to peripheral garland drains or mine workings.		
		Sub Head Total		19.98
C.	**Technical and Biological Reclamation of Mined-out of land and OB Dump**			
1	Filling of Void	Not envisaged in the post closure period.		
2	Top Soil management	Covered in Progressive Closure at Item 7.		
3	OB Rehandling for backfilling	This activity is not proposed in this Mining Plan.		
4	Terracing, blanketing with soil and vegetation of External OB Dump	No External dumps in this mine.		
5.A.	Peripheral road, gates and view point	Covered in Progressive Closure at Item 12.B.		
5.B.	Cemented steps on bank of water bodies		Job Outsourced	1.08
6	Expenditure on development of Agriculture land		Job Outsourced	6.28
7	Landscaping and Plantation		Job Outsourced	17.21
		Sub Head Total		24.57
D.	**Post Closure Management and Supervision**			
1	Power Cost		Job Outsourced	1.15
2	Post Mining Water quality management		Job Outsourced	0.17
3	Post Mining Air quality management		Job Outsourced	0.11
4	Subsidence monitoring for 5 years	Not Applicable for OC Mine.		
5	Waste Management	No Waste Management is envisaged during final closure.		
6	Manpower Cost and supervision		Job Outsourced	4.50
		Sub Head Total		5.93
E.	**Others**			
1	Entrepreneurship development (vocational) skill development training for sustainable income of affected people		Job Outsourced	20.75
2	Golden Handshake/ Retrenchment benefits to 100 employees of OC		Departmental	34.00
3	Golden Handshake/ Retrenchment benefits to 200 employees of UG	Not Applicable for OC Mine		
4	Onetime financial grant to vocational institutions/ organizations which is dependant upon the project.		Departmental	28.75
5	Provide jobs to other wards of the company	No other mine of the applicant.		
6	Continuation of other services like running of schools etc.		Job Outsourced	27.30
		Sub Head Total		110.80
		Total		458.65 Crores

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12.13	Cost of Activities to be taken up for closure of the mine (Given below:)	

Cost of Activities to be taken up for closure of the mine

Head			Units	Quantity	Rate Rs./Unit	Amount in 'Rs. Crore'
Progressive Closure	1.	Water quality management	Nos.	One water sample per month	₹ 5000/-	1.19
	2.	Air quality management	Nos.	Two sample per month	₹ 2500/-	1.19
	3.	Waste management	M Cum	Routine activity		
	4.	Barbed wire fencing around temporary dump area in North, South & West side	Km	6	6 Lakh	3.66
	5.	Barbed wire fencing around the Project area	Km	18	6 Lakh	10.97
	6.	Filling of Void – Rehandling of Crown Dump	Mm^3	Void filling is included as a routine mining operation. Crown rehandling is not proposed.		
	7.	Top Soil Management (Rehandling)	LS	–	–	0.82
	8 A.	Agro Reclamation of Mined out land	ha	447	3.50 Lakh	48.07
	8 B.	Technical and Biological Reclamation of Mined out land	ha	322	2.50 Lakh	24.72
	9.	Plantation over virgin area including green belt	ha	28.9	1.20 Lakh	3.31
	10.	Manpower Cost and supervision	Nos.	12	2.0 Lakh/ head/ year	71.07
	11.	Toe Wall around the temporary dump	Km	Making toe wall around the temporary dump is a routine mining operation.		
	12 A.	Garland drain around Mine/ Project Area	Km	18	4.5 Lakh	8.23
	12 B.	Peripheral road, gates & View point	LS	–	LS	89.22
	13.	Greening of temporary dumps	ha	410	1.04 Lakh	25.28
					Sub Head Total	**287.73**
Dismantling of Infrastructure & Disposal/ rehabilitation of Mining Machinery	1.	Dismantling of CHP, workshop, substation, store, magazine, ETP.	ha	19	1.0 Lakh	0.55
	2.	Rehabilitation of the dismantled facilities:				
	a.	Rehabilitation of five infra areas covering 9 ha as agriculture land at ₹ 3.00 lakh/ ha.	ha	9	3.0 Lakh	0.78
	b.	Rehabilitation of 12.2 ha of CHP area as plantation area at ₹ 2.00 lakh/ ha.	ha	12.2	2.0 Lakh	0.69

Rajesh Ranjan
ESE (E&S)
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(Recognised Qualified Person)
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Head			Units	Quantity	Rate Rs./Unit	Amount in 'Rs. Crore'
	3.	Dismantling of pumps and pipes/ other facilities	LS	–	–	0.29
	4.	Dismantling of stowing bunker, provisioning of pumps for borewell pumping arrangement		Not Applicable		
	5.	Dismantling of UG equipment		Not Applicable		
	6.	Rearranging water pipeline to dump top park/ Agriculture land	LS	–	–	1.44
	7.	Dismantling of Power line	LS	–	–	0.29
					Sub Head Total	**4.04**
Safety and Security	1.	Barbed wire fencing around dump		Covered in Progressive Closure at item 4.		
	2.	Barbed wire fencing around the pit (Project area)	m	Already done in Progressive Closure at item 5.		
	3.	Barbed wire fencing with masonalry pillars		Not Applicable for the OC mine.		
	4.	Concrete wall with masonalry pillars around the pit	m	Not Applicable for the OC mine.		
	5.	Securing air shaft and installation of borewell pump		Not Applicable for the OC mine.		
	6.	Securing of Incline		Not Applicable for the OC mine.		
	7.	Brick wall fencing around the water body	100 m	109	4.5 Lakh	14.12
	8.	Boundary wall around the water body		Done at 7 above.		
	9.	Stabilization (viz. benching, pitching etc.) of side walls of the water body	LS	–	–	2.86
	10.	Toe wall around the dump		Done in Progressive Closure at item 11.		
	11.	Garland drain		Done in Progressive Closure at item 12A.		
	12.	Garland drain around the dump		No External Dump.		
	13.	Drainage Channel from main OB dump		Not Applicable – No External O.B. Dump. Backfilled dumps drain to peripheral garland drains or mine workings.		
					Sub Head Total	**16.98**
Technical and Biological Reclamation of Mined out area and OB Dump	1.	Filling of Void	ha	Not envisaged in the post closure period.		
	2.	Top Soil management	Mm^3	Covered in Progressive Closure at item 7.		
	3.	OB Rehandling for backfilling	Mm^3	This activity is not proposed in this Mining Plan.		
	4.	Terracing, blanketing with soil and vegetation of External OB Dump	ha	No external dump.		
	5 A.	Peripheral road, gates and view point		Covered in Progressive Closure at item 12 B.		
	5 B.	Cemented steps on bank of water lagoon	LS	–	LS	1.08
	6.	Expenditure on development of Agriculture land	ha	59.48	3.50 Lakh	6.28

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Head			Units	Quantity	Rate Rs./Unit	Amount in 'Rs. Crore'
	7.	Landscaping and Plantation	ha	215.12	2.50 Lakh	17.21
					Sub Head Total	**24.57**
Post Closure Management and Supervision	1.	Power Cost	LS	–	–	1.15
	2.	Post Mining Water quality management	LS	–	–	0.17
	3.	Post Mining Air quality management	LS	–	–	0.11
	4.	Subsidence monitoring for 5 years	LS	Not Applicable		
	5.	Waste Management	LS	No Waste Management is envisaged during final closure.		
	6.	Manpower Cost and supervision	LS	–	–	4.60
					Sub Head Total	**6.03**
Others	1.	Entrepreneurship development (vocational/ skill development training for sustainable income of affected people	LS	–	–	28.75
	2.	Golden Handshake/ Retrenchment benefits to 100 employees of OC	Nos.	100	0.12 crore/ head	34.50
	3.	Golden Handshake/ Retrenchment benefits to 200 employees of UG		Not Applicable		
	4.	Onetime financial grant to societies/ institutions/ organizations which is dependent upon the project;	LS	–	–	28.75
	5.	Provide jobs in other mines of the company		No other mine of the applicant		
	6.	Continuation of other services like running of schools, health Centre etc.	LS	–	–	27.30
					Sub Head Total	**119.30**
					Total (Final Closure)	**170.92**
					Total (Progressive Closure)	**287.73**
					Grand Total	**458.65 Crore**

Vijay Kumar Singh
(Recognised Qualified Person)
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Rajesh Ranjan
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12.14	Amount to be deposited in Escrow account as a security against the mine activities to be carried out for the closure of the mine	

Base date for calculation of mine closure cost has been taken as July 2018.
(The month for which firm figure of WPI is available on website of Office of the Economic Adviser, GoI)

WPI			Aug-09	⟶	129.60 WPI
WPI in new Base Year	Base Year 11-12	Old WPI – 156.13 From year 11-12 – 100	July-18	119.90	187.200 WPI (On Old Base)
Escalation rate of Closure Cost from August–09 to July–18					1.44
				UG	OC
Base rate of Closure Cost "Rs. Crs./Ha"				0.01	0.06
Closure Cost "Rs.Crs/Ha"					0.06 x 1.44 = 0.087
Proposed Project Area "in ha"					1351.00
Base Amount for Escrow Account (Rs. in Crs)					1351 x 0.087 = 117.087
Rate of compounding of Annual Closure Cost					5.00%
Balance Life of the Project "in Yrs"					48
Annual Closure Cost					**2.4393**
Amount to be deposited into Escrow Account after compounding @ of 5% "Rs. in Crs"					**458.65**
Amount already deposited into Escrow Account "Rs. in Crs."					
Net Amount to be deposited into Escrow Account "Rs. in Crs."					**458.65**

Annual Amount to be deposited in Escrow A/c

Year	Annual Amount to be deposited in ₹ Crores
1	2.43930
2	2.56127
3	2.68933
4	2.82380
5	2.96499

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Year	Annual Amount to be deposited in ₹ Crores
6	3.11324
7	3.26890
8	3.43235
9	3.60396
10	3.78416
11	3.97337
12	4.17204
13	4.38064
14	4.59967
15	4.82965
16	5.07114
17	5.32469
18	5.59093
19	5.87048
20	6.16400
21	6.47220
22	6.79581
23	7.13560
24	7.49238
25	7.86700
26	8.26035
27	8.67337
28	9.10703
29	9.56239
30	10.04051
31	10.54253
32	11.06966
33	11.62314
34	12.20430
35	12.81451
36	13.45524
37	14.12800
38	14.83440
39	15.57612
40	16.35493

Rajesh Ranjan
CGE (Engg.)
TVNL, Hinoo, Ranchi-834002
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Year	Annual Amount to be deposited in ₹ Crores
41	17.17267
42	18.03131
43	18.93287
44	19.87951
45	20.87349
46	21.91716
47	23.01302
48	24.16367
	458.65107 say 458.65

13.	**RESPONSIBILITY OF MINE OWNER**	Owner is responsible for opening and maintaining an Escrow Account in a Nationalized Bank for meeting the mine closure expenses.		
14.	**PROVISION OF MINE CLOSURE**	Total provision including escalation @ 5% is Rs. 458.65 Crore.		
15.	**ANNEXURES**			
I	Copy of allotment order /Vesting order.	**Mandatory**	I & I A	
II	Certificate of CMPDIL that the project boundary considered for the Mining plan is in coherence with the block boundary vested with the allottee.	**Mandatory**	II & II A	
III	Approvals of Mine Closure plan from the Board of the company.	**Mandatory**	III	
IV	Copy of earlier approval of mining plan.	**Mandatory**	IV	
V	Copy of MOC's Letter granting recognition to RQP for preparation of Mining plan.	**Mandatory**	V	
VI	Letter of authorization by the Block allottee for formulation of Mining Plan & Mine Closure Plan by the RQP.	**MP & MCP**	VI	
VII	Certificate of acceptance of the RQP to formulate the Mining Plan & Mine Closure Plan on behalf of the project	**MP & MCP**	VII	

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	proponent.			
VIII	A certificate by the RQP that he has been duly authorized by the mining company to prepare Mining plan & MCP on their behalf and that he has a valid recognition from MOC under MCR, 1960 to prepare the Mining plan and that provisions of all relevant rules and regulations made there under have been observed in the preparation of mining plan.	**MP & MCP**	VIII	
IX	The Mining plan/ Mine Closure plan has been prepared considering the guidelines pertaining to mining plan/ mine closure plan issued by MoC, GOI & wherever specific permission will be required the applicant will approach the concerned authorities.	**MP & MCP**	IX	
X	Confirmation from RQP that he has verified the block area with the relevant plans supplied by CMPDI/ SCCL / NLC and area covered by the mining plan does not encroach on any other coal lignite block.	**MP**	X	
XI	Certificate from empowered representative of/or Block allottee/ applicant that he mine will be developed as per the approval of the mining plan from Ministry of coal and all other approvals, as required will be obtained from relevant authorities	**MP**	XI	
XII	Copy of the document to establish that the geological report has been duly purchased from CMPDI, GSI/ MECL as the case may be.	**MP**	XII	

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ESE (P & S)
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XIII	Certificate of RQP that the project boundary considered for the Mining Closure Plan has been verified by RQP. It is in coherence with the block boundary of vesting order and approved mining plan and no discrepancy has been found.	**MP & MCP**	XIII	
XIV	Certificate that the Mine Plan & Mine Closure plan have been prepared in line with the approved Mining plan and the mine parameters considered for formulation of mine closure plan is exactly the same, which has been approved in the Mining plan.	**MP & MCP**	XIV	
XV	Certificate from empowered representative of / or Block allottee/ applicant that he mine that the reclamation & rehabilitation work shall be carried out in accordance with the approved mine closure plan and any modification/amendments which may be made in the mine Closure Plan by Ministry of Coal, from time to time.	**MP & MCP**	XV	
XVI	Documents in support of Mining Lease, in case the lease has already been granted.	**MP & MCP**	XVI	
XVII	Hydrological study carried out if any.	**MP & MCP**	XVII.	
XVIII	Other document	**MP & MCP**	XVIII (A), XVIII (B) & XVIII (C)	
XIX	Environment Clearance to previous allottee & Transfer to current allottee	**MP & MCP**	XIX	
XX	Stage – I FC diversion approval from MoEF & CC to the previous allottee & Transfer to current allottee	**MP & MCP**	XX	

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Rajesh Ranjan
DGM (Mines)
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16.	**LIST OF PLANS**			
			Ref. Plate No.	
I	Location plan	**MP & MCP**	01A, 01B & 02A, 02B	
II	Reference no. of plan of block boundary issued by CMPDI/ SCCL/ NLC (A copy of the Plan also to be annexed)	**MP**	Plans attached with ***"Annex. – II & II A"***.	
III	Plan in scale of not less than 1: 10000 showing approved block boundary vis-à-vis proposed/existing mining lease & Mine boundary superimposed over it in distinct colour.	**MP & MCP**	03	
IV	Geological plan showing all the boreholes drilled and proposed to be drilled showing allotted block boundary and required lease area	**MP & MCP**	04	
V	Graphic Litholog	**MP & MCP**	08A & 08B	
VI	Surface Plan showing drainage system, Contour , at minimum 3m interval, location of BH	**MP & MCP**	07	
VII	Conceptual plan showing infrastructure facilities including colony, boundary of mining area, mine entries, roads including road diversion alignment etc	**MP & MCP**	11A & 11B	
VIII	Land use plan showing Govt, forest and Tenancy land	**MP & MCP**	06	
IX	Floor contour plan and seam folio plan, iso- grade plan	**MP & MCP**	Floor Contour – Seam I Bot to Seam R2 – 09A to 09S Seam Folio – Seam I Bot to Seam R2 – 10A to 10S	
X	X-section showing coal/Lignite seams	**MP & MCP**	05	
XI	Plan showing existing and	**MP & MCP**	11A	

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	proposed surface layout			
XII	Post mining land use plan	**MP & MCP**	16A	
XIII	Progressive mine closure plan/ stage plan indicating stages at 1st,3rd, 5th, 10th, and 20th interval (showing area, volume, dump height etc for OC and seam-wise layout projects and ventilation system in UG)	**MP & MCP**	Year / Plate No. 1st Year – 15A 3rd Year – 15B 5th Year – 15C 10th Year – 15D 20th Year – 15E 30th Year – 15F 40th Year – 15G 48th Year – 15H	
XIV	Reclamation plan	**MP & MCP**	16A	
	OPENCAST MINES			
XV	Plan showing total coal thickness and overburden thickness and stripping ratio	**OC**	14	
XVI	Final stage quarry plan showing haul road alignment	**OC**	15L	
	UNDERGROUND MINES – Not Applicable			
XVII	Plan showing mode and location of entries and surface layouts	**UG**	Not Applicable	
XVIII	Layout of the panel for each system Longwall, Bord & Pillar, road header should be given)	**UG**	Not Applicable	
XIX	Layout of pillar extraction	**UG**	Not Applicable	
XX	Support system	**UG**	Not Applicable	
XXI	Haulage and transport system	**UG**	Not Applicable	

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SUMMARISED DATA

1.	General	
a)	Name and address of the Applicant Company	Tenughat Vidyut Nigam Ltd. (TVNL) **Registered Office & Address for Correspondence:-** Tenughat Vidyut Nigam Ltd. At. – Hinoo, P.O. – Doranda, Dist. – Ranchi Jharkhand, PIN – 834002
b)	Name and address of the Block Allottee	Tenughat Vidyut Nigam Ltd. (TVNL)
c)	Relationship between the applicant and allottee company	Same
d)	Status of the Applicant Company : Central /Public Sector Undertaking/State Government Undertaking/JV Company/ Pvt. Company/Public Co/Others (Specify)	State Government Undertaking
e)	Name of the Coal Block together with name of Coalfield & State where located	Rajbar E & D Coal Mine; Auranga Coalfield, Jharkhand
f)	Date of allotment	30.06.2015 (***"Annex. – I"***).
g)	End Use of Coal as per Approval by the Competent Authority	Power generation
h)	ROM Quantity proposed to be produced as per Mining Plan	10 MTPA
i)	Norms adopted for calculating ROM quantity requirement in case it differs from the quantity indicated in the Allotment Order.	No Difference
j)	Beneficiation required – Yes/No	No
k)	Requirement of Beneficiated Coal & expected availability thereof.	Not Applicable
l)	Period for which Mining Lease has been granted/ is to be renewed/ is to be applied for.	30 years and to be renewed for further period.
m)	Date of Expiry of earlier Mining Lease, if any	Not Applicable

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n)	**RQP** who has prepared the Mining Plan	
	Name	**Vijay Kumar Singh**
	Address	Hill Top, Mahalla – Chandwe, Kanke Road, Ranchi - 834008, Jharkhand
	Phone No/Fax/Email ID	Mob. 08226865342 Vijay7143@gmail.com,
	Recognition No & date till valid Date of grant/Renewal of RQP Status Validity	**Recognition Number: 34012/ (03)/ 2014-CPAM dt – 29/05/2015** **Valid till 28.05.2025**

2.	**Information regarding earlier approved Mining Plan, if any – NOT APPLICABLE**	
S. N	**Items**	
a)	Approval Letter no. & Date	
b)	Lease Area	
c)	Date of grant of Lease	
d)	Date of Expiry of Lease	
e)	Targeted Production	
f)	Proposed year of start of Production	
g)	Proposed year achieving the targeted production level	
h)	Envisaged life of the mine (in years)	
i)	Date of actual commencement of Mining Operations, if operations already started	
j)	Likely date of Mining Operations, if operations not yet started & reasons for non-commencement of operations	
k)	Planned production and actual levels achieved in last 3 years	
l)	Coal :- U/G O/Cast OB	
m)	Reasons for difference between the planned and actual production levels	
n)	Reason for revision of the Mining Plan	

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o)	Details of changes in the new mining plan compared to earlier approval		
	(i) Lease Area		
	(ii) Block Boundary		
	(iii) Production level		
	(iv) Reserves		
	(v) Mining Technology (Additional sheets to be used, if required)	Old Plan	New Plan
	(vi) Land use pattern		

3. LOCATION	
a) Location of the Block Taluka/ Village/ Khasra/ Plot / Block Range / etc. District / State	Revenue Villages – Jerang, Rajbar, Lejang, Renchi, Darea & Serak. Revenue Anchal – Chandwa, Balumath & Latehar District – Latehar State - Jharkhand
b) Name of the Coalfield/ Coal belt	Auranga Coalfield
c) Particulars of adjacent blocks: North, South, East, West	**North** – Rajbar A, B & C – CCL blocks **East** – Metamorphic rocks **South** – Metamorphic rocks and then Banhardih coal block. **West** – Coal bearing area yet to be blocked and allocated
d) Area of the Allotted Block (hectares) i. Geological block area ii. Mining Block Area	 1487 ha 1351 ha (1320 ha + 31 ha)
e) Reference no. of plan of block boundary issued by CMPDI/ SCCL/ NLC (A copy of the Plan along with the coordinates of the boundaries to be annexed)	Copy of CMPDI letter no. CMPDI/DG/Captive/153/770 dated 20.07.2016 to Nominated Authority, MoC enclosing the geographical coordinates of cardinal points and a plan of Rajbar E & D Coal Mine (***"Annex-II"***). Vide their letter no. CMPDI/BD/C(886-A)/E-220387/I-4734 dated 26.10.2018, (***"Annex-II A"***), CMPDI have enclosed certified plan with their observation; being incorporated as Plate No. – 03.
f) Whether the lease boundary/ required boundary is same as demarcated by CMPDI/ SCCL/ NLC for delineating block/ sub-block	Allotted Block Area – 1487 ha as per coordinates given by CMPDI Project/ Lease Area – 1351 ha as per this Mining Plan.

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g) Existing mining Lease Area in case of existing mines. (hectares)	Not Applicable
h) Applied/ required Lease Area as per the Mining Plan under consideration (hectares)	Project Area – 1351 ha Required Lease Area – 1351 ha
i) Whether the applied lease area falls within the allotted block	Out of proposed project/ lease area of 1351 ha, the coal bearing part of 1320 ha falls within allotted block and 31 ha falls outside the allotted block in non coal bearing area for accommodating infrastructure & township.
j) Area (hectares) of lease which falls outside the block/sub-block delineated by CMPDI/SCCL/NLC	31 ha
k) Details of outside area: – Whether forms part of any other coal block – Whether it contains any coal/ lignite reserves – Purpose for which it is required, e.g. roads/ OB dumps/ service buildings/ colony/ safety zone/ others (specify)	31 ha No No Electrical Substation – 2.0 ha Workshop – 2.9 ha Store – 1.9 Road – 4.0 Garland Drain – 0.8 Office – 1.9 13.5 ha Green Belt – 7.4 ha Township – 10.1 ha **Total – 31 ha**
l) Whether some part(s) of the allotted block has not been applied for mining lease. - Total area in ha of such part(s). - Total reserves in such part(s). - Brief reasoning for leaving such part(s),	150 ha + 17 ha = 167 ha 7.85 + 1.18 = 9.03 Mt Reserves are blocked in river bed and its meanders (1.18 Mt) & beneath thick habitation over metamorphic high area (7.85 Mt).
m) Type of Land involved in Hectares – Forest Land – Non Forest Land o Tenancy Land o Govt. Land	Total Project area – 1351 ha. 497.28 ha 853.72 ha 581.18 ha 272.54 ha
n) Broad Land Use Pattern (Forest, Township, Industrial, Agricultural, Grazing, Barren etc.)	See text, Chapter – XIII, Page no. XIII-3, Table No. – 13.3.
o) Proximity of public road/ railway line/ major water body if any and approximate distance	a) Sukri River on nothern edge of proposed mine. b) NH–75 is 9.5 Km on South. c) Chetar Railway Station is 13.7 Km on South.

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p) Toposheet No. with latitude and longitude	F45A9 RF 1:50000 As per Corrigendum No. 1 of MoC ("*Annex-I A*"). Latitude – 23° 45' 27.491" N to 23° 48' 2.680" N Longitude – 84° 37' 38.780" E to 84° 40' 27.119" E

4. GEOLOGY AND EXPLORATION

a) Name of the Geological Block and area in hectares	Rajbar E & D Coal Mine 1487 ha
b) Name of the Geological Report (GR) with year of preparation	Geological Report on Rajbar E & D Coal Mine dated October 2013 (Modified Report).
c) Name of the agency which conducted exploration and prepared GR	i. Geological Survey of India ii. DGM, Jharkhand State through outsourced agencies
d) Period of conducting exploration	December 2010 to November 2011

e) Details of drilling (by all agencies)

Agency	Meterage	No. of bhs
GSI	2824.40	8
DGM, Jharkhand	26115.50	98
Total	**28939.90**	**106**

f) No. of boreholes drilled within the block	97
g) Overall borehole density within the block (no./ sq. km)	6.5 Bh/sq. Km. in 1487 ha i.e. coal bearing area in the block – 97 BH
h) Area covered by 'detailed' exploration within the block (hectares)	Total block area – 1487 ha.
i) Area covered by 'detailed' exploration outside the block (hectares) - No. of boreholes drilled outside the block - Borehole density for outside area (no./sq. km)	9 Boreholes – (i.) 2 Boreholes over 0.31 Sq. Km. of infra area – 6.5 bh/ Sq. Km. (ii) 7 Boreholes over peripheral areas of the block in Eastern side.
j) Whether entire lease area has been covered by 'detailed' exploration.	Yes
k) Whether any further exploration is required or suggested and timeframe in which it is to be completed	Not Required

l) Number of coal seams: 7 seams – I to VII in Barakar Formation. 17 coal horizons including splits in Barakar Formation.
2 Seams – R1 & R2 in Raniganj Formation.
- Total 19 coal horizons

- thickness range of coal seams (Excl. NCB)-0.15m (Seam I Bot) to 24.26m (Seam III Bot)
- mean Thickness of total coal horizon – 66.5 m.
- Standard Deviation of thickness –

SEAM	R2	R1	VII T	VII M	VII B	VI T	VI M	VI B	V	IV T	IV M	IV B	III T	III M	III B	II T	II B	I T	I B
SD	1.7	1.6	2.3	4.0	0.7	3.1	3.3	2.6	2.0	2.5	3.0	2.5	1.7	2.6	7.1	2.4	2.1	1.6	2.2

- Minimum & maximum depth of coal seams – 6 m (VII Top) to 630.50 m (I Bot)

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m) Gross Calorific Value (GCV in K.Cal/kg) and useful Heat Value (UHV in K.Cal/kg), of coal as per GR:

Seam	Proximate Analysis (60% RH & 40^0 C)		GCV (Kcal/Kg)		Grade Band
	M%	Ash%	Calculated Range	Mean	
R2	2.9-3.6	42.0-51.6	3279-4081	3680	G11 – G14
R1	2.8-4.0	36.2-52.0	3256-4569	3912	G10 – G14
VII Top	3.4-5.3	19.0-43.8	3941-5999	4970	G5 – G12
VII Middle	2.7-5.3	19.0-49.4	3233-5999	4616	G5 – G14
VII Bottom	3.0-5.3	19.0-49.4	3472-5999	4736	G5 – G13
VI Top	2.9-4.5	28.8-51.7	3270-5193	4232	G8 – G14
VI Middle	2.9-5.3	19.0-51.5	3289-5999	4644	G5 – G14
VI Bottom	2.3-5.38	19.0-52.2	3237-5988	4618	G5 – G14
V	3.2-5.3	19.0-46.9	3678-5999	4838	G5 – G13
IV Top	2.9-5.3	19.0-51.5	3289-5999	4644	G5 – G14
IV Middle	2.9-5.3	19.0-51.2	3317-5999	4658	G5 – G14
IV Bottom	2.8-5.3	19.0-51.9	3266-5999	4632	G5 – G14
III Top	2.8-5.3	19.0-52.2	3237-5999	4618	G5 – G14
III Middle	2.9-5.3	19.0-51.6	3279-5999	4639	G5 – G14
III Bottom	3.0-5.3	19.0-50.2	3394-5999	4696	G5 – G14
II Top	3.1-5.3	19.0-47.9	3598-5999	4798	G5 – G13
II Bottom	3.1-5.2	19.3-48.5	3542-5986	4764	G5 – G13
I Top	3.1-5.3	19.0-48.7	3523-5999	4761	G5 – G13
I Bottom	3.0-5.3	19.0-50.0	3415-5999	4707	G5 – G13

n) Quality (Grade) of coal as per GR :	Range	G5–G14 (Based on GCV)
	Mean	G11 (Based on GCV) Avg. GCV–4276 (Kcal/Kg)
o) Total geological reserves in the block		**784.48 Mt**
p) Depletion of reserves (in case of running mine)		Not Applicable
q) Additional reserves established (if any for running mine)		Not Applicable
r) Geological reserves considered for mining: by opencast by Underground		 574.86 Mt 131.17 Mt
s) Corresponding Extractable reserves: by opencast by Underground		 420.22 Mt 39.35 Mt (Broad Estimate)
t) Percentage of recovery w.r.t. geological reserves: by opencast by Underground		 73% 30% (Broad Estimate)

* Seam wise details of items (f) to (t) to be included in the relevant chapter.

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5. MINING

a) Existing and proposed method of mining (Opencast for OB & coal separately with dragline/ shovel/ surface miners/ manual/ etc.) (underground by longwall/ Bord & Pillar/ continuous miners/ LHD/ SDL/ manual/ etc.)	Opencast. Underground mining to be planned for the lowest 2 seams (Seam I & II). Bord & Pillar/ LHD
b) **The Peak capacity as well in addition to targeted capacity** in mtpa when the mine is fully developed and the year in which proposed to be achieved By Underground : By Opencast : Total :	Opencast Mine 10 MTPA to be achieved by 8th year. Peak and targeted capacity are same. Underground Mine to be planned in future for Seam I & II.
c) Life of the mine : Underground workings : Opencast workings : Overall :	 Within 40 years (To start 7 yrs after production of OC Mine) 48 years 48 Years

d) Indicate quantum of production and expected grade as in table below :-

Years	UG Production Mt	Opencast			ROM coal/ lignite (Mt)	Saleable/ Beneficiated coal/ lignite (Mt)	Washery rejects (Mt)
		Production Mt	OB (Mcum)	Cum. Stripping Ratio (cum/t)			
1.		1	5.5	5.50			
2.		2	11	5.50			
3.		4	22	5.50			
4.		7	38.5	5.50			
5.		8	44	5.50			
6.		8	44	5.50			
7.		9	50	5.51			
8.		10	55	5.51			
Total for full lease period		**420.22**	**2119**	**5.04**			

Furnish the detailed calendar programme of coal production year wise and seam wise along with OB removal in the relevant chapter	See Chapter – V, Table No. – 5.19. Average grade is G-11.
e) Whether the proposed external OB dump site is coal/ lignite bearing: - If so, whether coal/ lignite below waste disposal area is extractable.	No External O.B. Dumping Not Applicable
f) Whether negative proving for coal/ lignite in the proposed site for OB dump/ infrastructure has been done	Infra area is non coal bearing – proved in boreholes.

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g) Proposed configuration of HEMM for OC (Coal & OB) & Major Equipment for UG.

Operation	Item	Mining Equipment	Equipment Capacity	Total No. of Eqpt.
Waste Removal	i. Drilling	Blast Hole Drill	383 mm	3
		Blast Hole Drill	250 mm	6
	ii. Loading	Hydraulic Backhoe	40 Cum	3
		Hydraulic Backhoe	12 Cum	6
	iii. Transport	Rear Dumper	360 t	20
		Rear Dumper	120 t	34
Coal Production	i. Drilling	Blast Hole Drill	250 mm	
	ii. Coal Cutting	Surface Miner	3.8 m drum	4
	iii. Loading	Front End Loader	18 Cum	4
	iv. Transport	Coal Body Dumper	100 t	20
		Trunk Belt	2000 tph	2 sets
		Mobile Belt	2000 tph	10 sets
		Mobile Hopper & Apron Feeder	2000 tph	5 sets
Road , Drain & Culvert	i.	Wheel Dozer	350 Kw (45 t class)	1
	ii	Track Dozer with Ripper	300 Kw	4
	iii	Motor Grader	16 Ft Blade (200 Kw)	4
	iv	Vibratory Compactor	25 t	4
	v	Water Sprinkler	40-45 Kl	4
	v	FE Loader	5 Cum	1
	vi	FE Loader	2 Cum	1
	vii	Diesel Back hoe (20 t class)	1 Cum	1
Maintenance & Safety Equipment	i	Crane	100 t	1
	ii	Crane	40 t	1
	iii	Crane	8 t	1
	iv	Boom Truck		4
	v	Heavy Duty Toe Truck		2
	vi	Tyre Handler		2
	vii	Mobile Maint. Van		4
	viii	Fire Tender		2
Supplies & Transport	i	Diesel Bowser		4
	ii	Fork Lift	8 t	2
	iii	Line Truck	20 t	2

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		iv	Tipping Truck	8 t	6
	Reclamation & Envt. Mgt	i	Motor Grader	16 Ft Blade 200 Kw	2
		ii	Dozer	300 Kw	4
		iii	Water Sprinkler	40-45 Kl	4
		iv	Farm Tractor		4

h) Mode of entry for underground mines (shaft, incline, adit):	In future planning. Pair of inclines envisaged presently.
i) Operations that are proposed to be outsourced	MDO route is envisaged for all mining operations.
j) Proposed coal evacuation facilities Face to Surface Surface to end use plants	Combination of Dumpers and Conveyors. Tube Conveyor & Indian Railways

6. END USE OF COAL

a) Capacity of the approved end use plants

Sl. No.	Name of Allottee	End Use Plant	Location	Coal Requirement
1.	Tenughat Vidyut Nigam Ltd. (TVNL)	2 x 660 MW (In Process)	Around LALPANIA Village Near TENUGHAT Reservoir	5.40 MTPA

b) Coal/ lignite requirement for end use plant with grade/quality	5.40 MTPA – G-11 grade (at 4100 Kcal/ Kg after mining)
c) %age of end use requirement to be met from this mine	It meets total requirement
d) If washing/ beneficiation of the coal/ lignite is planned to be conducted on site or adjacent to the extraction area, briefly describe the nature of the beneficiation and recovery rate with consumption of water etc.	Not Planned
e) Proposed Use of Rejects/Middling	Not Applicable

7. ENVIRONMENTAL MANAGEMENT

a) Existing land use pattern

Sl. No.	Land Uses	Area (in ha)
1.	Tenancy	581.18
2.	Govt. NF	272.54
3.	Forest	
i.	Reserve	NIL
ii.	Protected	495.20
iii.	C-J-B-J	2.08
	Total	**1351**

b) Land area indicating the area likely to be degraded due to mining, dumping, roads, workshop, washery, township etc.	1351 ha
c) Surface features over the block area	Habitation & Village roads,

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	Water Bodies etc.
d) No. of villages/Houses to be shifted	About 550 families to be relocated from 4 villages.
e) Population to be affected by	Estimated at about 3000
f) Year wise proposal for reclamation of land affected by mining activities	Stage wise reclamation is covered in stage plans. Final reclamation is completed in post mining period. Details are given in Chapter – XIV in table no. – 14.15 & 14.16.
g) Monitoring schedules for different environmental components after the commencement of mining and other related activities.	As per the guidelines of SPCB in their permission letter for consent to operate.
8. PROGRESSIVE AND FINAL MINECLOSURE PLAN (A separate chapter is also to be incorporated)	
i) Progressive Closure Activities	**287.73 Crores**
ii) Final Closure Activities	
A. Dismantling of Infrastructure & Disposal/ rehabilitation of Mining Machinery	4.04 Crores
B. Safety and Security	16.98 Crores
C. Technical and Biological Reclamation of Mined out area and OB Dump	24.57 Crores
D. Post Closure Management and Supervision	6.03 Crores
E. Others – Covering Social activities & Golden handshake	119.30 Crores
Sub Total (Final Closure Activities)	**170.92 Crores**
Total	**₹ 458.65 Crores (Table No. – 15.15)**

9. OTHERS	
a) Base date of Mining Plan.	July - 2018
b) Calendar year from which the production will start from the zero date i.e. date of approval of mining plan.	By the Calendar year Year – 2019
c) Results of any investigation carried out for scientific mining, conservation of minerals and protection of environment; future proposals.	To be carried out as and when required
d) Signature or RQP Date 31/10/2018 Place RANCHI	

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MAIN TEXT

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LIST OF TABLES

Vijay Kumar Singh
(Authorised Person)
(Regd. No. ...)
[F. ... 014-CPAM
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Rajesh Ranjan
ESE (E&S)
TVNL Hiryur Road

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LIST OF ANNEXURE

Annexure No.	Title
I	Allotment Order no. 103/19/2015/NA dated 30.06.2015 for Rajbar E & D Coal Mine from Nominated Authority, MoC, GoI.
I A	Copy of MoC letter F. No. 103/19/2015/NA dated 21.12.2016 to TVNL enclosing the Corrigendum no. 1 to the above allotment order.
II	Copy of CMPDI Letter No. CMPDI/DG/Captive/153/770 dated 20.07.2016 to Nominated Authority, MoC, enclosing the geographical coordinates of the cardinal points of Rajbar E & D Coal Mine.
II A	A certificate of CMPDI vide letter no. CMPDI/BD/C(886-A)/ E-220387/I-4734 dated 26.10.2018 enclosing certified plan with its observation.
III	Approvals of Mine Closure plan from the Board of the company.
IV	Copy of earlier approval of mining plan.
V	Copy of MoC's Letter granting recognition to RQP for preparation of Mining plan.
VI	Letter of authorization by the Block allottee for formulation of Mining Plan & Mine Closure Plan by the RQP.
VII	Certificate of acceptance of the RQP to formulate the Mining Plan & Mine Closure Plan on behalf of the project proponent.
VIII	A certificate by the RQP that he has been duly authorized by the mining company to prepare Mining plan & MCP on their behalf and that he has a valid recognition from MoC under MCR, 1960 to prepare the Mining plan and that provisions of all relevant rules and regulations made there under have been observed in the preparation of mining plan.
IX	The Mining plan/ Mine Closure plan has been prepared considering the guidelines pertaining to Mining Plan/ Mine Closure Plan issued by MoC, GoI & wherever specific permission will be required the applicant will approach the concerned authorities.
X	Confirmation from RQP that he has verified the block area with the relevant plans supplied by CMPDI/ SCCL / NLC and area covered by the mining plan does not encroach on any other coal lignite block.

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XI	Certificate from empowered representative of/or Block allottee/ applicant that he mine will be developed as per the approval of the mining plan from Ministry of coal and all other approvals, as required will be obtained from relevant authorities.
XII	Copy of the document to establish that the geological report has been duly purchased from CMPDI, GSI/ MECL as the case may be.
XIII	Certificate of RQP that the project boundary considered for the Mining Closure Plan has been verified by RQP. It is in coherence with the block boundary of vesting order and approved mining plan and no discrepancy has been found.
XIV	Certificate Regarding Mining Plan & Mine Closure Plan
XV	Certificate from empowered representative of/or Block allottee/ applicant that he mine that the reclamation & rehabilitation work shall be carried out in accordance with the approved mine closure plan and any modification/amendments which may be made in the mine Closure Plan by Ministry of Coal, from time to time.
XVI	Documents in support of Mining Lease, in case the lease has already been granted.
XVII	Regarding Hydrological Studies.
XVIII	Other Documents :- (A). Our submissions on the observations of Standing Committee vide MoC, GoI letter no. 34011/12/2016–CPAM dated 20.06.2016 & 34011/18/2017–CPAM dated 07-03-2018. (B). Our submissions on the observations of Standing Committee vide MoC, GoI letter no. 34011/18/2017–CPAM dated 21-06-2018. (C). Application for Issuance of Letter of Intent (LoI) from State Government of Jharkhand for 31 ha of land included in the proposed project area of Rajbar E & D Coal Mine but outside the allotted block area in District Latehar allotted to M/s TVNL vide letter no. 555/18-19 dated 02.08.2018.
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(Recognised Professional Person)
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ESE (P & S)
TVNL Hindi, Ranchi
21 DEC 2021

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 3012(53)/2014-CPAM
Dated- 29.05.2015]

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Rajesh Ranjan
ESE (Mines)
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Main Text

CHAPTER - I

INTRODUCTION

1.1 THE COMPANY

The Rajbar E & D Coal Mine in Auranga Coalfield, lies in Latehar District of Jharkhand State. It has been allotted to M/s. Tenughat Vidyut Nigam Ltd. (TVNL), a State of Jharkhand Undertaking for power generation; vide Order No. 103/19/2015/NA dated 30-06-2015 by MoC, GoI (***"Annex. – I"***, to be read with Corrigendum No. 1 dated 21.12.2016, placed as ***"Annex. – I A"***). The power generating company has been incorporated in the year 1987. The coal produced from the mine will be for captive use of extension power units (660 MW x 2) of M/s TVNL. The TVNL, presently, have functional 210 MW x 2 units. 660 MW x 2 units are proposed for expansion in Lalpania village near Tenughat Reservoir in Bokaro District of the State of Jharkhand. The functional power units are also stationed at Lalpania village, near Tenughat Reservoir. The registered office address and address for communication for M/s. TVNL is the same and is given below:

Registered Office Address:

Tenughat Vidyut Nigam Ltd. (TVNL)
At. – Hinoo, P.O. – Doranda,
Dist. – Ranchi
Jharkhand,
PIN – 834002

1.2 LOCATION OF THE END USE PLANTS OF TVNL

The end use plants of TVNL are located & proposed to be located in village Lalpania in P. S. – TTPS-Lalpania, falling in Bokaro District of Jharkhand State. The power station is near Tenughat Reservoir. This area is near DUMRIBIHAR Railway Station (newly created) on the East Central Zone of Indian Railway (E. C. Railway). An 8 km railway line from DUMRIBIHAR Station goes upto power station in Lalpania. The proposed coal mine is situated near Chetar

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Railway Station of E. C. Railway. Both DUMRIBIHAR and Chetar Railway Stations lie on Gomoh – Barkakana – Dehri-on-Sone loop line of E. C. Railway. The distance from project pit head (coal dispatch point) to power plant at Lalpania is 160 km.

1.3 COAL REQUIREMENT FOR END USE PLANTS

As already stated two units of 210 MW are operational at Lalpania. Two units of 660 MW in super critical size are proposed to be added by M/s TVNL at Lalpania. The average GCV of Rajbar E & D Coal Mine has been assessed at 4276 Kcal/kg with geological data which puts it in G–11 grade. However, due to the following reasons, slippage of grade takes place during mining.

i. The machine cut coal contains all the materials in the seam. In geological assessment there is provision for excluding non combustible band for arriving at coal quality. This is not feasible in opencast, high capacity mines. Total coal seam is cut and loaded, including the non combustible bands. Thereby, the process increases ash content.

ii. While cutting coal near floor of the seam, some floor stone are likely to get cut and it mixes with coal and gets loaded on to trucks/ conveyors. This dilutes the coal quality. This is an integral part of mechanised working in O.C. mines.

Taking these dilution into consideration (say about 4%) the available GCV could go down to 4100 Kcal/kg. It is still within G–11 grade. Therefore, for calculating the coal requirement, GCV of 4100 Kcal/kg has been considered. Coal requirement for the two extension units i.e. 2 x 660 MW is calculated below, based on MoC-GoI guidelines for coal consumption for different coal grades G–4 to G–15.

Table No. – 1.1
Coal Requirement for End Use Plants at 85% PLF & 4100 GCV

Sl. No.	Size of EUP	Unit Heat Rate Kcal/unit	Annual Coal Consumption at 85% PLF & 4100 Kcal/kg In tonnes/MW	Total Coal Per annum in Mt
1.	660 x 2 units	2250	4086	5.39352
			Total	**5.39352**

Total coal requirement for extension units comes to 5.39352 Mt say 5.40 Mt.

Rajesh Ranjan
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1.4 MEETING THE REQUIREMENT

The proposed mine has peak capacity of 10 MTPA which is achieved by 8th year. It is reaching level of 7 MTPA in 4th year, which will meet coal requirement for the extension units. Any balance coal after meeting the requirements of TVNL will be delivered to CIL or other users as per the then governmental norms.

1.5 COAL WASHING

The mine is expected to have G–11 grade of coal on GCV basis. It is suitable for this short distance movement which is about 160 km. Hence no coal washing is proposed.

1.6 MINERAL WHICH APPLICANT INTENDS TO MINE – Coal.

1.7 PERIOD FOR WHICH MINING LEASE IS REQUIRED

Mining Lease will be applied for 30 yrs. It will be renewed before expiry of 30 yrs lease, as mine's productive life is estimated to be nearly 48 years.

1.8 NAME OF RQP PREPARING MINING PLAN-

Vijay Kumar Singh
Hill Top,
Mahalla – Chandwe
Kanke Road,
Ranchi – 834008
Jharkhand
Recognition Number: 34012/(03)/2014-CPAM dt-29.05.2015 ***("Annex – V")***
Valid till 28.05.2025
Contact No. Mobile – 08226865342

The authorisation by TVNL to RQP for preparation of this Mining Plan & Mine Closure Plan, is enclosed as "***Annex – VI***".

1.8.1 The RQP has accepted to formulate the Mining Plan & Mine Closure Plan for Rajbar E & D Coal Mine for the project proponent. This acceptance by RQP is enclosed as "***Annex – VII***".

1.8.2 A certificate by RQP that he has been fully authorised by the mining company to prepare mining plan and mine closure plan on their behalf and that he has a valid recognition from MoC under MCR, 1960 to prepare the mining plan and

Vijay Kumar Singh
(Recognised Qualified Person)
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that provisions of all relevant rules and regulations made there under have been observed in the preparation of mining plan, is enclosed as "***Annex – VIII***".

1.8.3 The proponent M/s TVNL have certified that the Mining Plan/ Mine Closure Plan have been prepared considering the guidelines pertaining to Mining Plan/ Mine Closure Plan issued by MoC, GoI and wherever specific permission will be required the applicant will approach the concerned authorities and the same has been enclosed as "***Annex – IX***".

1.8.4 Confirmation from RQP that he has verified the block area with the relevant plans supplied by CMPDI/ SCCL/ NLC and area covered by the mining plan does not encroach on any other coal/ lignite block and the same is enclosed as "***Annex – X***".

1.8.5 Certificate from empowered representative of/or Block allottee/ applicant that he mine will be developed as per the approval of the mining plan from Ministry of coal and all other approvals, as required will be obtained from relevant authorities and the same is enclosed as "***Annex – XI***".

1.8.6 The proponent M/s TVNL have submitted the certificate regarding Mining Plan & Mine Closure Plan. This is enclosed as "***Annex – XIV***".

1.9 NAME OF PROSPECTING AGENCY

Directorate of Geology
Department of Mines & Geology
Govt. of Jharkhand, Ranchi

***

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34/12/(03)/2014-CPAM
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Rajesh Ranjan
ESE (P & S)
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CHAPTER - II

DETAILS OF EARLIER APPROVAL OF MINING PLAN

The Rajbar E & D Coal Mine has been allotted to M/s Tenughat Vidyut Nigam Ltd. (TVNL) vide MoC, GoI Order No. 103/19/2015/NA dated 30-06-2015 (***"Annex – I"***, To be read with Corrigendum No. 1 dated 21.12.2016, placed at ***"Annex. – I A"***) issued by the Office of Nominated Authority, MoC, GoI. The Mining Plan was submitted for the first time in January 2016. This plan was presented before the Standing Committee of MoC, GoI on 17-06-2016. Some observations were made by the Standing Committee on 20-06-2016. One of the observations was related to the specification of the block boundary. On application from TVNL, to Nominated Authority; the coordinates issued by MoC were corrected by CMPDI. Accordingly 71 coordinates specified by CMPDI were issued for block boundary certification. This was firmed up in December 2016. While the Mining Plan was ready for resubmission after incorporating boundary specification etc., fresh guidelines from MoC, GoI, were issued in May 2017, for including Checklist as an additional item in a Mining Plan. After including this Checklist, the Mining Plan was resubmitted in December 2017. This resubmitted Mining Plan was presented on 09-02-2018. Further observations were issued on 07-03-2018 and also on 21-06-2018. This Mining Plan incorporates compliance of all the observations made so far.

***

Vijay Kumar Singh
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CHAPTER - III

LOCATION, TOPOGRAPHY & COMMUNICATION

3.1 LOCATION OF THE COALFIELD

The Auranga Coalfield has been named after Auranga River flowing through the Central portion of the coalfield. In west, the coalfield extends about 5 km beyond Kumandi Railway Station. In east, it ends about 5 kms West of Tori Railway Station. It lies North of NH-75.

Auranga Coalfield is the eastern most part of the Koel Valley Group of Coalfields. It lies in Latehar district of Jharkhand (Plate No. – I A and I B). It is separated from North Karanpura Coal Field by a 20 km wide stretch of metamorphic belt lying east of Auranga coalfield. The Auranga Coal Field covers an area of 250 sq km and is bounded by latitude 23^0 40' to 23^0 55' N and longitude 84^0 20' to 84^0 45' E. It is an East-West trending Gondwana basin, wide in the east and narrow in Westward direction.

3.1.1 Location of Rajbar E & D Coal Mine

Rajbar E & D Coal Mine, in the Auranga Coalfield, has been allotted to TVNL by MoC, GoI vide Allotment Order no. 103/19/2015/NA dated 30-06-2015 (***"Annex – I"***, To be read with Corrigendum No. 1 dated 21.12.2016, placed as ***"Annex. – I A"***). A mining plan for Rajbar E & D Coal Mine was prepared and submitted to MoC in January 2016. The presentation of mining plan was held on 17.06.2016. One of the observations of the standing committee is as follows:

"As indicated in the CMPDIL certificate, the geological boundary of Rajbar E & D Coal Mine is not in accordance with the geographic coordinates given in the vesting order". In view of above, CMPDI was requested by TVNL to send the coordinates to MoC so that bounding coordinates indicated earlier by MoC can be modified based on the revised coordinates furnished by CMPDI. Vide their letter dated 20.07.2016, CMPDI have since furnished the revised coordinates (based on WGS-84 datum and UTM projection) of terminal points including bounding coordinates of Rajbar E & D Coal Mine to MoC (***"Annex. – II"***). The Nominated Authority vide Corrigendum No. 1 have sent

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the letter no. 103/19/2015/NA dated 21.12.2016 ("***Annex. – I A***") and communicated to TVNL the revised bounding coordinates of Rajbar E & D Coal Mine. The bounding coordinates in the allotment letter dated 30.06.2015 and revised coordinates vide letter dated 21.12.2016 are given below:-

Bounding Coordinates as per Allotment Letter dated 30.06.2015 (Kalyanpur 1975)	**Revised Bounding Coordinates as per Letter dated 21.12.2016 (Coordinates are in WGS-84 Datum & UTM Projection)**
Latitude – 23° 45' 19" N to 23° 47' 59" N Longitude – 84° 37' 47.4" E to 84° 40' 51.6" E	Latitude – 23° 45' 27.491" N to 23° 48' 2.680" N Longitude – 84° 37' 38.780" E to 84° 40' 27.119" E

Subsequently CMPDI issued a certified plan of the allotted block area under cover of their letter no. – CMPDI/BD/C(886-A)/E-220387/I-4734 dated 26.10.2018. The letter is placed as "***Annex. – II A***". The certified plan is placed as Plate No. – 03.

Based on the 71 co-ordinate points given in the certified plan (Plate No. – 03) of CMPDI, the block area has been firmed up to 1487 ha, which is coal bearing. The CMPDI as per the requirement, have also certified in the plan (Plate No. – 03) that planned infra areas proposed are South of the allotted block and are on non coal bearing area.

The allotted area for coal mine covers 1487 ha and it is located in Survey of India Toposheet No. – F45A9 (Plate No. – 02). The revenue villages within the area come under Chandwa, Balumath and Latehar Anchals of Latehar District in the State of Jharkhand. The revenue villages falling in the allotted Coal Mine area of 1487 ha are Jerang, Rajbar, Lejang, Renchi, Darea & Serak.

3.1.2 Coal Block Boundary

The boundary of Rajbar E & D Coal Mine allotted to TVNL is bounded by part of Sukri River in its North side. The East, South and West sides are lines as per the block boundary map, provided by CMPDI vide their letter dated 20.07.2016 ("**Annex. – II**"). Subsequently CMPDI issued a certified plan of the allotted block area under cover of their letter no. – CMPDI/BD/C(886-A)/E-220387/I-4734 dated 26.10.2018. The letter is placed as "***Annex. – II A***".

Vijay Kumar Singh
(Recognised Qualified Person)
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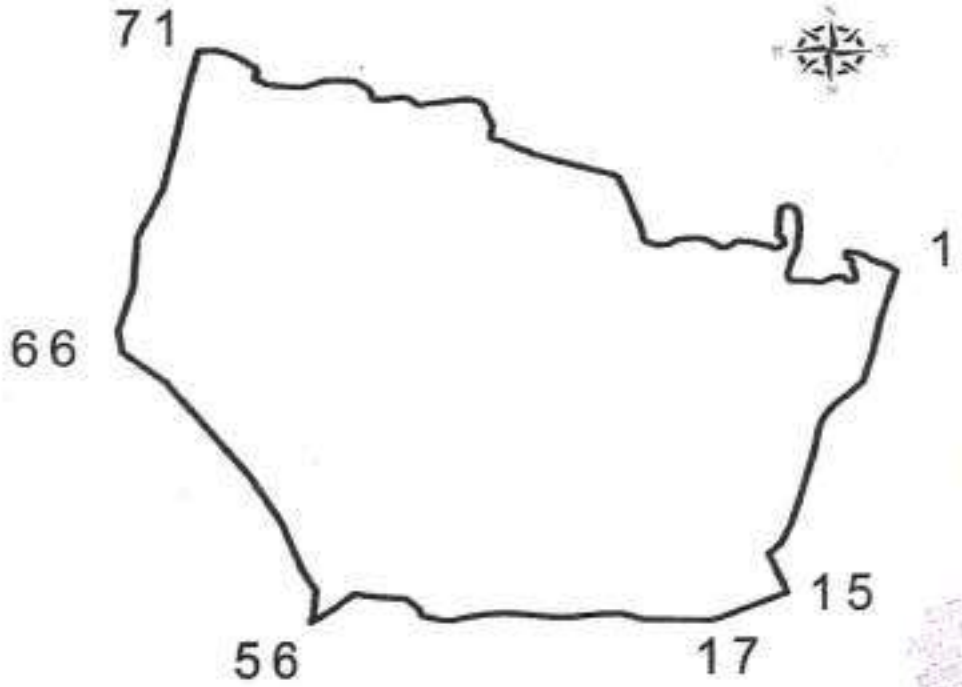
The certified plan is placed as Plate No. – 03. Based on the 71 co-ordinate points given in the certified plan (Plate No. – 03) of CMPDI, the block area has been firmed up 1487 ha, which is coal bearing. The CMPDI as per the requirement, have also certified in the plan (Plate No. – 03) that planned infra areas proposed are South of the allotted block and is on non coal bearing area. The map showing the coal mine boundary as per CMPDI/ MoC's is enclosed as Plate No. – 3. The coordinates of 1 to 71, covering corner points and showing the Latitude & Longitude of each point has been enclosed in "***Annex. – II***". For clarification of the boundary the figure is given below:-



North side

Northern boundary is delineated by Sukri River from extreme East point of the block and going in W-NW direction, as it flows, and leaves the area at its extreme West point. The North side boundary along the Sukri River covers a distance of about 6746 m. It lies between point 1 and 71.

East side

The Eastern boundary runs in a North-South direction and it is the contact between coal bearing formation & metamorphics. Total distance covered by the East Side boundary comes to about 2858 m. It lies between point 1 & 15.

Rajesh Ranjan
ESE (P & S)
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Vijay Kumar Singh
(Recognised Qualified Person)
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South side

The Southern boundary runs from extreme east point no. 15 to extreme west point no. 56 of south side boundary. It covers a distance of about 3180 m.

West side

The Western boundary starts from point no. 56 and runs NNW and then takes a turn towards NNE. Thereafter, it reaches the extreme north point i.e. point no. 71 of the allocated coal mine and covers a distance of about 5167 m.

3.1.3 Area of the Coal Mine Block

The allotted Rajbar E & D Coal Mine block covers an area of 1487 ha which is coal bearing. The maximum span is about 4.7 km in East West direction and about 4.5 km in North-South direction. Of these 1487 ha, about 1320 ha is planned for developing the mine. Breakup of the rest about 167 ha which would not be covered under mine planning is as follows:

- Part of River Bed & Meander – 17 ha
- North metamorphic high area with meagre coal deposit and densely inhabitated area. – 150 ha

Sub Total – 167 ha

Proposed Mine Area – 1320 ha

Grand Total – 1487 ha

3.1.4 Proposed Project Area/ Proposed Lease Area

Beyond the 1320 ha of the mining area, the area to be covered for allied activities, is assessed as follows.

Sl. No.	Uses	Area in ha
1.	Electrical Substation – 2.0 Work Shop – 2.9 Store – 1.9	6.8
2.	Road	4.0
3.	Garland Drain	0.8
4.	Office	1.9
5.	Township	10.1
6.	Green Belt between Mine & Infra areas	7.4
	Total	**31.0**

Vijay Kumar Singh
(Recognised Qualified Person)
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It will be seen from above table that 31 ha of land will be required for allied activities for this mining project. Hence the proposed Project/ Lease area comes to 1320 ha + 31 ha i.e. 1351 ha. Detailed land uses of this 1351 ha has been covered in subsequent chapters wherever required. For clearance of this 31 ha land, outside allotted block, a request has been made to State Govt. for issuance of Letter of Intent (LoI). This is enclosed as ***"Annex. – XVIII (C)"***. Further a certificate of RQP that the project boundary considered for the Mining Closure Plan has been verified by RQP. It is in coherence with the block boundary of vesting order and approved mining plan and no discrepancy has been found, is enclosed as ***"Annex. – XIII"***.

3.2 COMMUNICATION & ACCESSIBILITY

The Rajbar E & D Coal Mine is approachable from NH-75, by an all season road, & lies about 9.5 km towards North from the NH. This point on NH-75, is located at a distance of about 18 km from district town Latehar. The district headquarter Latehar is situated in SW direction of the block and is at about 27.5 km distance through the roads. The nearest Railway Station is Chetar about 13.7 km from projects coal dispatch area towards South. It lies on Gomoh-Barkakana-Dehri on Sone loop line of the East-Central Railway (E.C. Railway). Coal from Chetar Railway Station will move to Dumri Bihar Railway Station (138 km) near Gomia Railway Station on E.C. Railway. Coal from Dumri Bihar Railway Station will move through 8 km long MGR to TVNL plants at Lalpania. Therefore distance from pit head to End Use Plant comes to 13.7 + 8 + 138 = 159.7 km say 160 km. Nearest Airport is at Ranchi which is the capital of Jharkhand State. Ranchi airport is about 100 km from the coal mine.

3.3 AVAILABITY OF POWER & WATER

Power will be available from the nearest sub-station of Jharkhand Bijli Vitran Nigam Limited (JBVNL). Within 25 km radius, thermal power plants are likely to come up through Pvt. Companies. Hence, there will be no shortage of power for the mine. Water gets pumped out of mine for operation of the mine. This pumped out water will be used for industrial purposes. A small quantity of

Rajesh Ranjan
TVNL, Hinoo, Ranchi-834002
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Vijay Kumar Singh
(Recognized Qualified Person)
(Recognition No. 3402/(03)/2014-CPAM
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water would be drawn from ground water for domestic purposes after obtaining competent approval for the same.

3.4 PHYSIOGRAPHY & DRAINAGE

3.4.1 Physiography

Rajbar E & D Coal Mine falls in the Palamu plateau of Chotanagpur Gneissic Complex. In general, the topography of the area is mildly undulating and the general slope is towards NW. Due to undulating nature of the land, a number of natural ponds have got formed. General elevation in the coal mine area is around 440 m above MSL. The maximum elevation inside the coal mine area is around 471 m. in the south-eastern part, whereas minimum elevation is around 415 m above the MSL in the north-western part of the coal mine (Plate No. – 07).

About 37% of the project area is covered with Protected Forests. Important amongst them are Rajbar, Jerang, Renchi, Darea & Serak. Rest of the area is covered with agricultural land, habitation area, water bodies etc.

3.4.2 Drainage

The drainage of the Coalfield is mainly controlled by Auranga River. The Sukri River, one of the important tributaries of the Auranga, flows from east to west over the entire length of the Rajbar E&D Coal Mine along its northern boundary. Some 1st & 2nd order channels join the Sukri River. The flow direction of the water channels is generally towards NW. These water channels joining Sukri River are quite shallow.

However, one 3rd order stream coming from East side runs through the coal block. This will have to be guided towards Sukri River through garland drain.

Rajesh Ranjan
ESE (P & S)
HQ, Hinoo, Ranchi-834002
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3.5 CLIMATE

The area experiences Sub-Tropical climate. In summer, the temperature rises up to 45^0 C or so. It is very cold during the month of December and January

Vijay Kumar Singh
(Recognised Qualified Person)
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when temperature lowers down to as low as 4^0 C. The monsoon starts from the middle of June and continues up to mid October.

Rainfall

The average annual rainfall for Latehar district is about 1335 mm. However, during last 15 years, it has shown decrease in rainfall in the area in some years getting less than 1000 mm. Annual rainfall in the block area during last 10 years has shown lower rainfall i.e. below 1000 mm in 2004, 2005, 2009 and 2010. In the remaining years, rainfall recorded was more than 1000 mm.

3.6 SURFACE FEATURES IN ALLOTTED AREA & NEIGHBOURHOOD

The area is typical Chhotanagpur Pleatu area. The existing land uses of the proposed project area of 1351 ha has both forest and non forest land. The non forest land is agricultural land, habitation with roads, water bodies etc. covers about 63% and forest land is about 37%. The allotted area is nearly 13.7 km from nearest Railway Station of Chetar on E. C. Railway and 9.5 km from NH-75. About 3000 persons would need shifting from the proposed mining area. Details are covered in Chapter – XIV on Environment Management Plan.

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Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 3412/(03)/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
Dy. GM (P&P)
TVNL, Hindpiri, Ranchi-834002
17 DEC 2024

CHAPTER - IV

EXPLORATION, GEOLOGY, SEAM SEQUENCE, COAL QUALITY & RESERVES

4.1 EXPLORATION

4.1.1 Previous Work

Rajbar E & D Coal Mine is located in the Auranga Coalfield in Latehar district, Jharkhand. The coalfield is the eastern most member of the North Koel Valley Coalfields in Gondwana basin. It is only 20 Km. away on west of the North Karanpura Coalfield which is the Western most part of the Damodar Valley Coalfields.

The coalfield was named by Ball (1880) after Auranga River which traverses through the coalfield and joins North Koel River.

Regional Exploration of the area was carried out by GSI in 1980 – 83 and a geological map for the coalfield, on RF 1:63,600, is available.

4.1.2 Present Investigation

The present investigation comprised surveying, mapping, drilling and analysis of coal samples and processing of data. Exploration activity in this block was started by Directorate of Geology & Mines (DGM), Jharkhand state, in December 2010 with Topographic survey. Borehole survey and planning for drilling was carried out on the basis of the available Regional GR of GSI on Rajbar Block. The drilling for detailed exploration was started in March 2011. The G.R. for the allocated coal mine was prepared in the year 2012 and finally completed in the year 2013. This has been certified by M/s TVNL and certificate is enclosed as ***"Annex. – XII"***. This mining plan is based on the final G.R. submitted by DGM, Jharkhand State. The G.R. was not needed to be purchased from CMPDI/ MECL etc.

Rajeev Ranjan
AEE
TVNL, Hinoo, Ranchi-8
ESE (P & S)
27 DEC 20

Vijay Kumar Singh
(Recognised Competent Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

4.1.3 Drilling

The drilling details, covering the allocated coal mine, are given in table no. – 4.1.

Table No.-4.1

Drilling Details

Agency	No. of Boreholes Drilled	Total Drilling(m)
GSI	8	2824.40 m
DGM, Jharkhand State through Outsourced Agencies	98	26,115.50 m
Total	106	28,939.90 m

With total allocated coal mine area of 1487 ha for Rajbar E &D Coal Mine, the drilling density comes to more than 6.5 borehole/ Sq. Km. considering 97 boreholes drilled within the coal mine area.

4.1.4 Exploration Inputs

Various exploration activities such as Topographic Survey, Geological Mapping, Drilling, Core Logging, Sampling / Packing, Coal Analysis, Geophysical Logging etc. were undertaken. Topographic, Geological and Borehole survey was carried out over 1487 ha area of the block. Geological logging was done and coal core samples were subjected to Band by Band analysis, Seam Overall Proximate Analysis, Ultimate Analysis, Petrographic Studies and special tests like Washability, HGI and Physico-mechanical tests were conducted at CIMFR, Dhanbad and the State Geological Laboratory, Hazaribagh. Geo-physical logging was carried out in 65 bore holes.

4.1.5 Borehole Density of the Coal Mine

In the Rajbar E& D Coal Mine, covering an area of 1487 ha. A total of 106 boreholes (98 BHs by DGM, Jharkhand and 8 BHs by GSI) were drilled with an average density of about 6.5 boreholes per sq. km. within the coal mine. The coal bearing area in the allocated coal mine comes to 1487 ha. There are 97 boreholes in this area. The density comes to 6.5 boreholes/ Sq.km.

Rajesh Ranjan
ESE (P&S)
TVNL, Hindpiri, Ranchi-834002
17 DEC 2024

Vijay Kumar Singh
(Recognised Qualified Person)
[Letter No. J-11015/331/2014-CPAM
Dated- 29.05.2015]

Seam wise borehole density within the coal mine as per GR is given in table no. – 4.2.

Table No.-4.2

Seam wise Borehole Density of the Coal Mine

Seams	No of Borehole Intersections	Area of Occurrence (Sq. Km)	Borehole Density (BHs/Sq.Km)
R2	8	2.046	3.9 (say 4)
R1	10	2.051	4.9 (say 5)
VII Top	35	5.806	6
VII Middle	40	7.140	5.6 (say 6)
VII Bottom	34	6.190	5.5 (say 6)
VI Top	41	7.671	5.3 (say 5)
VI Middle	42	8.328	5
VI Bottom	46	8.271	5.5 (say 6)
V	45	7.566	5.9 (say 6)
IV Top	58	9.683	5.9 (say 6)
IV Middle	46	8.312	5.5 (say 6)
IV Bottom	65	11.306	5.7 (say 6)
III Top	56	10.377	5.3 (say 5)
III Middle	40	6.804	5.8 (say 6)
III Bottom	65	11.480	5.6 (say 6)
II Top	47	8.356	5.6 (say 6)
II Bottom	55	11.04	4.9 (say 5)
I Top	49	9.090	5.3 (say 5)
I Bottom	48	8.623	5.5 (say 6)

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 21012/(03)/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
ESE (P & S)
TVNL, Hirnoo, Ranchi-834002
27 DEC 2021

4.1.6 Analysis of Borehole Cores

Coal core samples were collected on a "Band by Band" basis along with dirt bands, for chemical analysis. Where thicker coal bands were available, two samples at an interval of 1 m. were collected. These samples were then subjected to detail Band by Band analysis, Proximate Analysis, Ultimate analysis determination of Sulphur content & Ash Fusion Temperature to establish the quality of the coal seams.

Geophysical investigation was carried out in 65 boreholes in which Self Potential, Long Spacing Density, Bed Resolution Density, High Resolution Density, Caliper, Short Normal, Long Normal, Natural Gamma, and Single Point Resistant were recorded to ascertain the deviation for interpretation of coal seam intersection.

The "Rock Quality Designation" Test (RQD) was conducted to know the strength of roof and floor strata for a zone of 3 to 5 meter above the coal seam and 3 to 5 meter below the coal seam. This RQD test was carried out for each borehole and the data obtained indicates that the roof and floor rocks of all seams come under "Fair to Good' category.

The Physico-mechanical study of two boreholes, i.e. JAR-45 & 65 has been carried out in the laboratory. The details of the above studies are incorporated in the Geological Report.

4.1.7 Surveying

Detailed Topographic Mapping of the area on RF 1:4,000 was carried out by DGM in which all possible details such as roads, river, nala, tributaries, wells, ponds, forest, hutments, temples, outcrops etc were plotted. Contouring of the area was done at an interval of 2 m with the help of Theodolite.

Altogether 99 drilling points were proposed at 400 m. interval on a grid pattern. Boreholes drilled by GSI were taken into consideration during the

Rajesh Ranjan
ESE (P & S)
TVNL, Hinoo, Ranchi
27 DEC 2024

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 4-CPAM
Dated- 29.05.2015]

development of grid for the proposed borehole points. Borehole survey was carried out on RF 1:4,000.

4.2 REGIONAL GEOLOGY

4.2.1 General

Auranga Coalfield is located in the eastern most part of the Koel Valley Group of Coalfields in Latehar district of Jharkhand. It is separated from North Karanpura Coalfield by a 20 km wide stretch of Metamorphic belt forming the eastern part of the Coalfield. The Coalfield covers an area of 250 sq km and is sub-divided in to 8 coal blocks of which Rajbar sector is the largest covering 50 Sq. Km(as per GSI). Rajbar E & D Coal Mine, covering 1487 ha, forms part of the larger Rajbar sector within the coalfield.

4.2.2 Stratigraphic Succession in Auranga Coalfield

A generalized stratigraphic succession of the Auranga Coal Field is given in table no. – 4.3.

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated: 29.05.2015]

Rajesh Ranjan
[RQP-ESE (P-ES)]
Ranchi, Ranchi-834002
21 DEC 2015

Table No.-4.3
Stratigraphic Succession of the Auranga Coalfield

Age	Group	Formation	Lithology	Thickness (m)
Upper Triassic	**Upper Gondwana**	**Mahadeva**	Thick, highly cross-bedded medium to coarse grained ferruginous, brownish red to grey sandstone with red shale bands.	180-210 m
------ Unconformity ------				
Lower Triassic	**Lower Gondwana**	**Panchet**	Greenish to yellowish green, pinkish, cross-bedded medium to coarse grained Felspathic sandstone with brown, red, chocolate, Micaceous sandstone, shale, clay.	130-150 m
Upper Permian		**Raniganj**	Fine to medium grained sandstone, siltstone, sandy shale, Carbonaceous shale & coal seams.	180-200 m
Middle Permian		**Barren Measures**	Medium to coarse grained sandstone, Carbonaceous shale and iron stone bands.	80-160 m
Lower Permian		**Barakar**	Grey to greyish white fine to coarse-grained cross-bedded and laminated arkosic sandstone, pebble beds, conglomerate and grey to carbonaceous shale, coal seams and fire clay.	400-450 m
		Karharbari	Grey, mottled, conglomeratic coarse grained sandstone and shale.	40-85 m
Lower Permian to Upper Carboniferous		**Talchir**	Tillites, Yellowish sandstone with needle shale and Rhythmites.	30-35 m
------ Unconformity ------				
Pre-Cambrian	**Metamorphics**		Granite gneiss with patches of mica-schist and quartz, amphibolite and pegmatite veins.	

4.2.3 Intrusive: - Evidence of the occurrence of intrusive bodies has not been reported in the Auranga coalfield.

Rajesh Ranjan
ESE (P & S)
TVNL Hindpiri (Ranchi-834002)
21 DEC 2021

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 36/12/(03)/2014-CPAM
Dated: 29.05.2015]

4.2.4 Regional Structure in Auranga Coalfield

The Auranga coalfield is the eastern most coalfield of the North Koel valley in Gondwana basin. It is 20 km away from the North Karanpura basin, the western most member of the Damodar valley coalfield and shows close similarity in its stratigraphic and tectonic setting with that of the adjacent Damodar valley basin.

Faulting:

Auranga basin is dissected into several blocks by a complex pattern of faulting. The dips are high, being around $20^0 - 30^0$ in areas of disturbances. In the areas free from such disturbances, dips are gentle being around $5^0 - 10^0$.

In the western part of coalfield, Gondwana sediments occur as a narrow wedge due to complex faulting. The boundary faults at places pass though the central part of the basin and develop into intra-basin faults. The boundary fault running along the Auranga River has truncated the coal measures of Jagaldaga area to south. A major east west trending fault has truncated the coal measures towards north.

In Auranga Coalfiled, the major faults have two regional trends; E-W and NW-SE. The basin, by and large, is fault bounded on both the sides and southern boundary is considerably disturbed by faulting. Some of these faults have a throw of more than 200m.

4.3 GEOLOGY OF RAJBAR E & D COAL MINE (Plate No. – 04)

4.3.1 General

The Rajbar E & D Coal Mine is situated in the north eastern part of Auranga Coalfield. This Coal Mine is spread over an area of 1487 ha comprising formations of Lower Gondwana Group unconformably overlying the Pre-Cambrian rocks. Barakar and Raniganj are the main coal bearing formations. Rock exposures, including that of coal, are found to occur along the river bed and nala sections. Sandstones crop out in limited portions only.

Rajesh Ranjan
GGE (Type S)
TVNL, Hindustan Zinc Limited
27 DEC 2021

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. ... (Coal) 2014, CPAM
Dated- 29.05.2015]

4.3.2 Stratigraphy:

On the basis of relevant data of Rajbar E & D coal mine, it is found that Talchir, Barakar, Barren Measures and Raniganj Formations of the Lower Gondwana Group lie unconformably over the Pre-Cambrian metamorphics (Plate No. – 08 A and 08 B).

A generalized geological succession of this coal mine is given in table no. – 4.4.

Table No. – 4.4

Generalized Geological Succession

Group	Formation	Lithology	Thickness (m)
Lower Gondwana	Raniganj	Fine to medium grained sandstone, siltstone, sandy shale, Carbonaceous shale & coal seams.	47.25 - 174.27
	Barren Measures	Greenish medium to coarse grained Feldspathic sandstone with predominant black shale, sandstone cross bedded and shows Flasher bedding.	3.85 - 42.39
	Barakar	Grey to greyish white fine to coarse-grained cross-bedded and laminated Arkosic sandstone, pebble beds, conglomerate and grey to carbonaceous shale, coal seams and fire clay.	51.0 - 581.50
	Talchir	Tillites, Yellowish sandstone with needle shale and Rhythmites.	4 – 42
------ Unconformity ------			
Pre -Cambrian		Granite gneiss with patches of mica-schist and quartz and pegmatite veins.	

Rajesh Ranjan
ESE (P & S)
TVNL, Hinoo, Ranchi-834002
21 DEC 2024

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

4.3.3 Coal Deposit

The Barakar is the principal coal bearing formation and to some extent Raniganj Formation also contributes to the coal reserves in the Rajbar E&D Coal Mine. There are 7 coal seams belonging to Barakar Formation designated I to VII and 2 coal seams belonging to Raniganj Formation designated R-1 and R-2 all in ascending order. Incrops of Barakar seams occur in all parts of the coal mine while Raniganj seams incrop in a very restricted zone - mostly in west central part (Plate No. – 04).

4.3.4 Description of Formations:-

- **Pre-Cambrians**

  The Metamorphic rocks of Pre-Cambrian form the basement of Rajbar E&D Coal Mine on which the rock formations of Lower Gondwana Group were deposited. It comprises of granite and granite-gneisses, both containing lenticular patches of Mica-Schist and Hornblende schist. It is well exposed in the southern and eastern boundary of the coal mine. In other areas it is directly overlain by the Barakar Formation.

- **Talchir Formation**

  Outcrops of Talchir Formation have not been observed in the block area. However, rocks of this formation have been encountered in BH No. AR-05 & AR-14 drilled earlier by GSI. This formation comprises greenish and brownish fine-grained sandstone with rock fragments and pebbles of vein quartz. The thickness as recorded from borehole data ranges from 4 m to 42 m.

- **Barakar Formation**

  Barakar Formation is generally seen to directly overlie the Metamorphics with an unconformity. The rocks of this formation are well exposed in the low lying areas, the Sukri river and nala sections. The outcrops of Barakar sandstone have been mapped in various parts of the study area.

Vijay Kumar Singh
(Recognised Qualified Person)
Dated- 29/05/2014-CPAM

Rajesh Ranjan
CGE (P & S)
TVNL, Hinoo, Ranchi-834002
21 DEC 2014

On the basis of vertical variation in litho facies the whole sequence of Barakar rocks has been grouped into three members. The Upper Member is represented by the medium to coarse grained sandstone, grey shale with minor carbonaceous shale bands and shale/sand stone intercalations (40%-50%). The Middle Member comprises fine to coarse grained grayish white sandstone, siltstone, grey shale with carbonaceous shale and coal seams/horizons. The Basal Member is represented by a very coarse grained, cross bedded-sandstone with pebbly lenses and minor bands of shale and coal. The thickness of Barakar Formation varies from 51 m to 581 m.

Barakar is the principal coal bearing formation of this coal mine and is the repository of 7 coal seams, designated I-VII together with a few local seams established on the basis of sub surface data.

The Barakar seams range in thickness from 0.10 to 25.11 m in Seam III Bottom. With a thickness of 25.11 m (JAR 68), seam III Bottom is found to be the thickest in the block whereas this very seam is also the thinnest one measuring 0.10 m encountered in borehole no. JAR-28. Seam VII Middle has recorded the maximum average thickness of 13.83 m. in the coal mine.

- **Barren Measures**

Outcrops of Barren Measures are not exposed on the surface except in the SW portion of the block where a few pebbles of ferruginous sandstone were found. Borehole data of JAR – 35, 36, 40 & 62 have intersected Barren Measures strata. The thickness of this formation varies from 4 m to 42 m.

- **Raniganj Formation**:-

Raniganj Formation occupies the West-Central part of Rajbar E&D Coal Mine. It comprises fine to medium grained, greenish to yellowish laminated sandstone, grey shale with thin bands of carbonaceous shale and thin coal

Rajesh Ranjan
ESE (P & S)
TVNL, Hindo, Ranchi-834002
21 DEC 2015

Vijay Kumar Singh
(Recog. Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM]
Dated- 29.05.2015]

seams. Raniganj Formation has been encountered in 10 boreholes drilled in the area. The thickness of this formation varies from 47 m to 174 m.

This formation comprises two coal seams namely R-1 and R-2 with an average thickness of 3.92 m – 4.71 m and having a general inclination of 5^0 - 10^0 towards SW.

It is evident from borehole data of Rajbar E&D Coal Mine that both Raniganj and Barakar coal seams occur as mineable horizons. These coal seams exhibit wide variation in their thickness and disposition. The present drilling data have proved seven coal seams (I to VII) in Barakar Formation. The GSI in the Regional Geological Report (RGR) of Rajbar Sector had indicated six coal seams.

4.4 GEOLOGICAL STRUCTURE

4.4.1 Faulting

On account of a number of strike faults in the area, there is wide variation in quality, thickness and disposition of coal seams. This area is unique in its nature of development of coal seams (Plate No – 05).

A total of seven faults have been interpreted in Rajbar E&D Coal Mine on the basis of core logging, floor contour plan of every seam and disposition of coal seams. The coal mine is shallow in the northern and eastern part and deeper in the south western portion (Plate No – 09 A to 09 S).

All seven Barakar coal seams found in the coal mine are affected by these faults. Raniganj coal seams are localized in the south western portion of fault F3- F3 and are not affected by any of the faults. The details of faults are given in table no. – 4.5.

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 3402/(03)/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
ESE (P & S)
TVNL, Hqoo, Ranchi-834002
27 DEC 2021

Table No. – 4.5

Details of Faults

S.N.	No. of Fault	Alignment	Location of Fault	Type of Fault	Throw & direction of Fault (in m)	Evidence of Fault
1	F1 -F1	NW-SE-SSE	Position of the fault is in northern part of the block and ends at F4-F4	Normal Strike Fault	30-50 (East)	Shifting of floor contour and disposition of coal seam IV, V & VI
2	F2- F2	NW-SE	Starts from North West corner and ends near Jar-02	Normal Strike Fault	20-60 (North East)	Shifting of floor contour and disposition of coal seam IV
3	F3- F3	NW –SE-SW	Starts from AR-02 through JAR-43 to AR-13	Normal Strike Fault	20-60 (East)	Shifting of floor contour and disposition of coal seam IV, V, VI, VII
4	F4- F4	NE-SW-SE	In the central eastern portion passing through JAR-85	Arcuate Fault	60-130 (North)	Shifting of floor contour and disposition of coal seam III, IV & V
5	F5 -F5	N20^{0}W-S20^{0}E, NW-SE	Starting from F1-F1 boundary near North of JAR-10 ends near JAR-82	Oblique Fault	40-60 (East)	Shifting of floor contour and disposition of coal seam IV, V, VI, VII
6	F6 -F6	NW-SE	SE portion of the block starting from F3-F3 near JAR-43 ends at JAR-65	Normal Fault	20 (South West)	Shifting of floor contour and disposition of coal seam VII
7	F7-F7	EW-SE	In SW corner of the block starting from north of JAR-75 & ends between JAR-71 & 78	Normal Fault	130 (Northerly)	Shifting of floor contour and disposition of coal seams I - VII

4.4.2 Strike and Dip

The Rajbar E&D Coal Mine is one of the coal mines that were dissected due to two systems of normal faults of Auranga basin. The regional trend of the bedding in general, varies from N-S to NNW-SSE. The variation of dip ranges from 6^0 to 14^0 towards South. However the amount of dip, in general varies from 6^0 to 10^0 towards South-West. Deviations in the trend of bedding as well as in the amount of dip are very common, particularly near the faults. In the Northern part of the block the beds strike East-West with Southerly dips.

Rajesh Ranjan
TVNL, Hinoo, Ranchi-834002
21 DEC 2024

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

4.5 DESCRIPTION AND QUALITY OF COAL SEAMS

4.5.1 General

Barakar is the principal coal bearing formation and to some extent Raniganj Formation also contributes to the coal reserves in the Rajbar E & D Coal Mine. There are seven coal seams belonging to the Barakar Formation designated I to VII and two coal seams belonging to Raniganj Formation designated R-1 and R-2 in ascending order. Incrops of Barakar seams occur in all part of the block while Raniganj seams incrop in a very restricted zone; mostly in west central part.

4.5.2 Seam Correlation

Various criteria such as thickness of the coal seam, associated parting, seam structure, Band-by-Band data, characteristics of litho-units in the roof and floor of the seam, development of dirt bands within a coal seam etc. have been used to correlate different coal seams of the coal mine as per normal practice. Further, the correlation of coal seams established by Geological Survey of India in the entire Rajbar sector (comprising Jagaldaga, Gowa, Rajbar, Sabanu and Banhardi) has been taken as base for finalizing the correlation of coal seams of this coal mine. The correlation of coal seams of Rajbar E & D Coal Mine is compatible with other coal blocks of the Auranga coalfield.

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 3412/(03)/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
ESE (Planning)
TVNL, Hinoo, Ranchi-834002
27 DEC 2021

Rajesh Ranjan
TVNL, Hinoo, Ranchi-834002
27 DEC 2024

The Sequence of seams, Roof-Floor thickness, Average thickness of coal seams Excluding Non Combustible bands and thickness of intervening parting is given in table no. – 4.6.

Table No. – 4.6
Sequence of Coal Seams with Intervening Parting

Formation	Seams/ Parting	Thickness Range (m)		Avg. Seam Thickness (m)	Avg. Parting Thickness (m)	Thickness Range of Seam (Excl. NC Bands)	Avg. Seam Th. (Excl. NC Bands)	No. of BH Inter-sections
		Seams (Roof to Floor)	Parting					
Raniganj	R-2	0.80-5.73 JAR039-JAR062		3.98		0.80-5.05 JAR039-AR006	3.85	9
	Parting		1.05-17.95 AR006-JAR055		5.67			
	R-1	2.49-6.54 AR006-JAR062		4.79		2.49-6.54 AR006-JAR062	4.75	11
	Parting		97.49-151.85 JAR062-JAR055		129.35			
Barakar	VII Top	0.35-6.12 JAR053-JAR046		1.79		0.35-5.71 JAR053-JAR075	1.68	36
	Parting		0.71-12.30 JAR051-JAR035		4.15			
	VII Middle	0.60-22.10 JAR053-AR013		13.60		0.60-21.00 JAR053-AR013	13.11	42
	Parting		2.45-16.29 JAR058-JAR053		5.68			
	VII Bottom	0.18-3.10 JAR040-JAR051		1.01		0.18-3.10 JAR040-JAR051	1.01	40
	Parting		6.12-61.42 JAR029w-JAR068		39.60			
	VI Top	0.30-13.19 JAR030-JAR051		2.71		0.30-10.82 JAR030-JAR051	2.37	47
	Parting		0.81-11.15 JAR052-JAR059		5.55			

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

Formation	Seams/ Parting	Thickness Range (m)		Avg. Seam Thickness (m)	Avg. Parting Thickness (m)	Thickness Range of Seam (Excl. NC Bands)	Avg. Seam Th. (Excl. NC Bands)	No. of BH Inter-sections
		Seams (Roof to Floor)	Parting					
	VI Middle	0.35-14.94 JAR035A-JAR039		4.01		0.35-10.86 JAR035A-JAR039	3.66	50
	Parting		0.21-16.47 JAR036-JAR001		6.53			
	VI Bottom	0.09-15.70 JAR071-AR013		3.33		0.09-15.70 JAR071-AR013	3.20	52
	Parting		9.77-83.80 AR006-JAR068		26.41			
	V	0.24-7.47 JAR003-JAR001		1.62		0.24-7.47 JAR003-JAR001	1.56	49
	Parting		8.72-38.09 JAR008-JAR046		22.33			
	IV Top	0.17-9.68 JAR011-JAR060		2.60		0.17-8.62 JAR011-JAR025	2.48	63
	Parting		0.73-22.12 JAR064-JAR073		8.52			
	IV Middle	0.16-13.05 JAR057-AR006		2.58		0.16-11.48 JAR057-AR006	2.40	48
	Parting		1.44-21.86 JAR006-JAR018		8.02			
	IV Bottom	0.18-13.24 JAR010-JAR046		4.09		0.18-10.37 JAR010-JAR046	3.86	68
	Parting		6.32-70.04 JAR071-JAR050		26.11			
	III Top	0.25-8.59 JAR014-JAR024		2.42		0.25-8.38 JAR014-JAR024	2.25	58
	Parting		1.44-40.50 JAR031-JAR059		12.79			
	III Middle	0.24-10.39 JAR031-JAR019		2.59		0.24-10.30 JAR031-JAR019	2.52	47

Rajesh Ranjan
ESE (Mining)
TVNL, Minto, Ranchi-834002
21 DEC 2021

Vijay Kumar Singh
(Recognised Qualified Person)
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Formation	Seams/ Parting	Thickness Range (m)		Avg. Seam Thickness (m)	Avg. Parting Thickness (m)	Thickness Range of Seam (Excl. NC Bands)	Avg. Seam Th. (Excl. NC Bands)	No. of BH Inter-sections
		Seams (Roof to Floor)	Parting					
	Parting		3.95-37.52 JAR032-JAR029w		15.14			
	III Bottom	0.10-25.11 JAR028-JAR068		7.63		0.10-24.26 JAR028-JAR068	7.24	68
	Parting		12.44-72.19 JAR015-JAR035		45.76			
	II Top	0.18-9.90 JAR020-JAR048		2.75		0.18-9.90 JAR020-JAR048	2.57	53
	Parting		0.47-50.37 JAR058-JAR014		7.69			
	II Bottom	0.17-7.54 JAR053-JAR057		2.88		0.17-7.40 JAR053-JAR084	2.70	58
	Parting		4.24-45.20 JAR047-AR014		14.99			
	I Top	0.25-8.31 JAR031-JAR070		2.84		0.25-8.31 JAR031-JAR070	2.80	56
	Parting		0.25-21.38 JAR088-JAR035		4.67			
	I Bottom	0.15-11.80 JAR036-JAR070		2.63		0.15-11.80 JAR036-JAR070	2.54	57

Rajesh Ranjan
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4.5.3 Quality Parameters

On the basis of total percentage of ash and moisture content, carbonaceous matter is classified as Coal, Shaly Coal, Carbonaceous Shale and non-combustible bands. Coal bearing horizons containing up to 40% ash + moisture are classified as Coal, those with 40-55% ash + moisture are termed as Shaly Coal and those containing 55-75% ash + moisture are termed as Carbonaceous Shale. Beyond 75% ash + moisture they are classified as Non-combustible Bands.

Carbonaceous shale present in the immediate roof or floor of a coal seam has been excluded for determining the roof and floor depth because carbonaceous shale is considered as a dirt band. If, however, the thickness of carbonaceous shale, dirt band and /or non carbonaceous shale dirt band is less than 100 cm within a designated coal seam, it is included in the coal for the sake of quality and reserve estimation.

The analytical data reveals that coals of Rajbar E & D Coal Mine are Non – Coking in nature. Seams occurring in the coal mine are free from any type of burning effect either due to igneous intrusion or to surface burning.

4.5.3.1 Grading

The grading of coals of the coal mine has been done on the basis of Gross Calorific Value (Kcal / Kg).

The grade band vis-à-vis GCV is given in table no. – 4.7.

Vijay Kumar Singh
(Authorised Person)
(Reg. No. ...014-CPAM
(Reg. ...015)

Rajesh Ranjan
ESE (P & S)
TVNL, Hindo, Ranchi-834002
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Table No. – 4.7

Grade based on Gross Calorific Value (Kcal/Kg)

GCV Range (Kcal / kg)	Grade Band
> 7000	G 1
6700 – 7000	G 2
6400 – 6700	G 3
6100 – 6400	G 4
5800 - 6100	G 5
5500 – 5800	G 6
5200 – 5500	G 7
4900 – 5200	G 8
4600 – 4900	G 9
4300 – 4600	G 10
4000 – 4300	G 11
3700 – 4000	G 12
3400 - 3700	G 13
3100 – 3400	G 14
2800 – 3100	G 15
2500 – 2800	G 16
2200 - 2500	G 17

4.5.3.2 Proximate Analysis

Band by Band Proximate Analysis is undertaken to determine the percentage of Moisture, Ash, Volatile Matter and Fixed Carbon of coal seams. Core samples from 93 boreholes were subjected to Proximate Analysis. Further, Overall Proximate Analysis from 37 boreholes has also been carried out on 60% RH and 40^0 C.

Coals of Rajbar E & D Coal Mine are High Moisture non coking in nature. Bands of thickness 1 m and above have been excluded to determine the quality of the coal seam. Result of Proximate Analysis on 60% RH and 40^0 C together with grade based on UHV and GCV is given in table no. – 4.8. The GCV for different seams of the block has been calculated from the available

Rajesh Ranjan
TVNL, Hindpiri, Ranchi-834002
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seam wise Proximate Analysis data since determined values of GCV are not furnished in the G.R.

Table No. – 4.8

Computed Seam's Overall Analysis with Grade

Seam No.	Proximate Analysis on 60% RH and 40° C				Grade based on UHV	Grade based on GCV Bands
	Moisture %		Ash %			
	Max.	Min.	Max.	Min.		
R-2	3.6 (JAR-68)	2.9 (JAR-38)	51.6 (JAR-38)	42 (JAR-68)	F to G	G11 – G14
R-1	4.0 (JAR-46)	2.8 (JAR-38)	52.0 (JAR-38)	36.2 (JAR-46)	F to G	G10 – G14
VII T	5.3 (JAR-45)	3.4 (JAR-37)	43.8 (JAR-37)	19.0 (JAR-45)	C to G	G5 – G12
VII M	5.3 (JAR-57)	2.7 (JAR-77)	49.4 (JAR-56)	19.0 (JAR-51)	C to G	G5 – G14
VII B	5.3 (JAR-67)	3.0 (JAR-66)	49.4 (JAR-51)	19.0 (JAR-67)	C to G	G5 – G13
VI T	4.5 (JAR-74)	2.9 (JAR-04)	51.7 (JAR-04)	28.8 (JAR-74)	C to G	G5 – G14
VI M	5.3 (JAR-65)	2.9 (JAR-02 & 38)	51.5 (JAR-38)	19.0 (JAR-65)	C to G	G5 – G14
VI B	5.38 (JAR-66)	2.3 (JAR-38)	52.2 (JAR-01)	19.0 (JAR-65)	C to G	G5 – G14
V	5.3 (JAR-03 & 05)	3.2 (JAR-77)	49.1 (JAR-75)	19.0 (JAR-03 & 50)	C to G	G5 – G13
IV T	5.30 (JAR-50 & 65)	2.9 (JAR-22 & 53)	51.5 (JAR-53)	19.0 (JAR-50 & 65)	C to G	G5 – G14
IV M	5.30 (JAR- 65)	2.9 (JAR-40)	51.2 (JAR-40)	19.0 (JAR- 65)	C to G	G5 – G14
IV B	5.30 (JAR-65)	2.8 (JAR-07 & 22)	51.9 (JAR-07)	19.0 (JAR-65)	C to G	G5 – G14
III T	5.30 (JAR-57)	2.8 (JAR-11)	52.2 (JAR-11)	19.0 (JAR-57)	C to G	G5 – G14
III M	5.30 (JAR- 50)	2.9 (JAR-07 & 17)	51.8 (JAR-17)	19.0 (JAR- 50)	C to G	G5 – G14
III B	5.30 (JAR-65)	3.0 (JAR-07,22 & 23)	50.22 (JAR-38)	19.0 (JAR-65)	C to G	G5 – G14
II T	5.30 (JAR-65 & 67)	3.1 (JAR-26)	47.90 (JAR-26)	19.0 (JAR-65 & 67)	C to G	G5 – G13
II B	5.20 (JAR-57)	3.1 (JAR-38)	48.5 (JAR-38)	19.3 (JAR-57)	C to G	G5 – G13
I T	5.30 (JAR-57)	3.1 (JAR-14 & 34)	48.7 (JAR-14)	19.0 (JAR-57)	C to G	G5 – G13
I B	5.30 (JAR-67)	3.0 (JAR-53)	50.0 (JAR-53)	19.0 (JAR-67)	C to G	G5 – G13

Vijay Kr. Gopal Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
E.E. & Mining Engineer
TVNL, Hinoo, Ranchi-834002
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4.5.4 Special Tests:

To ascertain various characteristics of coal, a number of special tests were carried out on the coal core samples viz: Ultimate analysis, Ash Fusion temperature, HGI, Coal petrography (BH. No. JAR – 29, 32, 50 & 70) and Physico - mechanical properties test (BH. No. JAR – 45 & 65) by CIMFR, Namkum, Dhanbad and Digwadih. Various special tests and the respective analysis reports are discussed below:-

4.5.4.1 Ultimate Analysis:

This special test is useful in determining the quantity of air required for combustion and the volume and composition of the combustion gases. This analysis indicates percentage of various elemental chemical constituents such as Carbon, Hydrogen, Oxygen, Sulphur, etc. This information is required for the calculation of flame temperature and the flue duct design etc.

Ultimate analysis report of various coal seams of Rajbar E & D Coal Mine are given in table no. – 4.9.

Table No. – 4.9

Ultimate Analysis of Coal Samples

Parameters (%)	Coal Seams of Rajbar E & D Coal Mine						
	VII	VI	V	IV	III	II	I
Carbon	41.98	36.00	37.77	38.06	40.45	39.90	35.70
Hydrogen	2.65	2.15	2.32	2.32	2.47	2.42	2.10
Nitrogen	0.96	0.81	0.80	0.78	0.80	0.80	0.70
Sulphur	0.55	0.48	0.50	0.42	0.45	0.50	0.40
Oxygen	13.87	12.58	12.60	12.96	12.97	12.77	11.40

4.5.4.2 Ash Fusion Temperature:

Ash Fusion Temperature Test is carried out to ascertain the behavior of coal's ash residue at various temperatures because it is a critical factor in selecting coals for steam power generation.

Seam wise details are given in table no. – 4.10.

Rajesh Ranjan
ESE (P & S)
TVNL, Hmcp
27 DEC 2016

Vijay Kumar Singh
(Recognised Qualified Person)
Regn. No. 1001/(03)/2014-CPAM
Dated- 27.12.2016

Table No. – 4.10
Seam wise Ash Fusion Temperature

Ash Fusion Temperature (A.F.T.) ^{0}C	Coal Seams of Rajbar E & D Coal Mine						
	VII	VI	V	IV	III	II	I
I.D.T. *(Initial Deformation Temperature)*	1237.50	1270	1307.50	1354	1367.50	1380	>1400
H.T. (*Hemispherical Temperature)*	1370.00	>1400	>1400	>1400	>1400	>1400	>1400
F.T. (*Flow Temperature)*	1372.50	>1400	>1400	>1400	>1400	>1400	>1400

4.5.4.3 Hard Grove Grindability Index:

The Hard Grove Grindability Index (HGI) Test is carried out to evaluate the resistance of coal to crushing-for obtaining desired particle size by grinding in a pulveriser.

There is a fixed relationship between Grindability and Rank of coal in the natural series from brown coal to Lignite & Anthracite. Typical resulting HGI values lie between 30 (increased resistance to pulverization) and 100 (more easily pulverized).

Seam wise average value of HGI is given in table no. – 4.11.

Table No. – 4.11

Seam wise Hard Grove Grindability Index

	Coal Seams of Rajbar E & D Coal Mine						
	VII	VI	V	IV	III	II	I
Hard Grove Grindability Index (HGI)	52.50	55.33	68.00	67.66	59.50	56.60	62

4.5.4.4 Coal Petrography:

This test is carried out to evaluate bituminous coals, coal blends and their ability to produce blast furnace coke. Coal petrography is used to determine a sample's degree of coalification and the amount and class of macerals. This can also be used to determine contaminants and oxidized coal in sample.

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 3401/2(03)/2014-CPAM
Dated- 29.05.2015]

Rajesh Gupta
TVNL Lingpse Project

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Seam-wise petrographic analysis report of Rajbar E & D Coal Mine is given in table no. – 4.12.

Table No. – 4.12
Seam wise Petrographic Analysis

Petrographic Analysis Maceral (Volume %)	Coal Seams						
	VII	VI	V	IV	III	II	I
Vitrinite	39.72	29.62	31.12	29.54	31.32	26.50	29.6
Liptinite	8.45	15.70	8.70	12.10	15.30	13.60	-
Inertinite	15.40	15.00	19.32	13.14	16.65	23.67	13.1
Mineral Matter	22.05	24.60	27.47	31.94	27.47	30.37	27.3
Mean Ro%	0.40-0.46	0.41-0.47	0.43-0.47	0.44-0.46	0.45-0.48	0.45-0.51	0.48

4.5.4.7 Physico Mechanical Test:

Physico Mechanical test has been carried out to know the rock mass strength, strata density, Porosity, Compressive strength, Tensile strength, moisture content, Young's Modulus, Poisson's ratio, Point Load Index as well as Internal Friction for coal as well as non-coal strata. For this purpose two boreholes i.e. JAR 45 & 65 were selected which encountered a complete sequence of non-coal and coal strata. This study has been carried out in the CIMFR laboratory at Dhanbad/ Ranchi. Physico Mechanical properties of rocks occurring in a depth range of 30 m – 350 m are summarized and given in table no. – 4.13.

Table No. – 4.13

Physico Mechanical properties of Rocks pertaining to BH No. JAR 45 & 65

Formation	Porosity %	Compressive Strength-Dry (MPa)	Tensile Strength-Dry (MPa)	Young's Modulus-Dry (GPa)
Shale	6.28 – 13.47	9.11 – 29.57	1.60 – 5.78	1.82 – 6.86
Sandy Shale	3.66 – 9.87	5.79 – 18.52	1.78 – 5.68	1.35 – 5.83
Sandstone	4.61 – 13.22	2.32 – 32.36	0.78 – 6.34	0.77 – 6.70
Carbonaceous Shale	3.89 – 14.49	2.28 – 30.29	0.69 – 5.68	0.47 – 4.36
Shaly Coal	3.79 – 14.58	8.26 – 23.03	0.76 – 2.88	0.75 – 2.54
Coal	2.58 – 13.01	2.04 – 28.90	0.42 – 3.12	0.49 – 1.87

Rajesh Ranjan
CSE (Civil)
TVNL, Hirakud, Rajbar
27 DEC 2016

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 540(E)] CEAI, CFAM
Dated- 29.05.2015]

4.6 DESCRIPTION OF INDIVIDUAL COAL SEAMS

4.6.1 General

Rajbar E & D Coal Mine comprises 7 Barakar coal seams designated I – VII and 2 Raniganj Seams designated R1 & R2, in ascending order. A total of 19 coal horizons, including splits, have been delineated in the block. All seams are banded in nature, comprising both combustible & non combustible bands and are non-coking in nature.

A brief description of the individual seams from R2, the youngest Raniganj seam, down to the oldest seam I of the Barakar Formation (Plate No – 10 A to 10 S), is given below:-

SEAM – R2

- This seam is the younger of the two Raniganj Seams occurring in the coal mine and has been encountered in 9 Borehole intersections.
- It varies in thickness from 0.80 m – 5.73 m with an average thickness of 3.98m. Thickness of < 1m has been recorded in only one borehole (JAR039). Depth of occurrence of the seam varies from 16.90 m to 112.75 m.
- Incrop of the seam occurs in the West-Central part of the coal mine with a strike length of approximately 3.2Km.
- The grade of the seam (excluding band of thickness 1 m & above) based on Calculated GCV is given below:
  GCV Range 3279 – 4081 (Kcal/ Kg) GCV Grade G11 – G14

SEAM – R1

- This seam is the older of the two Raniganj Seams and is encountered in 11 Borehole intersections.
- It ranges in thickness from 2.49 m – 6.54 m with an average thickness of 4.79 m and occurs below seam R2 with a parting varying from 1.05 m – 17.95 m.
- The depth of occurrence of the seam ranges between 24.70 m – 122.86 m.

Vijay Kumar Singh
[Recognition No. 34012/(03)/2014-CPAM
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Rajesh Ranjan
Executive (Mining)
MNL, Ranchi-834002
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- Incrop of the seam occurs in the West Central part of the coal mine with a strike length of approximately 3.2 Km.
- The grade of the seam (excluding band of thickness 1 m & above) based on Calculated GCV is given below:
  GCV Range 3256 – 4569 (Kcal/ Kg) GCV Grade G10 – G14

SEAM – VII

This is the youngest group of the Barakar Seams of the coal mine and occurs in three splits namely Top, Middle & Bottom. The incrop of the seams including splits occurs in 4 faulted segments with a lateral extent of approx. 5.4Km

Seam – VII Top

- It has been encountered in 36 borehole intersections and underlies seam R1 with a parting varying between 97.49 m – 151.85m.
- It ranges in thickness from 0.35 m – 6.12 m with an average thickness of 1.79m. Thickness of < 1m has been recorded in 11 boreholes.
- The depth of occurrence of the seam varies between 6.0 m to 243.25 m.
- The grade of the seam (excluding band of thickness 1 m & above) based on Calculated GCV is given below:
  GCV Range 3941 – 5999 (Kcal/ Kg) GCV Grade G5 – G12

SEAM – VII Middle

- This seam has been encountered in 42 borehole intersections and occurs below seam VII Top with a parting varying between 0.71 m – 12.30 m. Parting of < 1m with seam VII Top has been recorded in 3 boreholes in the Western & Southern part of the coal mine.
- It ranges in thickness from 0.60 m – 22.10 m with an average thickness of 13.60 m. Thickness of < 1m has been recorded in only one borehole.
- The depth of occurrence of the seam varies from 5.20 m – 246.67 m.
- The grade of the seam (excluding band of thickness 1 m & above) based on Calculated GCV is given below:
  GCV Range 3233 – 5999 (Kcal/ Kg) GCV Grade G5 – G14

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Vijay Shankar Singh (Recognised Qualified Person) [Recognition No. 34012/(03)/2014-CPAM Dated- 29.05.2015]

SEAM – VII Bottom

- The seam has been encountered in 40 borehole intersections including 5 boreholes in which it has deteriorated to Carbonaceous Shale / Shale and lies below seam VII Middle with a parting varying between 2.45 m – 16.29 m.
- It ranges in thickness from 0.18 m – 3.10 m with an average thickness of 1.01m.Thickness of < 1m has been recorded in 21 boreholes.
- The depth of occurrence of the seam varies from 30.66 m – 266.26 m.
- The grade of the seam (excluding band of thickness 1 m & above) based on Calculated GCV is given below:
  GCV Range 3472 – 5999 (Kcal/ Kg) GCV Grade G5 – G13

SEAM – VI

This group of seams lies below seam VII and occurs in 3 splits i.e. Top, Middle & Bottom. The incrop of the seams including splits occurs in 4 faulted segments in the coal mine with a lateral extent of approx. 5.6 Km.

SEAM – VI Top

- The seam has been encountered in 47 borehole intersections including 3 boreholes in which it has deteriorated to Carbonaceous Shale.
- It lies below seam VII Bottom with a parting varying between 6.12 m – 61.42 m.
- It ranges in thickness from 0.30 m – 13.19 m with an average thickness of 2.71m.Thickness of < 1m has been recorded in 9 boreholes.
- The depth of occurrence of the seam varies from 13.81 m – 310.65 m.
- The grade of the seam (excluding band of thickness 1 m & above) based on Calculated GCV is given below:
  GCV Range 3270 – 5999 (Kcal/ Kg) GCV Grade G5 – G14

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. [illegible]/(03)/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
GM (P&S)
TVNL, Hindo, Ranchi-834002
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SEAM – VI Middle

- The seam has been encountered in 50 borehole intersections including 3 boreholes in which it has deteriorated to Carbonaceous Shale.
- It lies below seam VI Top with a parting varying between 0.81 m – 11.15 m. A parting of < 1m with seam VI Top has been recorded in 2 boreholes in the Western and SW part of the coal mine.
- It ranges in thickness from 0.35 m – 14.94 m with an average thickness of 4.01 m. A thickness of < 1m has been recorded in 11 boreholes.
- The depth of occurrence of the seam varies from 13.60 m – 321.98 m.
- The grade of the seam (excluding band of thickness 1 m & above) based on Calculated GCV is given below:
  GCV Range 3289 – 5999 (Kcal/ Kg) GCV Grade G5 – G14

SEAM – VI Bottom

- The seam has been encountered in 52 borehole intersections including 6 boreholes in which it has deteriorated to Carbonaceous Shale.
- It lies below seam VI Middle with a parting varying between 0.21m – 16.47 m. A parting of < 1m with seam VI Middle has been recorded in 1 borehole in the Central part of the coal mine.
- It ranges in thickness from 0.09 m – 15.70 m with an average thickness of 3.33m. Thickness of < 1m has been recorded in 10 boreholes.
- The depth of occurrence of the seam varies from 25.94 m – 337.30 m.
- The grade of the seam (excluding band of thickness 1 m & above) based on Calculated GCV is given below:
  GCV Range 3237 – 5988 (Kcal/ Kg) GCV Grade G5 – G14

Rajesh Ranjan
ESE (P & S)
TVNL Hindal, Ranchi-834002
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Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. ...03/2014-CPAM
Dated: 29.05.2015]

SEAM – V

- The seam occurs as a single horizon and has been encountered in 49 borehole intersections including 2 boreholes in which it has deteriorated to Carbonaceous Shale. The incrop of the seam occurs in 4 faulted segments covering approx 3.1Km in lateral extent.
- It lies below seam VI Bottom with a parting varying between 9.77 m – 83.80 m.
- It ranges in thickness from 0.24 m – 10.94 m with an average thickness of 1.62m. Thickness of < 1m has been recorded in 29 boreholes.
- The depth of occurrence of the seam varies from 18.02 m – 396.88 m.
- The grade of the seam (excluding band of thickness 1 m & above) based on Calculated GCV is given below:

  GCV Range 3678 – 5999 (Kcal/ Kg) GCV Grade G5 – G13

SEAM – IV

The seam occurs in 3 splits namely Top, Middle & Bottom. The parting between the splits is generally more than 1m except in 2 boreholes where the parting between IV Middle & IV Top is < 1m. The incrop of the seams including splits occurs in 4 faulted segments in the coal mine covering approximately 4.5 Km in lateral extent.

SEAM – IV Top

- The seam has been encountered in 63 borehole intersections including 3 boreholes in which it has deteriorated to Carbonaceous Shale.
- It lies below seam V with a parting varying between 8.72 m – 38.09 m.
- It ranges in thickness from 0.17 m – 9.68 m and an average thickness of 2.60m.Thickness of < 1m has been recorded in 23 boreholes.
- The depth of occurrence of the seam varies from 13.0 m – 426.83 m.
- The grade of the seam (excluding band of thickness 1 m & above) based on Calculated GCV is given below:

  GCV Range 3289 – 5999 (Kcal/ Kg) GCV Grade G5 – G14

Vijay Kumar Singh
(Recognised Qualified Person)
(Recognition No. [illegible])
Dated- [illegible]

Satyendra Ranjan
ESE (P & SL)
TVNL, Hindoo, Ranchi-834002

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SEAM – IV Middle

- The seam has been encountered in 48 borehole intersections including 3 boreholes in which it has deteriorated to Carbonaceous Shale.
- It lies below seam IV Top with a parting varying between 0.73 m – 22.12 m. Less than 1m parting has been recorded in 2 boreholes in the Western and SW part of the coal mine.
- It ranges in thickness from 0.22 m – 13.05 with an average thickness of 2.58m .Thickness of < 1m has been recorded in 18 boreholes.
- The depth of occurrence of the seam varies from 22.50 m – 447.08 m.
- The grade of the seam (excluding band of thickness 1 m & above) based on Calculated GCV is given below:

  GCV Range 3317 – 5999 (Kcal/ Kg) GCV Grade G5 – G14

SEAM – IV Bottom

- The seam has been encountered in 68 borehole intersections including 2 boreholes in which it has deteriorated to Carbonaceous Shale.
- It lies below seam IV Middle with a parting varying between 1.44 m – 21.86 m.
- It ranges in thickness from 0.18 m – 13.24 m with an average thickness of 4.09m. Thickness of < 1m has been recorded in 11 boreholes.
- The depth of occurrence of the seam varies from 10.60 m – 457.59 m.
- The grade of the seam (excluding band of thickness 1 m & above) based on Calculated GCV is given below:

  GCV Range 3265 – 5999 (Kcal/ Kg) GCV Grade G5 – G14

SEAM – III

The seam occurs in 3 splits namely Top, Middle & Bottom. The parting between the splits is more than 1m as per borehole records. The incrop of the seams including splits occurs in 4 faulted segments in the coal mine covering approximately 3.1Km laterally.

Ratish Ranjan
ESE (P & C)
TVNL, Hindpiri, Ranchi
21 DEC 2021

Vijay Kumar Singh
(Competent Person)
Regd. No. - NOIDA-CPAM
Dated- 20.05.2015

SEAM – III Top

- The seam has been encountered in 58 borehole intersections including 4 boreholes in which it has deteriorated to Carbonaceous Shale.
- It lies below seam IV Bottom with a parting varying between 6.32 m – 70.04 m.
- It ranges in thickness from 0.25 m – 8.59 m with an average thickness of 2.42m.Thickness of < 1m has been recorded in 13 boreholes.
- The depth of occurrence of the seam varies from 13.84 m – 515.16 m.
- The grade of the seam (excluding band of thickness 1 m & above) based on Calculated GCV is given below:
  GCV Range 3237 – 5999 (Kcal/ Kg) GCV Grade G5 – G14

SEAM – III Middle

- The seam has been encountered in 47 borehole intersections including 3 boreholes in which it has deteriorated to Carbonaceous Shale.
- It lies below seam III Top with a parting varying between 1.44 m – 40.50 m.
- It ranges in thickness from 0.24 m – 10.39 m with an average thickness of 2.59m. Thickness of < 1m has been recorded in 17 boreholes.
- The depth of occurrence of the seam varies from 9.50 m – 415.90 m.
- The grade of the seam (excluding band of thickness 1 m & above) based on Calculated GCV is given below:
  GCV Range 3279 – 5999 (Kcal/ Kg) GCV Grade G5 – G14

SEAM – III Bottom

- The seam has been encountered in 68 borehole intersections including 3 boreholes in which it has deteriorated to Carbonaceous Shale.
- It lies below seam III Middle with a parting varying between 3.95m–37.52 m.
- It ranges in thickness from 0.10 m – 25.11 m with an average thickness of 7.63m.Thickness of < 1m has been recorded in 8 boreholes.
- The depth of occurrence of the seam varies from 9.45 m – 543.72 m.

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012[03]2014-SAM
Dated- 29.05.2015]

Rajesh Ranjan
GSE-IB & SP
TVNL, Hirodi, Ranchi-834002
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- The grade of the seam (excluding band of thickness 1 m & above) based on Calculated GCV is given below:
  GCV Range 3394 – 5999 (Kcal/ Kg) GCV Grade G5 – G14

SEAM – II

The seam occurs in 2 splits, namely, Top & Bottom. The parting between the splits is more than 1m as per borehole records except in 1 borehole in the Western part where the parting is < 1m. The incrop of the seams including splits occurs in the NE part of the coal mine over a lateral extent of approximately 0.3 Km

SEAM – II Top

- The seam has been encountered in 53 borehole intersections including 4 boreholes in which it has deteriorated to Carbonaceous Shale.
- It lies below seam III Bottom with a parting varying between 12.44 m – 72.90 m.
- It ranges in thickness from 0.18 m – 9.90 m with an average thickness of 2.75m.Thickness of < 1m has been recorded in 15 boreholes.
- The depth of occurrence of the seam varies from 16.16 m – 595.47 m.
- The grade of the seam (excluding band of thickness 1 m & above) based on Calculated GCV is given below:
  GCV Range 3598 – 5999 (Kcal/ Kg) GCV Grade G5 – G13

SEAM – II Bottom

- The seam has been encountered in 58 borehole intersections including 4 boreholes in which it has deteriorated to Carbonaceous Shale.
- It lies below seam II Top with a parting varying between 0.47 m – 50.37 m. Less than 1 m parting has been recorded in only 2 boreholes in the Western part.
- It ranges in thickness from 0.17 m – 7.54 m with an average thickness of 2.88m.Thickness of < 1m has been recorded in 12 boreholes.
- The depth of occurrence of the seam varies from 24.24 m – 607.15 m.

Ratan Ranjan
ESE (P & S)
TVNL, Hehal, Ranchi-834002
27 DEC 2024

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

- The grade of the seam (excluding band of thickness 1 m & above) based on Calculated GCV is given below:
  GCV Range 3542 – 5986 (Kcal/ Kg) GCV Grade G5 – G13

SEAM – I

This is the oldest group of Barakar seams occurring in the coal mine and occurs in 2 splits, namely Top & Bottom. The parting between the splits is more than 1m as per borehole records. However, in 8 boreholes located in three isolated patches the parting between the splits is less than 1m. The incrop of the seams including splits occurs in the NE part of the block over a length of approximately 0.17Km laterally.

SEAM – I Top

- The seam has been encountered in 56 borehole intersections including 3 boreholes in which it has deteriorated to Carbonaceous Shale.
- It lies below seam II Bottom with a parting varying between 4.24m – 45.20 m.
- It ranges in thickness from 0.25 m – 8.31 m. with an average thickness of 2.84m. Thickness of < 1m has been recorded in 9 boreholes.
- The depth of occurrence of the seam varies from 47.73 m – 619.51 m.
- The grade of the seam (excluding band of thickness 1 m & above) based on Calculated GCV is given below:
  GCV Range 3523 – 5999 (Kcal/ Kg) GCV Grade G5 – G13

SEAM – I Bottom

- The seam has been encountered in 57 borehole intersections including 6 boreholes in which it has deteriorated to Carbonaceous Shale.
- It lies below seam I Top with a parting varying between 0.25 m – 21.38 m. Less than 1m parting has been recorded in 7 boreholes located in the Eastern, Southern and SW part of the coal mine.
- It ranges in thickness from 0.15 m – 11.80 m. with an average thickness of 2.63m. Thickness of < 1m has been recorded in 14 boreholes.

Rajesh Ranjan ... DEC 2021

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
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- The depth of occurrence of the seam varies from 48.50 m – 630.50 m.
- The grade of the seam (excluding band of thickness 1 m & above) based on Calculated GCV is given below:

  GCV Range 3415 – 5999 (Kcal/ Kg) GCV Grade G5 – G13

4.7 RESERVES

4.7.1 General

In the Rajbar E & D Coal Mine occurrence of 9 coal seams with splits (19 coal horizons) have been identified and proved. All the 19 identified coal horizons are mineable and hence have been considered for coal reserve estimation. Seams belonging to the Barakar Formation are IT, IB, IIT, IIB, IIIB, IIIM, IIIT, IVB, IVM, IVT, V, VIB, VIM, VIT, VIIB, VIIM & VIIT. The two youngest coal seams i.e. Seam-R-1 & Seam-R-2 belong to Raniganj Formation.

A study of disposition of coal seams, their structure, thickness as well as depth from surface reveals that the coal seams of the coal mine are mineable by open cast mining. The estimation of reserves of the coal seams have been done on the basis of various data obtained from exploratory drilling and geological mapping and has been placed in "Proved" category.

4.7.2 Basic Assumptions and Norms adopted

Definitions

- **Coal Seam:** A coaly horizon which occurs independently over a substantial area attaining a thickness of more than 0.9 m and containing ash + moisture up to 55% is considered as Coal Seam. Nomenclature of the coal seams has been retained as given in the RGR of Rajbar Sector prepared by GSI.
- **Combustible Band**: Bands which have ash + moisture content between 55% to 75% have been designated as Combustible Band (Carbonaceous shale).

Rajesh Ranjan
ESE (P & S)
TVNL, Hinoo, Ranchi
27 DEC 2024

Vijay Kumar Singh
(Recognised Qualified Person)
(Recognition No. 1003/2014-CPAM
(Recognition Valid upto 25.05.2015)

- **Non- Combustible Band**: Bands with ash + moisture content more than 75% have been designated as Non-Combustible Band with a cut-off thickness of 5 cm.
- Reserve has been estimated for I_{100} samples i.e. samples containing bands less than 100 cm. in thickness.
- The seams which are less than 0.90 m, not properly developed or have deteriorated to shale / carbonaceous shale and heave zones of faults have been excluded for the purpose of reserve estimation.
- The Specific Gravity of individual coal seams has been calculated as per the following formula for High Moisture Coals-
  Sp. Gr. = 1.28 x 0.01 x Ash%

4.7.3 Methodology of Reserve Estimation

The estimation of geological reserves manually is subject to averaging of the thickness and Sp. Gr. values within a selected polygon by considering the enclosing contour values. The MINEX method is far more precise as compared to the manual method.

The Polygon Area is calculated from its coordinates (A).

The Polygon Thickness is accumulated and averaged (T).

The Sp. Gr. (RD) is also averaged from grid cell values (D).

Finally, the reserves are calculated by the rule

A x T x D (Area x Thickness x Sp. Gr.)

- Depth wise, Grade wise and Thickness wise in-situ geological reserves of various coal seams of the block have been estimated with "Detailed Resources Menu" of MINEX.
- The average thickness of a seam has been computed from the Isochore plan by taking the average of two consecutive Isochore value and influence of the nearest boreholes.
- Seams which are less than 0.90 m, not properly developed or deteriorated to shale/ carbonaceous shale and heave zones of faults have been excluded for the purpose of reserve estimation.

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
GSE (R&S)
TVNL, Hindalco, Ranchi-834002
21 DEC 2021

4.7.4 Categorization of Reserves

Reserve of all the 19 coal horizons have been placed in "Proved" category as per ISP norms. Total gross reserves have been calculated seam wise within coal bearing area of 14.87 Sq. Km. of the coal mine which comes to 784.48 Mt which has been given in table no. – 4.14. Net coal reserve has been estimated as 90% of gross reserve. Seam wise & grade wise (based on GCV) net reserve is also given in table no. – 4.14. Seam wise & thickness wise net reserve is given in table no. – 4.15.

Table No. – 4.14

Seam wise Reserves (Million Tonnes)

Seam	Gross Reserve	GCV Grade wise Net Coal Reserve										
		G5	G6	G7	G8	G9	G10	G11	G12	G13	G14	TOTAL
R2	10.40							3.81	2.34	2.15	1.06	9.36
R1	16.08						1.84	3.68	3.62	3.56	1.77	14.47
VII Top	14.13	0.10	0.23	0.95	2.20	2.50	2.42	2.33	1.99			12.72
VII Middle	141.40	0.68	1.58	10.77	28.29	35.06	24.27	13.48	8.34	3.21	1.59	127.26
VII Bottom	7.31	0.02	0.06	0.05	0.13	0.16	0.81	1.46	1.52	2.37		6.58
VI Top	25.38	0.17	0.40	0.27	0.48	0.43	1.97	3.51	5.22	6.94	3.45	22.84
VI Middle	42.97	0.02	0.04	0.08	0.99	1.82	3.97	6.13	8.70	11.28	5.64	38.67
VI Bottom	34.36	0.00	0.00		0.73	0.68	2.10	3.53	7.30	11.07	5.51	30.92
V	14.09	0.02	0.05	0.12	0.31	0.40	1.49	2.59	2.90	4.80		12.68
IV Top	41.30	0.07	0.15	0.26	1.99	3.46	4.80	6.15	7.38	8.61	4.30	37.17
IV Middle	28.67	0.03	0.08	0.44	0.82	0.77	1.79	2.81	5.82	8.84	4.40	25.80
IV Bottom	74.86	0.05	0.11	0.32	2.83	5.02	10.86	16.70	14.14	11.58	5.76	67.37
III Top	30.78	0.02	0.04	0.06	0.54	0.97	3.67	6.38	6.40	6.42	3.21	27.70
III Middle	22.03	0.03	0.06	0.24	1.31	2.15	2.69	3.24	3.74	4.25	2.12	19.83
III Bottom	134.98	0.26	0.62	1.65	9.32	15.34	18.62	21.89	21.66	21.43	10.70	121.49
II Top	31.44	0.09	0.20	0.45	1.31	1.72	3.82	5.92	5.92	8.87		28.30
II Bottom	37.17	0.07	0.15	0.16	0.89	1.47	3.74	6.02	7.50	13.45		33.45
I Top	41.31	0.59	1.37	0.52	1.32	1.60	4.60	7.60	7.75	11.84		37.18
I Bottom	35.82	0.84	1.97	0.66	1.25	1.18	2.47	3.76	6.44	13.66		32.24
TOTAL	784.48	3.04	7.11	17.00	54.71	74.73	95.93	120.99	128.68	154.33	49.51	706.03

Rajesh Ranjan
Asst. Manager
ESE (P&S)
TVNL Hindpiri, Ranchi-834002
17 DEC 2024

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012(03)/2014-CPAM
Dated- 29.05.2015]

Table No. – 4.15

Seam wise & Thickness wise Reserves (Million Tonnes)

Seam	0.90-1.20m	1.20-1.50m	1.50-3.00m	3.00-6.00m	6.00-9.00m	9.00-12.00m	>12.00m	Total
R2	0.12	0.15	1.64	6.40	0.95	0.09	0.00	9.36
R1	0.01	0.02	0.54	10.44	3.47	0.00	0.00	14.47
VII Top	1.92	1.98	6.23	2.59	0.00	0.00	0.00	12.72
VII Middle	0.08	0.14	0.69	2.50	6.05	17.94	99.87	127.26
VII Bottom	2.52	1.68	2.33	0.04	0.00	0.00	0.00	6.58
VI Top	2.01	2.82	7.39	6.56	3.48	0.59	0.00	22.84
VI Middle	1.23	1.16	8.17	20.63	6.69	0.79	0.00	38.67
VI Bottom	1.24	1.60	11.69	13.75	1.09	0.79	0.76	30.92
V	1.56	1.54	4.94	3.98	0.66	0.00	0.00	12.68
IV Top	1.89	1.88	8.65	16.58	8.01	0.15	0.00	37.17
IV Middle	2.17	1.57	5.77	9.55	5.27	1.48	0.00	25.80
IV Bottom	0.77	1.15	10.90	35.73	17.73	1.08	0.00	67.37
III Top	1.99	2.39	12.73	9.76	0.83	0.00	0.00	27.70
III Middle	1.34	1.50	7.36	7.39	1.22	1.02	0.00	19.83
III Bottom	0.59	0.84	8.37	16.17	18.48	12.25	64.78	121.49
II Top	1.26	1.26	9.28	12.11	4.16	0.23	0.00	28.30
II Bottom	1.68	1.54	12.18	15.84	2.21	0.00	0.00	33.45
I Top	0.66	0.80	14.90	18.82	1.99	0.00	0.00	37.18
I Bottom	1.15	2.30	12.31	12.79	2.36	1.30	0.03	32.24
Total	**24.18**	**26.33**	**146.09**	**221.63**	**84.65**	**37.70**	**165.44**	**706.03**

4.8 OVERBURDEN

The bulk of the overburden rocks are represented by sandstone and shale followed by their intermediate varieties, i.e. Carbonaceous Shale, intercalation of shale and sandstone and sandy clay.

The coal mine is also seen to be covered by mixed type of soil i.e. sandy, clayey and loamy.

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 3211/2(03)/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
GM (P & S)
TVNL, Mecon, Ranchi-834002
27 DEC 2016

CHAPTER-V

MINING

5.1 GEOLOGY OF THE BLOCK

Barakar is the main coal bearing formation in the block. However, Raniganj formation also exists and it contains two coal seams which add to the coal reserves. There are seven coal seams occurring in Barakar formation designated as Seam I to Seam VII and two seams in Raniganj formation named R1 & R2. Most of the coal seams are interbanded in nature and exhibit split section developmental pattern. There are also variations in thickness and lithological characters of inter-seam partings. In total there are 19 coal horizons, 17 in Barakar measures and 2 in Raniganj measures.

It is noticed that the maximum thickness of Barakar Formation is about 581 m. Raniganj formation is about 174 m in thickness. The lowest seam is Seam I which is basal seam of Barakar Measure and hence for the coal block.

The land uses around allotted block are as follows:

Sl. No.	–	Side	–	Land Uses
1.	–	North Side	–	Coal Bearing Area – Rajbar A, B & C Blocks
2.	–	East Side	–	Non Coal Bearing Forest Area – Metamorphics
3.	–	South Side	–	Non Coal Bearing Area – Metamorphics & then Banhardi coal block
4.	–	West Side	–	Coal Bearing Area – Coal blocking still to be done

A total of 7 faults (1 dip fault & 6 oblique/ strike faults) have been interpreted in the block. These faults have been interpreted on the basis of core logging, floor contour plan of seams and their disposition. This block is comparatively less deep in the northern part up to fault F_5 & deeper in the south beyond the downthrown side of fault F_5. The area between faults F_3 & F_4 forms a trough and between faults F_4 & F_5 a Horst has developed.

Rajesh Ranjan
CSE (P & S)
WNL, Hinoo, Ranchi-834002
21 DEC 2015

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

The regional trend of the bedding in general, varies from N-S to NNW-SSE. The variation of dip ranges from 6^0 to 14^0. However the amount of dip, in general varies from 6^0 to 10^0 towards South-West. Deviations in the trend of bedding as well as in the amount of dip are common, particularly near the faults. In the truncated Northern part of the block, the beds strike East-West with Southerly dips.

5.2 TOPOGRAPHY AND DRAINAGE

5.2.1 Topography

Rajbar E & D Coal Mine falls in the Palamu plateau of Chotanagpur Gneissic Complex. In general, the topography of the area is mildly undulating and the general slope is towards NW. Due to undulating nature of the land, a number of natural ponds have formed. General elevation in the block area is around 440 m – 450 m above M.S.L. The maximum elevation inside the block area is about 471 m in the South-Eastern portion, whereas minimum elevation is about 415 m above M.S.L. in the North portion.

About 37% of the project area is covered with Protected Forests. Important amongst them are those of Rajbar, Jerang, Renchi, Darea & Serak. Rest of the areas is covered with agricultural land, habitation area & road and water bodies etc.

5.2.2 Drainage

Drainage pattern of the Coalfield is mainly controlled by Auranga River. Sukri River, one of the important tributaries of Auranga River, flows from east to west over the entire length of Rajbar E & D Coal Mine area, along its northern boundary. Some 1st & 2nd order streams join Sukri River, the main drainage channel in the area. General flow direction of the streams is towards NNW. The streams joining Sukri River, flow at quite shallow depth. Their bank cliffs are on average about 2 m in height.

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
EE (P & C)
TVNL, Hindpiri, Ranchi-834002
21 OCT 2016

5.3 THE COAL SEAMS

Based on profile and characteristics of the seams, coal layers have been grouped into seven coal seams numbered I to VII in ascending order within Barakar measures. Two coal seams of Raniganj Formation also exist which are numbered R-1 & R-2. The details of coal layers & intervening parting are given below in Table No.-5.1.

Table No.-5.1

Mining and geological characteristics of the Seams

Formation	Seams/ Parting	Thickness Range (m)		Avg. Seam Thickness (m)	Avg. Parting Thickness (m)	Thickness Range of Seam (Excl. NC Bands)	Avg. Seam Th. (Excl. NC Bands)	No. of BH Inter-sections
		Seams (Roof to Floor)	Parting					
Raniganj	R-2	0.80-5.73 JAR039-JAR062		3.98		0.80-5.05 JAR039-AR006	3.85	9
	Parting		1.05-17.95 AR006-JAR055		5.67			
	R-1	2.49-6.54 AR006-JAR062		4.79		2.49-6.54 AR006-JAR062	4.75	11
	Parting		97.49-151.85 JAR062-JAR055		129.35			
Barakar	VII Top	0.35-6.12 JAR053-JAR046		1.79		0.35-5.71 JAR053-JAR075	1.68	36
	Parting		0.71-12.30 JAR051-JAR035		4.15			
	VII Middle	0.60-22.10 JAR053-AR013		13.60		0.60-21.00 JAR053-AR013	13.11	42
	Parting		2.45-16.29 JAR058-JAR053		5.68			
	VII Bottom	0.18-3.10 JAR040-JAR051		1.01		0.18-3.10 JAR040-JAR051	1.01	40
	Parting		6.12-61.42 JAR029w-JAR068		39.60			
	VI Top	0.30-13.19 JAR030-JAR051		2.71		0.30-10.82 JAR030-JAR051	2.37	47
	Parting		0.81-11.15 JAR052-JAR059		5.55			
	VI Middle	0.35-14.94 JAR035A-JAR039		4.01		0.35-10.86 JAR035A-JAR039	3.88	50
	Parting		0.21-16.47 JAR036-JAR001		6.53			
	VI Bottom	0.09-15.70 JAR071-AR013		3.33		0.09-15.70 JAR071-AR013	3.20	52
	Parting		9.77-83.80 AR006-JAR068		26.41			
	V	0.24-7.47 JAR003-JAR001		1.62		0.24-7.47 JAR003-JAR001	1.56	49
	Parting		8.72-38.09 JAR008-JAR046		22.33			

Formation	Seams/ Parting	Thickness Range (m)		Avg. Seam Thickness (m)	Avg. Parting Thickness (m)	Thickness Range of Seam (Excl. NC Bands)	Avg. Seam Th. (Excl. NC Bands)	No. of BH Inter-sections
		Seams (Roof to Floor)	Parting					
	IV Top	0.17-9.68 JAR011-JAR060		2.60		0.17-8.62 JAR011-JAR025	2.48	63
	Parting		0.73-22.12 JAR064-JAR073		8.52			
	IV Middle	0.16-13.05 JAR057-AR006		2.58		0.16-11.48 JAR057-AR006	2.40	48
	Parting		1.44-21.86 JAR006-JAR018		8.02			
	IV Bottom	0.18-13.24 JAR010-JAR046		4.09		0.18-10.37 JAR010-JAR046	3.86	68
	Parting		8.32-70.04 JAR071-JAR050		26.11			
	III Top	0.25-8.59 JAR014-JAR024		2.42		0.25-8.38 JAR014-JAR024	2.25	58
	Parting		1.44-40.50 JAR031-JAR059		12.79			
	III Middle	0.24-10.39 JAR031-JAR019		2.59		0.24-10.30 JAR031-JAR019	2.52	47
	Parting		3.95-37.52 JAR032-JAR029w		15.14			
	III Bottom	0.10-25.11 JAR028-JAR068		7.63		0.10-24.26 JAR028-JAR068	7.24	68
	Parting		12.44-72.19 JAR015-JAR035		45.76			
	II Top	0.18-9.90 JAR020-JAR048		2.75		0.18-9.90 JAR020-JAR048	2.57	53
	Parting		0.47-50.37 JAR058-JAR014		7.69			
	II Bottom	0.17-7.54 JAR053-JAR057		2.88		0.17-7.40 JAR053-JAR084	2.70	58
	Parting		4.24-45.20 JAR047-AR014		14.99			
	I Top	0.25-8.31 JAR031-JAR070		2.84		0.25-8.31 JAR031-JAR070	2.80	56
	Parting		0.25-21.38 JAR088-JAR035		4.67			
	I Bottom	0.15-11.80 JAR036-JAR070		2.63		0.15-11.80 JAR036-JAR070	2.54	57

5.4 MINING STRATEGY

5.4.1 Coal Deposit Features

The allotted Rajbar E & D Coal Mine area has a geological block area of 1487 ha. There are a total of 19 layers of coal, within 7 coal seams of Barakar Formation and 2 coal seams of Raniganj Formation. Except Seams III Bottom, IV Bottom, VI Bottom, VI Middle & VII Middle of Barakar and the two Seams R1 & R2 of Raniganj formation, average thickness of all other 12 coal layers

are within 3 m. The dip of the seams varies in general from 6^0 to 10^0. Out of 1487 ha of coal bearing area, an area of about 17 ha falls within river bed & river meander, which cannot be accessed for mining (Plate No – 12, 13 & 14).

Further, nearly 150 ha patch in the North Central segment of the property, has high metamorphics floor. This area has very poor coal deposit with occurrence of Seam III, IV, V & VI only. The thickness of these coal layers is varying from less than a meter to maximum of 3 m. Total coal reserve comes to 7.85 Mt over this 150 ha patch. Further, the surface above this patch has sizeable population of about 800 people, posing Rehabilitation and Resettlement (R&R) problem for comparatively small quantity of extractable coal. The 4 layers of Seam I & II are almost absent due to this metamorphic high floor. These situations have resulted into making the patch unfeasible from mining point of view. Hence total coal bearing area for extraction and further deliberation, comes to 1487 ha – 167 ha (150 + 17) = 1320 ha.

5.4.2 Deposit Features causing Mining Difficulty

i. Very High Coal : Waste Stripping Ratio of 1 : 5.35 covering upto the basal Seam I, which goes down to a peak depth of 584 m in the block.

ii. Quite High Coal : Waste SR of 5.04, even if opencast mining is limited with Seam III Bottom as basal layer.

iii. Even S.R. of 5.04 would involve lot of waste to be put up, with space constraint, as temporary dump; which has to be rehandled, thereby adding to cost of production.

iv. Thickness of coal and waste layers vary widely. This would need varied size of equipment, hence operational & maintenance problems get aggrevated.

v. Coal seam dip varies from 6^0 to 14^0. However, workable portion is covered mostly within 7.5^0 to 9.5^0, even this is rather high gradient for O.C. mining.

5.4.3 Approach to work the Deposit

Coal reserve of the allotted area has been subjected to in depth analysis. For this purpose 1487 ha of allotted area has been divided in three parts namely 17 ha beneath reverine patch, 150 ha over metamorphic high and the

remaining 1320 ha as normal deposit. Based on borehole data, net coal reserve over these areas were found to be as follows.

Area in ha	Net Reserve in Mt	Coal Intensity (Mt/ Sq. Km.)
17 ha within River Sukri	1.18	6.94
150 ha over Metamorphic high	7.85	5.23
1320 ha	697	52.80
Total – 1487 ha	Total – 706.03	

i. The riverine patch of 17 ha is considered inaccessible for mining being practically under water.

ii. (a.) Area of 150 ha above metamorphic high has been further examined. The lower Seams I & II are completely missing in this area. Seam III & IV have also thinned out. Seam wise thickness is given hereafter.

Seam wise Geological Reserve in 150 ha Patch

Seams	Net Reserves (Mt)
VI Top	0.05
VI Middle	0.41
VI Bottom	0.48
V	1.29
IV Top	1.67
IV Middle	0.40
IV Bottom	1.34
III Top	1.03
III Middle	0.80
III Bottom	0.38
II Top	NIL
II Bottom	NIL
I Top	NIL
I Bottom	NIL
Total	**7.85**

Working such thin seams is generally very difficult.

(b.) Waste rock to work coal deposit of 7.85 Mt was calculated and found to be 58.7 Mm^3. Extractable deposit from this area was estimated to be 7.30 Mt. Stripping ratio was worked out and found to be 8.04.

Rajesh Ranjan

Vijay Kumar Singh
(Recognised Qualified Person)
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Average quality of coal being G-11, stripping ratio of 8.04 was considered financially uneconomical. This happened to be one of the important reasons for dropping these 150 ha from quarriable area.

(c) Further this coal bearing area of 150 ha, has large habitational area with population of about 800 persons. Resettlement and rehabilitation would cause an extremely serious social problem, making the deposit unworkable even for U/G mining.

For the above mentioned reasons working beneath this 150 ha metamorphic high patch area has been decided to be dropped out of the area of 1470 ha for opencast mining leaving only 1320 ha for further consideration. This has also been explained at clause no. 5.4.1.

(d) The coal seams III, IV, V and VI occur over this 150 ha of metamorphic high floor. However these seams have thinned out and are inconsistent in occurrence. These coal layers are therefore not suitable even for U/G mining. Moreover, thick population on the surface may not permit underground blasting. Since coal pillar extraction would not be possible due to thickly populated surface, coal recovery would be very poor. Considering these factors, possibility of underground mining over these 150 ha metamorphic high floor is negative. Therefore even UG mining over these 150 ha area is dropped.

5.4.4 Assessment of Mineability of Reserves over 1320 ha

We can consider two scenarios for opencasting.

a. Opencasting with Seam I Bottom as basal seam.

b. Opencasting with Seam III Bottom as basal seam.

i. Scenario-I – Extraction from Lowest Seam i.e. Seam I Bottom upwards

The following overall results were obtained for working upto Seam I B as basal layer.

Geological Reserves [706.03 Mt – (7.85 Mt+ 1.18 Mt)]	–	697.00 Mt
Reserve blocked in Barrier	–	4.42 Mt
Reserve blocked in Batter	–	150.85 Mt
Total Blockage	–	155.27 Mt

Rajesh Ranjan
ESE (P & S)
TVNL, Hirodi, Ranchi-834002
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Vijay Kumar Singh
(Recognised Qualified Person)
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Mineable Reserve	–	541.73 Mt
Mining Loss @ 5%	–	27.09 Mt
Winnable Coal	–	514.64 Mt
Waste to be removed (2811.10 – 58.70)	–	2752.40 Mm^3
Stripping Ratio (2752.40 Mm^3 ÷ 514.64 Mt)	–	5.35

The block is surrounded by coal deposit on the sides and forest area on East side. Hence no external dumping is possible. Therefore, this high stripping ratio of 5.35 will necessitate large quantity of waste disposal as temporary dump. On detailed examination of working this deposit it is revealed that area required to temporarily accommodate the waste till excavated void takes care of annual waste and temporarily laid waste would occupy so much of additional space over quarriable area, that quarry face would get blocked, a few years before reaching 20th year of mine life. Hence this scenario gets dropped from further consideration as it leads to stoppage of mining.

ii. Scenario-II – O.C. Mining from Seam III Bottom upwards

The Seam III Bottom is a thicker seam in ascending order from Seam I Bottom. Quarry started with Seam III Bottom as basal floor has following overall figures. The GR upto Seam IIIB is 574.86 Mt (see table 5.5)

Net Geological Reserve (574.86 – 7.85)	–	567.01 Mt
Barrier Blockage	–	3.24 Mt
Batter Blockage	–	121.43 Mt
Sub Total	–	**124.67 Mt**
Mineable Reserve	–	442.34 Mt
Mining Loss @ 5%	–	22.12 Mt
		420.22 Mt
Waste to be removed	–	2119 Mm^3
Stripping Ratio	–	5.04

On detailed examination of this scenario, it was found that this strategy to work upto Seam III Bottom is technically feasible. It would be possible to accommodate the temporary dumps for subsequent rehandling and quarrying would continue uninterrupted. From 23 year onwards, excavated void is

sufficient to accommodate annual waste & part of temporary waste. This allows mine to run uninterrupted.

5.4.5 Selection of the Best Alternative

Considering the results obtained in the two scenarios discussed above it is decided to undertake opencast mining over 1320 ha with Seam III Bottom as basal layer. The strategy to work the lower Seams I & II is being discussed at para no. 5.4.6.

5.4.6 Mining of Seam I & II

As discussed above, coal reserves up to Seam III Bottom will be worked by opencasting. For Seam I & II which are deeper and are rather thin, average thickness varying between 2.65 to 2.88, underground mining system would be deployed. These seams are thin and have to be extracted at high Stripping Ratio for O.C. mining, which makes the proposal unfeasible. This has been explained at Para 5.4.4.

It is envisaged to open these seams through inclines, located in the North-East area, where seams are incroping. A mining plan for this U/G mining is proposed to be submitted for competent approval by 6th year of the O.C. mine. The opening of the inclines and working of the Seam I & II will start by 8th – 9th year. The idea is to keep the U/G working at least about 500 m away from opencast blasting faces. This U/G mine will progress keeping a safe distance from O.C. mine blasting faces. It is estimated that during the last decade of mine life, opencast mining would be carried out over North-Western region, where Seam I & II are not workable because of thinning & inconsistent deposit. The underground mining would be carried out in North area, where OC mining would have been completed before 41st year of mine life. Thus exhaustion of underground mine reserve in North area would take place as a coterminous operation of the OC mining in North-West. Therefore, despite initial lag of 7-8 years, the underground mine would close by 48th year of mine life.

Rajesh Ranjan
ESE (P&S)
TVNL, Hinoo, Ranchi-834002
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Vijay Kumar Singh
(Recognised Person)
[Recognition No. ... TVNL-CPAM
Dated- 20.01.2015]

5.5 RAJBAR E & D MINE AREA & PROJECT AREA

5.5.1 The Delineation of Excavation Area Over 1320 ha Coal Bearing Area

It is proposed to mine covering maximum area leaving the statutory barriers in the Northern and Western side. On South & East sides, coal bearing area does not exist near statutory barriers. However a minimum of 20 m wide corridor has been provided all around excavation for peripheral facilities. The delineated excavation boundary is described below:-

North: The surface limit of the quarry will be 30 m away from the river edge in North-Western portion. Then the boundary moves Southward & Eastward, encircling the North-Central metamorphic high area leaving 50 m wide barrier. It then, goes back to river side, in Eastern portion with 30 m barrier. This boundary of the mine takes care to protect the mine from flood, provides access road over embankment along the boundary and specially provides a peripheral green belt around the habitats over the metamorphic high area. The resultant floor boundary has been firmed up with 40^0 slope of quarry edge.

West: Leaving 20 m parallel inside the block boundary, the resultant surface limit of excavation has been planned. The floor of Seam III B has been firmed up on the Western side with 40^0 angle for Seam III B as final slope.

South: Contact line of metamorphic with Seam III Bottom or other younger seams, forms excavation boundary. Final quarry slope has been kept at 40^0.

East: The contact line of metamorphic with Seam III Bottom or other younger seams, forms excavation boundary after leaving a 30 m wide belt for boundary road, conveyor etc. After coal conveyor has left project area, corridor has been reduced to 20 m width.

With above delineation the assessed excavation area covers 1262 ha.

Vijay Kumar Singh
(Recognition No. [illegible])
[Recognition No. [illegible]
Dated- 29.05.2015]

Rajesh Ranjan

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5.5.2 Project Area of Rajbar E & D Coal Mine

After details discussed in the previous paragraphs, the surface area of the mine will have the following important different controlling areas.

5.5.2.1 Excavation Area

The proposed opencast mine in the Rajbar E & D Coal Mine area will have excavation area of 1262 ha. This area will be excavated from the surface and will be all below the ground level.

5.5.2.2 Project Area and Lease Area

For mining the seams, different activities are to be undertaken. Infrastructure areas, the water bodies and roads in the area are all covered in the project area. The lease area of 1351 ha would exclude non coal bearing area of 31 ha on the South earmarked for infrastructure. The detailed land uses, at present and in the mining period of the mine life are all covered in the project area. This total project area comes to 1351 ha. It is shown in table no. 13.1 to 13.4 of Chapter – XIII.

5.6 DETAILS OF GEOLOGICAL RESERVES (AS PER G.R.)

5.6.1 Upto Lowest Seam i.e. Seam I Bottom

The seam wise & thickness wise and seam-wise & grade wise (based on GCV) geological reserves are given in table no. – 5.2 & 5.3. The tables cover the reserves upto lowest seam i.e. Seam I Bottom.

Table No. – 5.2
Seam wise & Thickness wise Geological Reserves (Mt) (Area – 1487 ha)
Upto Floor of Seam – I Bottom

(Fig. in Million Tonnes)

Seam	0.90-1.20m	1.20-1.50m	1.50-3.00m	3.00-6.00m	6.00-9.00m	9.00-12.00m	>12.00m	Total
R2	0.12	0.15	1.64	6.40	0.95	0.09	0.00	**9.36**
R1	0.01	0.02	0.54	10.44	3.47	0.00	0.00	**14.47**
VII Top	1.92	1.98	6.23	2.59	0.00	0.00	0.00	**12.72**
VII Middle	0.08	0.14	0.69	2.50	6.05	17.94	99.87	**127.27**
VII Bottom	2.52	1.68	2.33	0.04	0.00	0.00	0.00	**6.57**
VI Top	2.01	2.82	7.39	6.56	3.48	0.59	0.00	**22.85**
VI Middle	1.23	1.16	8.17	20.63	6.69	0.79	0.00	**38.67**
VI Bottom	1.24	1.60	11.69	13.75	1.09	0.79	0.76	**30.92**
V	1.56	1.64	4.94	3.98	0.66	0.00	0.00	**12.67**

Rajesh Ranjan
ESE (P & S)
TVNL, Hirapur Bench, Dhanbad
21 DEC 2015

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. ... -CPAM
Dated- 29.06.2015]

Seam	0.90-1.20m	1.20-1.50m	1.50-3.00m	3.00-6.00m	6.00-9.00m	9.00-12.00m	>12.00m	Total
IV Top	1.89	1.88	8.65	16.58	8.01	0.15	0.00	**37.17**
IV Middle	2.17	1.57	5.77	9.55	5.27	1.48	0.00	**25.81**
IV Bottom	0.77	1.15	10.90	35.73	17.73	1.08	0.00	**67.37**
III Top	1.99	2.39	12.73	9.76	0.83	0.00	0.00	**27.70**
III Middle	1.34	1.50	7.36	7.39	1.22	1.02	0.00	**19.83**
III Bottom	0.59	0.84	8.37	16.17	18.48	12.25	64.78	**121.49**
II Top	1.26	1.26	9.28	12.11	4.16	0.23	0.00	**28.30**
II Bottom	1.68	1.54	12.18	15.84	2.21	0.00	0.00	**33.45**
I Top	0.66	0.80	14.90	18.82	1.99	0.00	0.00	**37.17**
I Bottom	1.15	2.30	12.31	12.79	2.36	1.30	0.03	**32.24**
Total	**24.18**	**26.33**	**146.09**	**221.63**	**84.65**	**37.70**	**165.44**	**706.03**

Table No.- 5.3
Seam wise & Grade wise Geological Reserves (Mt) (Area – 1487 ha)
Upto Floor of Seam – I Bottom

(Fig. in Million Tonnes)

Seam	G5	G6	G7	G8	G9	G10	G11	G12	G13	G14	TOTAL
R2							3.81	2.34	2.15	1.06	**9.36**
R1						1.84	3.68	3.62	3.56	1.77	**14.47**
VII Top	0.10	0.23	0.95	2.20	2.50	2.42	2.33	1.99			**12.72**
VII Middle	0.68	1.58	10.77	28.29	35.06	24.27	13.48	8.34	3.21	1.59	**127.26**
VII Bottom	0.02	0.06	0.05	0.13	0.16	0.81	1.46	1.52	2.37		**6.58**
VI Top	0.17	0.40	0.27	0.48	0.43	1.97	3.51	5.22	6.94	3.45	**22.84**
VI Middle	0.02	0.04	0.08	0.99	1.82	3.97	6.13	8.70	11.28	5.64	**38.67**
VI Bottom	0.00	0.00		0.73	0.68	2.10	3.53	7.30	11.07	5.51	**30.92**
V	0.02	0.05	0.12	0.31	0.40	1.49	2.59	2.90	4.80		**12.68**
IV Top	0.07	0.15	0.26	1.99	3.46	4.80	6.15	7.38	8.61	4.30	**37.17**
IV Middle	0.03	0.08	0.44	0.82	0.77	1.79	2.81	5.82	8.84	4.40	**25.80**
IV Bottom	0.05	0.11	0.32	2.83	5.02	10.86	16.70	14.14	11.58	5.76	**67.37**
III Top	0.02	0.04	0.06	0.54	0.97	3.67	6.38	6.40	6.42	3.21	**27.70**
III Middle	0.03	0.06	0.24	1.31	2.15	2.69	3.24	3.74	4.25	2.12	**19.83**
III Bottom	0.26	0.62	1.65	9.32	15.34	18.62	21.69	21.66	21.43	10.70	**121.49**
II Top	0.09	0.20	0.45	1.31	1.72	3.82	5.92	5.92	8.87		**28.30**
II Bottom	0.07	0.15	0.16	0.89	1.47	3.74	6.02	7.50	13.45		**33.45**
I Top	0.59	1.37	0.52	1.32	1.60	4.60	7.60	7.75	11.84		**37.18**
I Bottom	0.84	1.97	0.66	1.25	1.18	2.47	3.76	6.44	13.66		**32.24**
TOTAL	**3.04**	**7.11**	**17.00**	**54.71**	**74.73**	**95.93**	**120.99**	**128.68**	**154.33**	**49.51**	**706.03**

The geological reserve of the mine area comes to 706.03 Mt as detailed above.

Vijay Kr. Singh
(Recognized Qualified Person)
[Recognition No. 24012/(03)/2014-CPAM]
Dated- 29.05.2015]

Rajesh Ranjan
ESE (P&S)
TVNL, Hinoo, Ranchi-834002
27 DEC 2021

5.6.2 Coal Reserves upto Opencastable Basal Seam – Seam III Bottom

As discussed at item 5.4.4, the Scenario-II for opencasting is having 1320 ha of coal bearing area. However, total geological reserve covering 1487 ha of allotted block e.g. 1487 ha is given below. The geological reserves upto Basal Seam i.e. Seam III Bottom are covered below in table 5.4 & 5.5.

Table No. – 5.4
Seam wise & Thickness wise Geological Reserves (Mt) (Area – 1487 ha)
Upto Floor of Seam – III Bottom

Seam	0.90-1.20m	1.20-1.50m	1.50-3.00m	3.00-6.00m	6.00-9.00m	9.00-12.00m	>12.00m	Total
R2	0.12	0.15	1.64	6.40	0.95	0.09	0.00	**9.36**
R1	0.01	0.02	0.54	10.44	3.47	0.00	0.00	**14.47**
VII Top	1.92	1.98	6.23	2.59	0.00	0.00	0.00	**12.72**
VII Middle	0.08	0.14	0.69	2.50	6.05	17.94	99.87	**127.26**
VII Bottom	2.52	1.68	2.33	0.04	0.00	0.00	0.00	**6.58**
VI Top	2.01	2.82	7.39	6.56	3.48	0.59	0.00	**22.84**
VI Middle	1.23	1.16	8.17	20.63	6.69	0.79	0.00	**38.67**
VI Bottom	1.24	1.60	11.69	13.75	1.09	0.79	0.76	**30.92**
V	1.56	1.54	4.94	3.98	0.66	0.00	0.00	**12.68**
IV Top	1.89	1.88	8.65	16.58	8.01	0.15	0.00	**37.17**
IV Middle	2.17	1.57	5.77	9.55	5.27	1.48	0.00	**25.80**
IV Bottom	0.77	1.15	10.90	35.73	17.73	1.08	0.00	**67.37**
III Top	1.99	2.39	12.73	9.76	0.83	0.00	0.00	**27.70**
III Middle	1.34	1.50	7.36	7.39	1.22	1.02	0.00	**19.83**
III Bottom	0.59	0.84	8.37	16.17	18.48	12.25	64.78	**121.49**
Total	**19.44**	**20.42**	**97.40**	**162.07**	**73.93**	**36.18**	**165.41**	**574.86**

Table – 5.5
Seam wise & Grade wise Geological Reserves (Mt) (Area – 1487 ha)
Upto Floor of Seam – III Bottom

Seam	G5	G6	G7	G8	G9	G10	G11	G12	G13	G14	TOTAL
R2							3.80	2.34	2.15	1.06	**9.36**
R1						1.84	3.68	3.62	3.56	1.77	**14.47**
VII Top	0.10	0.23	0.95	2.20	2.50	2.42	2.33	1.99			**12.72**
VII Middle	0.68	1.58	10.77	28.29	35.06	24.27	13.48	8.34	3.21	1.59	**127.26**
VII Bottom	0.02	0.06	0.05	0.13	0.16	0.81	1.46	1.52	2.37		**6.58**
VI Top	0.17	0.40	0.27	0.48	0.43	1.97	3.51	5.22	6.94	3.45	**22.84**
VI Middle	0.02	0.04	0.08	0.99	1.82	3.97	6.13	8.70	11.28	5.64	**38.67**
VI Bottom	0.00	0.00		0.73	0.68	2.10	3.53	7.30	11.07	5.51	**30.92**
V	0.02	0.05	0.12	0.31	0.40	1.49	2.59	2.90	4.80		**12.68**
IV Top	0.07	0.15	0.26	1.99	3.46	4.80	6.15	7.38	8.61	4.30	**37.17**
IV Middle	0.03	0.08	0.44	0.82	0.77	1.79	2.81	5.82	8.84	4.40	**25.80**

Rajesh Ranjan
ESE (Mining)
TVNL, Hindalco Belwadih
27 DEC 2024

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 21012/(03)/2014-CPAM
Dated- 29.05.2015]

Seam	G5	G6	G7	G8	G9	G10	G11	G12	G13	G14	TOTAL
IV Bottom	0.05	0.11	0.32	2.83	5.02	10.86	16.70	14.14	11.58	5.76	67.37
III Top	0.02	0.04	0.06	0.54	0.97	3.67	6.38	6.40	6.42	3.21	27.70
III Middle	0.03	0.06	0.24	1.31	2.15	2.69	3.24	3.74	4.25	2.12	19.83
III Bottom	0.26	0.62	1.65	9.32	15.34	18.62	21.89	21.66	21.43	10.70	121.49
TOTAL	**1.46**	**3.41**	**15.21**	**49.94**	**68.76**	**81.30**	**97.68**	**101.07**	**106.51**	**49.51**	**574.86**

Further to above, the reserves of lower seams i.e. I & II is given below. These seams will be worked by U/G system of mining as explained at item 5.4.6.

Table No. – 5.6
Seam wise & Thickness wise Geological Reserves (Mt) (Area – 1487 ha)
Seam – I & II (Identified for Underground Mining)

Seam	0.90-1.20m	1.20-1.50m	1.50-3.00m	3.00-6.00m	6.00-9.00m	9.00-12.00m	>12.00m	Total
II Top	1.26	1.26	9.28	12.11	4.16	0.23	0	**28.30**
II Bottom	1.68	1.54	12.18	15.84	2.21	0	0	**33.45**
I Top	0.66	0.8	14.9	18.82	1.99	0	0	**37.18**
I Bottom	1.15	2.3	12.31	12.79	2.36	1.3	0.03	**32.24**
Total	**4.75**	**5.9**	**48.67**	**59.56**	**10.72**	**1.53**	**0.03**	**131.17**

Table No. – 5.7
Seam wise & Grade wise Geological Reserves (Mt) (Area – 1487 ha)
Seam – I & II (Identified for Underground Mining)

Seam	G5	G6	G7	G8	G9	G10	G11	G12	G13	G14	TOTAL
II Top	0.09	0.20	0.45	1.31	1.72	3.82	5.92	5.92	8.86		28.30
II Bottom	0.07	0.15	0.16	0.89	1.47	3.74	6.02	7.50	13.45		33.45
I Top	0.59	1.37	0.52	1.32	1.60	4.60	7.60	7.75	11.84		37.18
I Bottom	0.85	1.97	0.66	1.25	1.18	2.47	3.76	6.44	13.66		32.24
TOTAL	**1.58**	**3.70**	**1.79**	**4.77**	**5.97**	**14.63**	**23.30**	**27.61**	**47.81**	**0.00**	**131.17**

5.6.3 Reserves as per Scenario-II

As discussed at item 5.4.4, Scenario-II is the selected option for opencasting upto Seam III Bottom as basal seam. Area of metamorphic high patch, on the North side, covering about 150 ha has been left out due to poor coal deposits and social considerations. The table no. 5.8 gives the geological reserves in the 150 ha being left out and table no. 5.9 gives the geological reserves in 1320 ha chosen area for Seam III Bottom & above, for opencasting.

Vijay K. Singh
(Recognised Qualified Person)
[Recognition No. 24[illegible]3)/2014-CPAM
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Table No. – 5.8
Seam wise Reserves in North Metamorphic High Patch upto Sukri River in the North & East (Area – 150 ha)
Upto Seam – III Bottom

Seams	Net Reserves (Mt)
VI Top	0.05
VI Middle	0.41
VI Bottom	0.48
V	1.29
IV Top	1.67
IV Middle	0.40
IV Bottom	1.34
III Top	1.03
III Middle	0.80
III Bottom	0.38
II Top	NIL
II Bottom	NIL
I Top	NIL
I Bottom	NIL
Total	**7.85**

Table No. – 5.9
Seam wise Reserves in Firmed up Mine Area (1320 ha)
Upto Seam – III Bottom

Seams	Reserves in Opencast Area (Mt)
R2	9.36
R1	14.47
VII Top	12.72
VII Middle	127.26
VII Bottom	6.58
VI Top	22.80
VI Middle	38.26
VI Bottom	30.44
V	11.39
IV Top	35.49
IV Middle	25.41
IV Bottom	66.02
III Top	26.67
III Middle	19.03
III Bottom	121.11
Total	**567.01**

Rajesh Ranjan
ESE (P & S)
TVNL, Hinoo, Ranchi-834002
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This 567.01 Mt of geological reserve will be subjected to opencasting for this mine.

Vijay Kumar Singh
(Recognised Person)
[Recognition No. 34/14/(03)/2014-CPAM
Dated- 29.05.2015]

5.7 ASSESSMENT OF WINNABLE COAL

5.7.1 The opencast mine, whose excavation area has been delineated at para 5.5 is assessed to have the following mine parameter.

Table No. – 5.10
Mine Parameters

Sl. No.	Parameters	Unit	Value
1.	Maximum depth	Meter	474
2.	Maximum width (East-West): At the Mine Floor At the Surface	 Km Km	 3.90 4.70
3.	Maximum North-South Length : On the Mine Floor On the Mine Surface	 Km Km	 2.80 3.12
4	Area : On the Mine Floor On the Mine Surface	 Sq Km Sq Km	 8.90 12.62

5.7.2 To assess the minable reserves in the proposed excavation area, the coal blockage in the barriers and batters of the proposed mine has been calculated hereafter.

Table No.-5.11
Coal blocked in Barriers (Fig in Mtes)

Seam	North	East	West	South	Total
R2	-	-	0.06	-	0.06
R1	-	-	0.09	-	0.09
VII Top	-	-	0.07	-	0.07
VII Middle	-	-	0.20	-	0.20
VII Bottom	-	-	0.09	-	0.09
VI Top	0.02	-	0.03	-	0.05
VI Middle	0.09	-	0.11	-	0.20
VI Bottom	0.30	-	0.10	-	0.40
V	0.28	-	0.04	-	0.32
IV Top	0.32	-	0.07	-	0.39
IV Middle	0.13	-	0.08	-	0.21
IV Bottom	0.29	-	0.15	-	0.44
III Top	0.19	-	0.06	-	0.25
III Middle	0.18	-	0	-	0.18
III Bottom	0.09	-	0.20	-	0.29
Total	**1.89**	**-**	**1.35**	**-**	**3.24**

Rajesh Prasad
ESE (P & Quality)
TVNL, Hindo, Ranchi-834002
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Vijay Kumar Singh
(Recognised Qualified Person)
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Table No.-5.12
Coal blocked in Batters

Fig in Mtes

Seam	North	East	West	South	Total
R2	-	-	1.49	-	1.49
R1	-	-	2.28	-	2.28
VII Top	-	-	3.56	0.52	4.08
VII Middle	-	-	12.41	1.53	13.94
VII Bottom	-	-	3.08	-	3.08
VI Top	0.64	0.17	2.76	0.25	3.82
VI Middle	0.90	0.33	5.97	4.66	11.86
VI Bottom	0.70	0.03	6.47	0.35	7.56
V	0.60	0.21	0.98	3.44	5.22
IV Top	1.97	0.42	4.46	2.56	9.42
IV Middle	0.26	0.02	9.32	0.90	10.50
IV Bottom	1.65	0.16	10.06	2.73	14.60
III Top	0.90	0.01	5.78	0.14	6.82
III Middle	0.35	0.23	1.61	0.11	2.30
III Bottom	0.72	0.92	18.70	4.12	24.46
Total	**8.69**	**2.50**	**88.93**	**21.31**	**121.43**

Table No. – 5.13
Total Reserves Blocked (Mt)

Seams	Blocked in Barrier	Blocked in Batter	Total Blocked Reserves
R2	0.06	1.49	1.55
R1	0.09	2.28	2.37
VII Top	0.07	4.08	4.15
VII Middle	0.20	13.94	14.14
VII Bottom	0.09	3.08	3.17
VI Top	0.05	3.82	3.87
VI Middle	0.20	11.86	12.06
VI Bottom	0.40	7.56	7.96
V	0.32	5.22	5.54
IV Top	0.39	9.42	9.81
IV Middle	0.21	10.50	10.71
IV Bottom	0.44	14.60	15.04
III Top	0.25	6.82	7.07
III Middle	0.18	2.30	2.48
III Bottom	0.29	24.46	24.75
Total	**3.24**	**121.43**	**124.67**

Rajesh Ranjan
ESE (P & S)
TVNL, Hindd, Ranchi-834002
27 DEC 2024

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

5.7.3 Details of Mineable Reserves within Excavation area (1262 ha)

After deducting the coal blocked in barriers & batters of the proposed quarry, from Geological Reserve; the Seam wise minable reserves for opencast mining have been calculated and is presented below in Table No.- 5.14.

Table No. – 5.14
Seam wise & Grade wise Mineable Reserves (Mt)

(Fig in Million Tonnes)

Seam	G5	G6	G7	G8	G9	G10	G11	G12	G13	G14	TOTAL
R2							3.18	1.95	1.79	0.89	7.81
R1						1.65	2.97	2.99	3.01	1.49	12.11
VII Top	0.06	0.13	0.57	1.31	1.49	1.45	1.41	2.15			8.57
VII Middle	0.58	1.37	9.46	25.02	31.13	21.61	12.09	7.50	2.91	1.45	113.12
VII Bottom	0.01	0.01	0.02	0.05	0.06	0.29	0.53	0.81	1.62		3.40
VI Top	0.13	0.31	0.21	0.38	0.34	1.53	2.73	4.36	5.98	2.98	18.95
VI Middle	0.01	0.03	0.06	0.65	1.18	2.60	4.01	5.93	7.85	3.90	26.22
VI Bottom	0.00	0.00		0.51	0.47	1.47	2.47	5.33	8.20	4.09	22.54
V	0.01	0.01	0.04	0.12	0.16	0.58	1.00	1.41	2.72		6.05
IV Top	0.04	0.10	0.17	1.31	2.28	3.18	4.09	5.25	6.42	3.19	26.03
IV Middle	0.02	0.04	0.22	0.42	0.40	0.93	1.46	3.31	5.17	2.58	14.55
IV Bottom	0.03	0.08	0.24	2.11	3.74	8.15	12.56	10.80	9.05	4.51	51.27
III Top	0.01	0.02	0.05	0.36	0.64	2.44	4.25	4.59	4.94	2.46	19.76
III Middle	0.02	0.05	0.18	0.97	1.58	2.00	2.41	3.22	4.02	2.00	16.45
III Bottom	0.20	0.47	1.27	7.21	11.89	14.51	17.13	17.14	17.14	8.55	95.51
Total	1.12	2.62	12.49	40.42	55.36	62.39	72.29	76.74	80.82	38.09	442.34

5.7.4 Mining loss of 5 %

The mining loss arises from:

a) Loss of coal in the contact areas of roof and floor of seam

b) Loss of coal while segregating OB dirt from coal bench

c) Loss of coal during selective mining for >1m dirt bands

d) Loss of coal during transportation

The Mining loss is estimated at 5% for reason explained above. The detailed break up of seam wise estimated winnable coal after deducting the 22.12 Mt as mining losses, from the mineable coal of 442.34 Mt; is given below in table 5.15.

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-OPAM
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Table No. – 5.15
Seam wise Winnable Coal

Seams	Mineable Reserves	Mining Loss 5%	Winnable Reserves
R2	7.81	0.39	7.42
R1	12.11	0.61	11.50
VII Top	8.57	0.43	8.14
VII Middle	113.12	5.66	107.46
VII Bottom	3.40	0.17	3.23
VI Top	18.95	0.95	18.00
VI Middle	26.22	1.31	24.91
VI Bottom	22.54	1.13	21.41
V	6.05	0.30	5.75
IV Top	26.03	1.30	24.73
IV Middle	14.55	0.73	13.82
IV Bottom	51.27	2.56	48.71
III Top	19.76	0.99	18.77
III Middle	16.45	0.82	15.63
III Bottom	95.51	4.78	90.73
Total	**442.34**	**22.12**	**420.22**

5.7.5 Details of Winnable Coal & Inter seam Burden etc.

The table no. 5.16, given hereafter, shows the quantity of assessed winnable coal from the seams and quantity of seam wise interburden as waste. For top most seam i.e. R2 the overburden is 56.63 Mm^3.

Table No. – 5.16
Seam wise Winnable Coal & Quantity of Burden
Upto Seam III Bottom

Seam	Winnable Coal			Waste			Stripping Ratio
	Reserve (in Mt)		Avg. Thick (in m.)	Quantity (in Mbcm)		Avg. Thick (in m.)	
	Seam wise	Cumul-ative		Parting wise	Cumul-ative		
OB				56.63	56.63	59	
R2	7.42	7.42	3.79				7.63
Parting				31.58	88.21	6	
R1	11.50	18.92	4.66				4.66
Parting				519.00	607.21	124	
VIIT	8.14	27.06	1.88				22.44
Parting				57.25	664.46	7	
VIIM	107.46	134.52	13.39				4.94
Parting				46.44	710.90	9	
VIIB	3.23	137.75	1.03				5.16
Parting				208.39	919.29	34	
VIT	18.00	155.75	2.45				5.90

Rajesh Rajput
TVNL, Barpali
Engineering Assistant
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Seam	Winnable Coal			Waste			Stripping Ratio
	Reserve (in Mt)		Avg. Thick (in m.)	Quantity (in Mbcm)		Avg. Thick (in m.)	
	Seam wise	Cumul-ative		Parting wise	Cumul-ative		
Parting				58.15	977.44	7	
VIM	24.91	180.66	3.61				5.41
Parting				73.28	1050.72	8	
VIB	21.40	202.06	2.91				5.20
Parting				138.26	1188.98	47	
V	5.75	207.81	1.75				5.72
Parting				177.20	1366.18	33	
IVT	24.73	232.54	2.33				5.87
Parting				79.10	1445.28	11	
IVM	13.82	246.36	2.52				5.87
Parting				138.16	1583.44	11	
IVB	48.72	295.08	3.80				5.37
Parting				211.49	1794.93	38	
IIIT	18.76	313.84	2.27				5.72
Parting				111.04	1905.97	19	
IIIM	15.63	329.47	2.57				5.78
Parting				213.03	2119.00	20	
IIIB	90.74	420.22	6.73				5.04

5.7.6 Seam wise Grade wise (GCV) Winnable Coal

The following table no. 5.17 gives detail of grade wise break up of assessed winnable coal from the seam.

Table No. – 5.17
Seam wise & Grade wise Winnable Reserves (Mt)

Seam	G5	G6	G7	G8	G9	G10	G11	G12	G13	G14	TOTAL
R2							3.02	1.86	1.70	0.84	**7.42**
R1						1.57	2.82	2.84	2.85	1.42	**11.50**
VII Top	0.05	0.13	0.54	1.24	1.42	1.38	1.34	2.04			**8.14**
VII Middle	0.56	1.30	8.99	23.77	29.56	20.53	11.49	7.13	2.77	1.36	**107.46**
VII Bottom	0.01	0.01	0.02	0.05	0.05	0.28	0.51	0.77	1.53		**3.23**
VI Top	0.13	0.29	0.20	0.36	0.32	1.46	2.60	4.14	5.68	2.82	**18.00**
VI Middle	0.01	0.03	0.05	0.61	1.13	2.47	3.81	5.63	7.46	3.71	**24.91**
VI Bottom	0.00	0.00		0.47	0.45	1.39	2.34	5.07	7.78	3.90	**21.40**
V	0.01	0.01	0.04	0.10	0.15	0.55	0.95	1.34	2.60		**5.75**
IV Top	0.04	0.09	0.16	1.24	2.17	3.02	3.88	4.99	6.10	3.04	**24.73**
IV Middle	0.01	0.04	0.21	0.40	0.38	0.88	1.39	3.15	4.90	2.46	**13.82**
IV Bottom	0.03	0.08	0.23	2.00	3.55	7.74	11.94	10.27	8.58	4.30	**48.72**
III Top	0.01	0.02	0.04	0.34	0.60	2.32	4.03	4.36	4.70	2.34	**18.76**
III Middle	0.02	0.04	0.17	0.92	1.50	1.90	2.29	3.06	3.83	1.90	**15.63**
III Bottom	0.19	0.46	1.20	6.85	11.29	13.78	16.28	16.28	16.28	8.14	**90.75**
Total	**1.07**	**2.50**	**11.85**	**38.35**	**52.57**	**59.27**	**68.69**	**72.93**	**76.76**	**36.23**	**420.22**

The average GCV of winnable coal is about 4276 Kcal/Kg and the average grade is G-11. Percentage of extraction = 420.22 ÷ 574.86 = 73%.

5.7.7 Salient Figures of Coal Reserves

A comprehensive picture of the coal reserves is brought out as follows:-

Table 5.18

Salient Characteristics of Coal Reserves

A.	Geological reserve including 7.85 Mt within the 150 ha (not considered for Mining)	574.86 Mt
B.	Geological Reserves within proposed Mining area	**567.01 Mt**
C.	(a) Reserves blocked in Barrier (b) Reserves blocked in Batters	3.24 Mt 121.43 Mt
D.	Total Blockage (124.67 Mt + 7.85 Mt = 132.52 Mt) Blockage of 132.52 Mt includes 150 ha outside lease area	124.67 Mt
E.	Mineable reserve	**442.34 Mt**
F.	Mining Losses @ 5%	22.12 Mt
G.	Winnable coal	**420.22 Mt**
H.	Waste to be Removed	**2119 Mm^3**
I.	Stripping Ratio	**5.04**
J.	Percentage of Extraction	**73%**

5.8 FRAMEWORK FOR MINE DEVELOPMENT

5.8.1 Features of Deposit

The coal deposits of Rajbar have some peculiar & difficult features which require special considerations for developing the mine and working the deposits. These are:

- High Coal : OB stripping ratio – 1:5.04.
- Large area of metamorphic high floor in the Northern part of coal block.
- Metamorphic in the East and South sides also.
- River on the Northern boundary.
- The average thickness of seams are quite low. Except Seam VII Middle (13.60 m thick), and Seam III Bottom (7.63 m), remaining coal seams are less than 6 m and many are < 2 m thick.
- Seams gradient increases from about 1 in 7 (8^0) in outcrop area in the North East segment to about 1 in 5 (12^0) near southern boundary.

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- The seam and parting thicknesses vary very widely, necessitating varied capacity of equipment deployment.

5.8.2 Activities to match aforesaid features

At previous para, some of geological and topographical challenges, in working this deposit, have been identified. To overcome these constraints/ challenges, some strategies have to be undertaken. These are briefed below:

- Equipment would have to be selected to cope with multiple thin seams and variable thickness of coal seams.
- High capacity waste handling, loading and transport equipment to be deployed.
- Using vibratory rollers to compact the O.B. dumps to increase accommodation capacity of the internal dump areas.
- Rehandle the temporary dumps from 23rd year onwards, to clear space for sustained advance of quarry.

5.9 OPENCAST MINE DESIGN

5.9.1 Relevant Factors Considered for Mine design

i) Multi seam deposit with varying seam thickness.
ii) Large number of benches due to depth and multiple seams.
iii) Frequent movement of equipment from one bench to other.
iv) Large variation in thickness of partings.

5.9.2 Rated Capacity

The Rajbar E & D opencast project has been planned for a rated capacity of 10 MTPA of ROM Coal. This output is prima facie considered technically feasible because of its geo-mining conditions like:

(i) Large Coal reserves – 567.01 Mt Geological Reserves and 420.22 Mt Winnable Coal
(ii) Comparatively better face length (within 2-3 Km range)
(iii) Mine face along apparent dip (70^0 – 60^0 off from dip direction)
(iv) This apparent face direction enables early back filling from the 5th year itself.

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5.9.3 Mining Operational System

Based on Indian Practices and Norms, the following operational work design criteria have been adopted for this opencast project:

- Number of annual working days — 330
- Number of shifts /day — 3
- Duration of each shift (hours) — 8

5.10 SEQUENCES IN OPENING OF THE COAL MINE

5.10.1 Construction Activities

There will be construction period, before start of excavation. During this period, the following construction activities would be completed in about 2 years period (Plate No. – 11).

(i) Making approach road.
(ii) Ground survey.
(iii) Arranging temporary and permanent water supply system.
(iv) Ground preparation work.
(v) Bringing permanent power line to the project and construction of electrical sub-station of capacity 2 x 5 MVA and arranging power distribution.
(vi) Setting up/ constructing infrastructure like office, store, workshop, coal handling plant etc.
(vii) Construction of rehabilitation colony.
(viii) Construction of residential colony.

5.10.2 The Mine Layout

Considering the lay and disposition of the deposit, surface features, non availability of land for external waste dump in the project area, and for the optimal uses of resources; it has been proposed to open the mine from the North-East segment of the area. It has been envisaged to give thrust for development along apparent dip (70^0 to 60^0 off from dip direction) in the initial

Rajesh Ranjan ESE (P&T) 93340 TVNL Hirodi, Ranchi

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Vijay Kumar Singh (Competent Authorised Person) (Recognition No. J-11012-(03)/2014-CPAM Dated- 29.05.2015)

years up to 5th year. Thereafter, with formation of sustainable back dumping space, mine would progress along West direction to sustain 10 MTPA level.

This decision to proceed along the apparent strike and move face along West of the mine and later taking a turn towards North has been taken for following reasons:

1. Opening of all coal seams at the earliest.
2. Maintaining a steady stripping ratio.
3. Maximizing internal dumping.
4. Keep the ultimate void at minimum possible depth by maximizing the backfill volume in deep voids and thereby minimize the ultimate void volume.

With strike face and central road running along rise–dip, for a dip side progress, large area gets blocked in middle portion of the excavated void for meandering haul road. Hence internal dump capacity gets seriously reduced. For high strip ratio mine like Rajbar, internal dumping is to be maximized by avoiding central haul road in combination with strike faces. This has lead to opening of the face in apparent direction, thereby ensuring complete back filling of dip most void with mines progress.

For stripping ratio higher than 1:4, accommodation of waste within coal bearing area is a problem. This leads to increased temporary dumping. To solve this, one strategy is to increase internal dump capacity through early back filling. Problem of waste accommodation gets aggravated with thin layers of coal seams, which requires formation of increased number of benches for same level of production. A step for increasing internal filling is compacting through vibratory compactors for higher filling ratio.

5.10.3 Working thin seams over Inter burden Benches

The coal seams in the property have 15 coal layers upto III Seam Bottom including two layers i.e. R1 & R2 of Raniganj Series. Except four layers i.e. VII Middle, VI Middle, IV Bottom & III Seam Bottom of Barakar Series, all other 8 layers are less than 3 m thick (except VI Bottom which is 3.33 m). These 8

layers will be worked together with their inter burden benches. The benches are more than 2 km long from 5th year itself. On these benches, thin seam (8 layers) coal faces will move forward and inter burden faces would follow only after all the coal has been extracted. This would reduce required number of benches and increase the unworked coal bearing area to accommodate temporary dump. A three layer **agl** dump over **gl** backfill would further increase internal dump capacity.

5.10.4 Layout of Haul road and approach roads for this deep mine

The mine reaches its maximum depth of 474 m with R.L. of –30 m in 30th year stage in the South-West segment of the mine. It can be seen in the Plate No. – 15 F showing 30th year stage. The layout of haul road to reach a depth of 474 m is also shown on Plate No. – 15 L (Final Stage Quarry Plan). This is further explained below:

5.10.4.1 The Mine Entry Road along Northern Flank

a) The basal seam for O.C. mining i.e. Seam III has been reached from CHP area by cutting a mine entry road from surface (RL – 447 m) upto roof of the III Seam covering about 500 metre length at gradient of 1:12 and reaches R.L. of about 405 m.

b) From here on it runs for about 1900 metre, East to West, at a gradient of 1 in 15 and reaches an R.L. of 275 m.

Two parallel conveyor belts have been provided to transport coal along this North corridor running for 1900 + 500 metre length.

5.10.4.2 Road along the apparent dip

The bench faces are laid at 60^0 angle from the dip and have gradients varying from 1 in 11 to 1 in 14. At the end of 30th year the road on the benches runs at 1 in 11 and reaches at depth of 474 m in the South-West segment of the property. Transport of coal has been suggested by coal dumpers along face road to reach North side belt corridor.

Rajesh Ranjan
Exe. (P&S)
TVNL, Hinoc, Ranchi-834001
21 DEC 2024

Vijay Kumar Singh
(Authorised Person)
[Recognition No. J-12/(03)/2014-CPAM
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Approach roads on the quarry floor for different stages of mine e.g. 5th year, 10th year & 20th year stages are shown in the final stage quarry plan (Plate No. – 15 L) also.

5.11 LIFE OF THE PROPOSED MINE

The life of the mine has been considered as 48 years covering total working period of the mine. Therefore, Escrow A/c payment has been spread over 48 years. The start of production as per efficiency parameter of allotment agreement is scheduled for the year 2018-19. The production is likely to start by the beginning of year 2019.

5.12 CALENDAR PLAN OF EXCAVATION, WASTE REMOVAL AND COAL PRODUCTION

The summarized calendar program of coal production and waste excavation is given in Table No.-5.19 which has been developed based on adopted sequence of open cast mine development at optimum condition of mining operation in the block. Production is expected to start during Financial Year 2018-19.

Vijay Kumar Singh
(Recognised ... Person)
[Recognition No. ... -(61) 2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
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Table - 5.19
Calendar Plan of Production

Production Stage Years		Coal Mt	Cum Coal Mt	Waste including Top Soil Mbcm	Cum Waste including Top Soil Mbcm	Cum SR
Y-1	2018-19	1	1	5.5	5.5	5.50
Y-2	2019-20	2	3	11	16.5	5.50
Y-3	2020-21	4	7	22	38.5	5.50
Y-4	2021-22	7	14	38.5	77	5.50
Y-5	2022-23	8	22	44	121	5.50
Y-6	2023-24	8	30	44	165	5.50
Y-7	2024-25	9	39	50	215	5.51
Y-8	2025-26	10	49	55	270	5.51
Y-9	2026-27	10	59	55	325	5.51
Y-10	2027-28	10	69	54	379	5.49
Y-11	2028-29	10	79	52	431	5.46
Y-12	2029-30	10	89	52	483	5.43
Y-13	2030-31	10	99	52	535	5.40
Y-14	2031-32	10	109	52	587	5.39
Y-15	2032-33	10	119	52	639	5.37
Y-16	2033-34	10	129	52	691	5.36
Y-17	2034-35	10	139	52	743	5.35
Y-18	2035-36	10	149	52	795	5.34
Y-19	2036-37	10	159	52	847	5.33
Y-20	2037-38	10	169	52	899	5.32
Y-21	2038-39	10	179	50	949	5.30
Y-22	2039-40	10	189	50	999	5.29
Y-23	2040-41	10	199	50	1049	5.27
Y-24	2041-42	10	209	50	1099	5.26
Y-25	2042-43	10	219	50	1149	5.25
Y-26	2043-44	10	229	50	1199	5.24
Y-27	2044-45	10	239	50	1249	5.23
Y-28	2045-46	10	249	50	1299	5.22
Y-29	2046-47	10	259	50	1349	5.21
Y-30	2047-48	10	269	50	1399	5.20
Y-31	2048-49	10	279	50	1449	5.19
Y-32	2049-50	10	289	50	1499	5.19
Y-33	2050-51	10	299	50	1549	5.18
Y-34	2051-52	10	309	50	1599	5.17
Y-35	2052-53	10	319	50	1649	5.17
Y-36	2053-54	10	329	50	1699	5.16

Rajesh Ranjan
TVNL, Hinoo
21 DEC 2015

Vijay Kumar Singh
(Recognised Qualified Person)
(Recognition No. 34012/(03)/2014-CPAM
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Production Stage Years		Coal Mt	Cum Coal Mt	Waste including Top Soil Mbcm	Cum Waste including Top Soil Mbcm	Cum SR
Y-37	2054-55	10	339	50	1749	5.16
Y-38	2055-56	10	349	50	1799	5.15
Y-39	2056-57	10	359	47	1846	5.14
Y-40	2057-58	10	369	47	1893	5.13
Y-41	2058-59	8	377	47	1940	5.15
Y-42	2059-60	8	385	45	1985	5.16
Y-43	2060-61	7	392	40	2025	5.17
Y-44	2061-62	7	399	40	2065	5.18
Y-45	2062-63	7	406	26	2091	5.15
Y-46	2063-64	5	411	16	2107	5.13
Y-47	2064-65	5	416	10	2117	5.09
Y-48	2065-66	4.22	420.22	2	2119	5.04
		420.22		**2119**		

Total winnable coal has been estimated as 420.22 Mtes at the corresponding waste generation of 2119 Mbcm. This has given an average SR of 5.04 m^3/t. The rated Output of 10.00 MTPA is estimated to be achieved in 8th year of quarry excavation as is clear from the calendar plan shown above.

Besides calendar program year wise given in Table No. – 5.19, three additional tables nos. – 5.20, 5.21 and 5.22 have been given in the following pages providing details of coal produced seam wise with its grade and waste removed parting wise for each of the production year upto 48th year. The Table No. – 5.22 gives the maximum and minimum depth of working for each of the coal seams upto Seam III Bottom.

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 07/2014-CPAM
Dated 4th Jan 2015]

Rajesh Ranjan
ESE (P.S.)
TVNL, Ujjwal, Ranchi-834002
21 DEC 2021

Rajesh Ranjan
ESE (P & S)
TVNL, Hirodi, Ramgarh
21 DEC 2015

Table No. – 5.20
Year Wise, Seam Wise & Grade Wise Coal Production Program

Figures in Mt

Year	Seam	Seam	Seam	Seam	Seam	Seam	Seam	Seam	Seam	Seam	Seam	Seam	Seam	Seam	Seam	Year wise Coal	Year wise	
	R2	R1	VIIT	VIIM	VIIB	VIT	VIM	VIB	V	IVT	IVM	IVB	IIIT	IIIM	IIIB		GCV	Grade
Th (m)	3.8	4.7	1.9	13.4	1	2.5	3.6	2.9	1.8	2.3	2.5	3.8	2.3	2.6	6.7			
1													0.2	0.2	0.6	1	4593	G-10
2												0.2	0.35	0.35	1.1	2	4593	G-10
3						0.1	0.2	0.2	0.15	0.2	0.2	0.3	0.3	0.35	2.0	4	4499	G-10
4				0.8	0.1	0.4	0.5	0.5	0.15	0.5	0.3	1	0.4	0.35	2.0	7	4461	G-10
5			0.2	1.6	0.1	0.4	0.5	0.5	0.15	0.5	0.3	1	0.4	0.35	2.0	8	4426	G-10
6			0.2	1.6	0.1	0.4	0.5	0.5	0.15	0.5	0.3	1	0.4	0.35	2.0	8	4426	G-10
7			0.2	2.6	0.1	0.4	0.5	0.5	0.15	0.5	0.3	1	0.4	0.35	2.0	9	4435	G-10
8			0.2	2.9	0.1	0.4	0.65	0.55	0.15	0.65	0.4	1.2	0.4	0.4	2.0	10	4503	G-10
9			0.2	2.9	0.1	0.4	0.65	0.55	0.15	0.65	0.4	1.2	0.4	0.4	2.0	10	4503	G-10
10			0.2	2.9	0.1	0.4	0.65	0.55	0.15	0.65	0.4	1.2	0.4	0.4	2.0	10	4577	G-9
11			0.2	2.9	0.1	0.4	0.65	0.55	0.15	0.65	0.4	1.2	0.4	0.4	2.0	10	4258	G-11
12			0.2	2.9	0.1	0.4	0.65	0.55	0.15	0.65	0.4	1.2	0.4	0.4	2.0	10	4258	G-11
13			0.2	2.9	0.1	0.4	0.65	0.55	0.15	0.65	0.4	1.2	0.4	0.4	2.0	10	4258	G-11
14			0.2	2.9	0.1	0.4	0.65	0.55	0.15	0.65	0.4	1.2	0.4	0.4	2.0	10	4258	G-11
15			0.2	2.9	0.1	0.4	0.65	0.55	0.15	0.65	0.4	1.2	0.4	0.4	2.0	10	4258	G-11
16			0.2	2.9	0.1	0.4	0.65	0.55	0.15	0.65	0.4	1.2	0.4	0.4	2.0	10	4233	G-11
17			0.2	2.9	0.1	0.4	0.65	0.55	0.15	0.65	0.4	1.2	0.4	0.4	2.0	10	4234	G-11
18			0.2	2.9	0.1	0.4	0.65	0.55	0.15	0.65	0.4	1.2	0.4	0.4	2.0	10	4233	G-11
19			0.2	2.9	0.1	0.4	0.65	0.55	0.15	0.65	0.4	1.2	0.4	0.4	2.0	10	4233	G-11
20			0.2	2.9	0.1	0.4	0.65	0.55	0.15	0.65	0.4	1.2	0.4	0.4	2.0	10	4330	G-10
21			0.2	2.9	0.1	0.4	0.65	0.55	0.15	0.65	0.4	1.2	0.4	0.4	2.0	10	4326	G-10
22			0.2	2.9	0.05	0.4	0.65	0.6	0.15	0.65	0.4	1.2	0.4	0.4	2.0	10	4327	G-10
23			0.2	2.9	0.05	0.4	0.65	0.6	0.15	0.65	0.4	1.2	0.4	0.4	2.0	10	4327	G-10
24			0.2	2.9	0.05	0.4	0.65	0.6	0.15	0.65	0.4	1.2	0.4	0.4	2.0	10	4327	G-10

Vijay Kumar Singh
(Recog... alified Person)
...2/(03)/2014-CPAM
[Recog... ...e 2015]

Year	Seam	Seam	Seam	Seam	Seam	Seam	Seam	Seam	Seam	Seam	Seam	Seam	Seam	Seam	Seam	Year wise Coal	Year wise	
	R2	R1	VIIT	VIIM	VIIB	VIT	VIM	VIB	V	IVT	IVM	IVB	IIIT	IIIM	IIIB		GCV	Grade
Th (m)	3.8	4.7	1.9	13.4	1	2.5	3.6	2.9	1.8	2.3	2.5	3.8	2.3	2.6	6.7			
25			0.2	2.9	0.05	0.4	0.65	0.6	0.15	0.65	0.4	1.2	0.4	0.4	2.0	10	4327	G-10
26			0.2	2.9	0.05	0.4	0.65	0.6	0.1	0.65	0.4	1.2	0.4	0.45	2.0	10	4339	G-10
27			0.2	2.9	0.05	0.4	0.65	0.6	0.1	0.65	0.4	1.2	0.4	0.45	2.0	10	4339	G-10
28			0.2	2.9	0.05	0.4	0.65	0.6	0.1	0.65	0.4	1.2	0.4	0.45	2.0	10	4340	G-10
29			0.2	2.9	0.05	0.4	0.65	0.6	0.1	0.65	0.4	1.2	0.4	0.45	2.0	10	4340	G-10
30		0.2	0.2	2.8	0.05	0.4	0.65	0.5	0.1	0.65	0.4	1.2	0.4	0.45	2.0	10	4450	G-10
31	0.2	0.4	0.2	2.6	0.05	0.4	0.6	0.5	0.1	0.6	0.3	1.2	0.45	0.4	2.0	10	4316	G-10
32	0.4	0.5	0.2	2.4	0.05	0.4	0.55	0.5	0.1	0.6	0.3	1.2	0.45	0.35	2.0	10	4287	G-11
33	0.4	0.5	0.2	2.4	0.05	0.4	0.55	0.5	0.1	0.6	0.3	1.2	0.45	0.35	2.0	10	4287	G-11
34	0.4	0.6	0.2	2.4	0.05	0.4	0.55	0.5	0.1	0.5	0.3	1.2	0.45	0.35	2.0	10	4284	G-11
35	0.5	0.6	0.2	2.4	0.05	0.4	0.55	0.5	0.1	0.5	0.25	1.2	0.45	0.3	2.0	10	4276	G-11
36	0.5	0.7	0.2	2.3	0.05	0.4	0.55	0.5	0.1	0.5	0.25	1.2	0.45	0.3	2.0	10	4101	G-11
37	0.5	0.7	0.2	2.3	0.05	0.4	0.55	0.5	0.1	0.5	0.25	1.2	0.45	0.3	2.0	10	4101	G-11
38	0.5	0.7	0.2	2.3	0.05	0.4	0.55	0.5	0.1	0.5	0.25	1.2	0.45	0.3	2.0	10	4101	G-11
39	0.4	0.7	0.2	2.5	0.05	0.4	0.55	0.5	0.1	0.5	0.15	1.2	0.45	0.3	2.0	10	4123	G-11
40	0.4	0.7	0.2	2.5	0.05	0.4	0.55	0.5	0.1	0.5	0.15	1.2	0.45	0.3	2.0	10	4129	G-11
41	0.4	0.7	0.2	1.7	0.05	0.4	0.4	0.15	0.1	0.5	0.1	0.8	0.4	0.1	2.0	8	4053	G-11
42	0.4	0.8	0.1	1.7	0.05	0.4	0.4	0.15	0.1	0.5	0.1	0.8	0.4	0.1	2.0	8	4045	G-11
43	0.4	0.7	0.1	1.4	0.05	0.3	0.3	0.15	0.1	0.2	0.1	0.8	0.3	0.1	2.0	7	4036	G-11
44	0.4	0.7	0.1	1.4	0.05	0.3	0.3	0.15	0.1	0.2	0.1	0.8	0.3	0.1	2.0	7	4036	G-11
45	0.4	0.7	0.1	1.2	0.05	0.7	0.3	0.15	0.1	0.3	0.1	0.6	0.2	0.1	2.0	7	4002	G-11
46	0.4	0.6	0.1	1.2	0.05	0.4	0.3	0.15	0.1	0.2	0.1	0.2	0.15	0.05	1.0	5	4113	G-11
47	0.4	0.5	0.1	0.9	0.05	0.3	0.2	0.15	0.1	0.2	0.05	0.2	0.3	0.05	1.5	5	4078	G-11
48	0.4	0.5	0.1	0.66	0.05	0.3	0.2	0.15	0.1	0.2	0.05	0.4	0.56	0.05	0.5	4.22	4002	G-11
	7.40	**11.50**	**8.10**	**107.46**	**3.15**	**18.00**	**25.10**	**21.40**	**5.75**	**24.75**	**13.80**	**48.70**	**18.76**	**15.65**	**90.70**	**420.22**	**4276**	**G-11**

Rajesh Ranjan
GSE (P&M)
TVNL, Hindon, Ranchi-834002
27 DEC 2024

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 3[illegible]7(03)/2014-CPAM
Date: 7015]

Rajesh Ranjan
ESE (P & S)
TVNL, Hinoo, Ranchi-834002
27 DEC 2024

Table No. – 5.21
Year Wise Parting Wise Waste Removal Program

Figures in Mcum

Year	OB	Parting	Parting	Parting	Parting	Parting	Parting	Parting	Parting	Parting	Parting	Parting	Parting	Parting	Parting	Year
		R2/R1	R1/VIIT	VIIT/VIIM	VIIM/VIIB	VIIB/VIT	VIT/VIM	VIM/VIB	VIB/V	V/IVT	IVT/IVM	IVM/IVB	IVB/IIIT	IIIT/IIIM	IIIM/IIIB	wise
Th. (m)	31.5	15.4	76.7	8.1	6.3	25.7	7	8.8	16.5	19.9	8.7	14.8	22.3	11.6	22.2	Waste
1													2	1	2.5	5.5
2													4	2	5	11
3												4.30	7.00	3.70	7.00	22
4							0.7	2.4	4.6	5.90	2.60	4.60	7.00	3.70	7.00	38.5
5						4.30	1.90	2.40	4.60	5.90	2.60	4.60	7.00	3.70	7.00	44
6						4.30	1.90	2.40	4.60	5.90	2.60	4.60	7.00	3.70	7.00	44
7				1.90	1.50	6.90	1.90	2.40	4.60	5.90	2.60	4.60	7.00	3.70	7.00	50
8				1.90	1.50	8.00	1.90	2.40	5.00	6.50	2.80	5.00	8.00	4.00	8.00	55
9				1.90	1.50	8.00	1.90	2.40	5.00	6.50	2.80	5.00	8.00	4.00	8.00	55
10				1.90	1.50	7.50	1.90	2.40	4.60	5.90	2.60	4.60	7.70	3.70	7.70	54
11				1.90	1.50	7.50	1.90	2.40	4.60	5.90	2.60	4.60	7.70	3.70	7.70	52
12				1.90	1.50	7.50	1.90	2.40	4.60	5.90	2.60	4.60	7.70	3.70	7.70	52
13				1.90	1.50	7.50	1.90	2.40	4.60	5.90	2.60	4.60	7.70	3.70	7.70	52
14				1.90	1.50	7.50	1.90	2.40	4.60	5.90	2.60	4.60	7.70	3.70	7.70	52
15				1.90	1.50	7.50	1.90	2.40	4.60	5.90	2.60	4.60	7.70	3.70	7.70	52
16				1.90	1.50	7.50	1.90	2.40	4.60	5.90	2.60	4.60	7.70	3.70	7.70	52
17				1.90	1.50	7.50	1.90	2.40	4.60	5.90	2.60	4.60	7.70	3.70	7.70	52
18				1.90	1.50	7.50	1.90	2.40	4.60	5.90	2.60	4.60	7.70	3.70	7.70	52
19				1.90	1.50	7.50	1.90	2.40	4.60	5.90	2.60	4.60	7.70	3.70	7.70	52
20				1.90	1.50	7.50	1.90	2.40	4.60	5.90	2.60	4.60	7.70	3.70	7.70	52
21				1.90	1.50	6.90	1.90	2.40	4.60	5.90	2.60	4.60	7.00	3.70	7.00	50
22				1.90	1.50	6.90	1.90	2.40	4.60	5.90	2.60	4.60	7.00	3.70	7.00	50
23				1.90	1.50	6.90	1.90	2.40	4.60	5.90	2.60	4.60	7.00	3.70	7.00	50
24				1.90	1.50	6.90	1.90	2.40	4.60	5.90	2.60	4.60	7.00	3.70	7.00	50

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

Year	OB	Parting	Parting	Parting	Parting	Parting	Parting	Parting	Parting	Parting	Parting	Parting	Parting	Parting	Parting	Year
		R2/R1	R1/VIIT	VIIT/VIIM	VIIM/VIIB	VIIB/VIT	VIT/VIM	VIM/VIB	VIB/V	V/IVT	IVT/IVM	IVM/IVB	IVB/IIIT	IIIT/IIIM	IIIM/IIIB	wise
Th. (m)	31.5	15.4	76.7	8.1	6.3	25.7	7	8.8	16.5	19.9	8.7	14.8	22.3	11.6	22.2	Waste
25				1.90	1.50	6.90	1.90	2.40	4.60	5.90	2.60	4.60	7.00	3.70	7.00	50
26	3.20	1.80	28.10	0.60	0.50	2.20	0.60	0.80	1.50	1.90	1.50	1.50	2.30	1.20	2.30	50
27	3.20	1.80	28.10	0.60	0.50	2.20	0.60	0.80	1.50	1.90	1.50	1.50	2.30	1.20	2.30	50
28	3.20	1.80	27.70	1.00	0.50	2.20	0.60	0.80	1.50	1.90	1.50	1.50	2.30	1.20	2.30	50
29	3.20	1.80	27.70	1.00	0.50	2.20	0.60	0.80	1.50	1.90	1.50	1.50	2.30	1.20	2.30	50
30	3.20	1.80	28.20	1.00	0.50	2.20	0.60	0.80	1.50	1.90	1.00	1.50	2.30	1.20	2.30	50
31	3.20	1.80	28.20	1.00	0.50	2.20	0.60	0.80	1.50	1.90	1.00	1.50	2.30	1.20	2.30	50
32	3.20	1.80	28.20	1.00	0.50	2.20	0.60	0.80	1.50	1.90	1.00	1.50	2.30	1.20	2.30	50
33	3.20	1.80	28.20	1.00	0.50	2.20	0.60	0.80	1.50	1.90	1.00	1.50	2.30	1.20	2.30	50
34	3.20	1.80	26.90	1.00	1.00	3.00	0.60	0.80	1.50	1.90	1.00	1.50	2.30	1.20	2.30	50
35	3.20	1.80	26.90	1.00	1.00	3.00	0.60	0.80	1.50	1.90	1.00	1.50	2.30	1.20	2.30	50
36	3.20	1.80	26.90	1.00	1.00	3.00	0.60	0.80	1.50	1.90	1.00	1.50	2.30	1.20	2.30	50
37	3.20	1.80	26.90	1.00	1.00	3.00	0.60	0.80	1.50	1.90	1.00	1.50	2.30	1.20	2.30	50
38	3.20	1.80	26.90	1.00	1.00	3.00	0.60	0.80	1.50	1.90	1.00	1.50	2.30	1.20	2.30	50
39	2.00	1.00	26.66	1.00	1.00	3.00	0.60	0.80	2.50	2.50	1.00	1.41	1.40	1.13	1.00	47
40	2.00	1.00	27.26	1.00	1.00	3.00	0.60	0.80	2.50	2.50	0.80	1.41	1.00	1.13	1.00	47
41	2.00	1.00	27.76	1.00	1.00	3.00	0.60	0.80	2.50	2.50	0.80	1.41	0.50	1.13	1.00	47
42	2.00	1.00	24.12	1.00	1.00	3.00	1.50	1.50	2.50	2.50	0.80	1.48	0.50	1.10	1.00	45
43	2.00	1.00	20.80	1.00	1.00	3.00	1.50	1.50	2.00	2.50	0.90	1.50	0.60	0.50	0.20	40
44	2.00	1.00	21.80	1.00	1.00	3.00	1.50	1.50	1.50	2.50	0.90	1.40	0.20	0.50	0.20	40
45	1.00	1.00	9.25	1.00	1.00	3.00	1.45	1.50	1.50	2.40	0.80	1.20	0.20	0.50	0.20	26
46	1.00	0.50	1.80	1.00	1.00	3.00	1.10	1.10	1.50	2.00	0.20	1.20	0.20	0.30	0.10	16
47	0.83	0.50	0.10	0.75	0.70	3.00	0.80	0.50	0.20	2.00	0.20	1.20	0.20	0.31	0.10	10
48	0.20	0.20	0.10	0.20	0.20	0.21	0.10	0.10	0.10	0.10	0.10	0.19	0.10	0.10	0.10	2
	56.63	**31.60**	**519.00**	**57.25**	**46.40**	**208.40**	**58.15**	**73.30**	**138.30**	**177.20**	**79.10**	**138.20**	**211.50**	**111.00**	**213.00**	**2119.00**

Rajesh Ranjan
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Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
dt 05.2015]

Table No. – 5.22

Maximum & Minimum Depth of Working for Coal Seams

Sl. No.	Seam	Maximum Depth (m.)	Minimum Depth (m.)
1.	R2	64	27
2.	R1	65	19
3.	VII Top	197	29
4.	VII Middle	210	5
5.	VII Bottom	217	5
6.	VI Top	277	19
7.	VI Middle	307	21
8.	VI Bottom	310	19
9.	V	313	23
10.	IV Top	337	27
11.	IV Middle	372	27
12.	IV Bottom	388	19
13.	III Top	439	19
14.	III Middle	443	18
15.	III Bottom	474	33

5.13 EQUIPMENT SELECTION & CONFIGURATION

5.13.1 General

Geology of the coal deposit, annual production capacity of coal and stripping ratio primarily guide the requirements of equipment for a mine. In case of this project, the open pit mining has been envisaged for the extraction of the reserves. Therefore, Opencast Mining equipment have been selected to match the work load of 10 MTPA coal and about 50 Mbcm of annual waste rock removal. The choice of excavators, matching dumpers and other support equipment are discussed here after.

Rajesh Ranjan
ESE (P & S)
TVNL, Hirak, Rajbar
21 DEC 2024

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 3/012/(03)/2014-CPAM
Dated- 29.05.2015]

5.13.2 Choice of Mining Equipment

The following options could be considered for selection of equipment for an open cast project

1) Dragline
2) Bucket wheel excavator
3) Surface miners
4) Shovel dumper combination with or without IPCC combination

5.13.2.1 Dragline

The possibility of deploying dragline(s) at this mine has been examined: Dragline is ideally suitable for:

i. Low gradient coal seam dipping at angle not exceeding 6^0 (1 in 10)

ii. Either single seam deposit or the lowest seam out of a number of seams can also be worked provided the burden over it is not more than about 40 m.

iii. Geologically undisturbed coal deposit. The property should rather be free from geological disturbances. A dragline system works with a rigid operational geometry. Frequent changes in the geometry causes serious difficulty in its efficient operation.

iv. Long strike length say around 2 to 3 kms.

Rajbar deposit does not meet the basic requirements as appearing at item i, ii & iii above. Therefore, use of dragline has been ruled out.

5.13.2.2 Bucket wheel excavator

Bucket wheel excavator has been ruled out due to unfavorable seam gradient, multi seam and deep seated coal deposits. More importantly the hard rock of strata in this coalfield are not suitable for mining by bucket wheel excavator.

5.13.2.3 Surface Miner for Coal Winning.

Surface miner is suitable for thin seams and a gradient upto a maximum of 1 in 4. Surface miner requires large coal exposures which is possible only with long face length and reasonably good bench width. Application of Surface

Rajesh Ranjan
ESE (P&E)
21 DEC 2021

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Miner therefore, finds favour because of presence of multiple thin seams with variable thickness down to nil. Thus the deposit meets the necessary pre-requisite for application of the miner for its long faces and adequate width. Therefore, with favorable gradient of 1 in 7.5 and multi thin variable thickness seam situation, use of Surface Miners finds favour for this coal deposit.

5.13.2.4 Inpit Crushing and Conveying (IPCC) for Coal

IPCC for coal has not been selected in view of multiple thin seams and complicated arrangement needed for truck movement by providing bridge conveyor. Advantage of reduced truck lead can be partly met by installing a trunk belt close to Northern edge of quarry to carry coal upto CHP. Thus IPCC for coal does not suit multiple thin seam of Rajbar.

5.13.2.5 Inpit Crushing and Conveying (IPCC) for Waste

The maximum depth of mine goes to 474 m. This would require backfilling of waste in multiple layers. IPCC for waste would need multiple mobile stackers which would complicate the entire system with its rigidity and demand for hard discipline. The system becomes capital intensive and operational cost increases. Therefore IPCC is rejected for waste removal.

5.13.2.6 Shovel - Dumper for Waste Removal

Deployments of shovel and truck are considered suitable for waste removal under the following geological and mining situation for a coal deposit.

- Seam gradients ranging from 0^0 to 7.5^0 are suitable for in-seam-mining. The range is suitable for intervening partings as well.
- Steeper seam gradients demand level slicing instead of in seam workings. The shovel truck combination can easily adapt to this condition also.
- Shovel truck combination can mine seams dislocated by faults by making changes in bench direction if need be. The system has built in flexibility.
- Shovel dumper technology is well established. Skilled persons are easily available to operate and maintain the system.

Rajesh Ranjan
ESE (P & S)
TVNL Hinoo, Ranchi-834002
27 DEC 2014

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

5.13.3 Selected Technology for Coal Extraction & Waste Removal

5.13.3.1 Coal Extraction

Coal would be cut by surface miner with 1000 cum/hr cutting capacity. A surface miner with 2.2 m body width and 9 m length fitted with 3.8 m cutting drum is available which suits narrow coal bench of 25 m. Despite small body dimensions, such miners do have capacity of 1000 cum/ hr. It is planned to operate the miner in windrowing mode where in cut coal is laid on the floor Wheel loaders with 18 cum bucket. In combination with 100 t coal body dumpers would get loaded in 5-6 passes. Two trunk belts each of 2000 t/ hr capacity would be laid along Northern floor edge of the mine starting from receiving pit of CHP to collect these coals from operating surface miners. With four nos. of surface miners an average coal production of 2500 t/ hr would be reached. The annual capacity of 10 Mt per year would be comfortably achieved. As there are 15 layers of coal to be cut by four surface miner, a lot of time is likely to get involved in changing over from one coal seam to the other. Therefore higher capacity built up has been planned to cover time wasted in change over from one seam to the other. Coal benches are 2-3 km long which would provide a good productive run for the miner.

5.13.3.2 Waste Removal

It is proposed to deploy 40 m^3 hydraulic backhoe in conjunction with Rear Dumper of 360 t capacity for top waste removal and some thick inter seam parting specially between Seam R1 & VII. Higher capacity shovel dumper combination allows higher but smaller no of benches. This in turn creates higher overall face angle. Excavation area is reduced and additional coal bearing area is made available for temporary waste dump. This planning addresses major problem of waste accommodation

The medium thick intervening partings would be handled by 12m^3 Hydraulic Backhoe and transported by 120 t Rear Dumper.

Rajesh Ranjan
27 DEC 2024

Vijay Kumar Singh
(Recognized Qualified Person)
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The top waste benches and thick inter seam partings, would have horizontal and would be mined by horizontal slicing method. However, for other waste benches in seam mining would be practiced in the inter burden waste. In case of 40 m^3 backhoe the maximum height of bench would be maintained at 20 m. Benches 20 m high would also be formed for the thick inter seam parting below seam R-I. For 12 m^3 hydraulic backhoe, the bench height would be equal to thickness of parting and up to a height of 12 m.

5.13.3.3. Transport of Coal

Sized coal would be dropped at the floor by the miner. 18 cum FEL would load this coal into 100t coal body dumper. The loaded dumper would move towards North edge of the mine to unload it into Hopper /feeder for being picked up by belt conveyor to move it to CHP at North-East corner. Coal/ waste faces have been aligned at 30^0 off strike direction upto 30^{th} year stage. This face direction yields a negotiable gradient for truck movement on face.

5.13.3.4. Transport of Waste

Waste trucks would move either for temporary dumping over coal bearing area or to decoaled area for backfill dumping. Coal/ waste faces have been kept at 30^0 off strike direction upto 30^{th} year stage. This yields a negotiable gradient for truck movement on face. As strike direction changes towards West face angle has been given a swing towards North. This change has helped to keep the ultimate mine void at minimum depth and fill up decoaled deep mine area with maximum possible waste. Trucks would move towards comfortable ramps either to reach temporary dumps or to back filling area. Back fill dump has 20m step. The roads are 25m wide. These backfill roads join face benches through matching ramps.

5.13.3.5 Transport to Workshop, Store, CHP & Office

A peripheral road garlands excavation area. It is connected with CHP at North-East corner and workshop, store and office etc. on the South side. Wherever required temporary roads have been planned to provide connectivity as envisaged.

Rajesh Ranjan
ESE (P&T)
TVNL Hinoo, Ranchi
27 DEC 2018

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

5.13.3.6 System Parameters

Important system parameters for coal & waste are given below:

5.13.3.6.1 For 40 m^3 hydraulic backhoe working in Top OB benches and some inter burden partings.

1) Height of the bench	-20 m
2) Width of the working bench	-40m
3) Width of the non-working bench	-25m
4) Face wall angle of the bench	- 70^0

5.13.3.6.2 For 12 m^3 hydraulic backhoe working on the inter burden parting and coal benches.

1) Height of the bench	-12 m
2) Width of the working bench	-30m
3) Width of the non-working bench	-20m
4) Face wall angle of the bench	- 70^0

5.13.3.6.3 For 18 m^3 FEL working in the coal seam.

1) Height of the bench would equal to thickness of coal seam
2) Width of the working bench -25m to 40m
3) Width of the non-working bench -25m
4) High wall angle of the bench -70°

5 m^3 Front End Loader would also be engaged for mop up operation.

The above parameters may be modified according to the actual working condition. The high wall angle for the soft rock bench would not be steeper than 45°. South and West high wall angle would be around 40^0 where in depth of high wall goes beyond 250 m.

In this mining plan, it has been envisaged that the mine would be worked for 330 days per annum i.e. 7 days per week. The mine shall operate round the clock with 8 hour shifts.

Rajesh Ranjan
TVNL, Hindi, Ranchi

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Vijay Kumar Singh
(Recognised Qualified Person)
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5.13.4 Annual Productivity of Shovel and Dumpers

The annual productivity of shovel with matching dumper combination adopted in this project as per the prevalent norms is given below:

Table No. – 5.23

Particulars	Materials to be removed	Annual Productivity
40 Cum Hydraulic Backhoe + 360 t Rear Dumper	Waste	11.6 Mbcm
12 Cum Hydraulic Backhoe + 120 t Rear Dumper	Waste	3.24 Mbcm
3.8 m drum surface miner	Coal	1500 tph
18 Cum FEL	Coal	3 Mt per year
100 t Coal Body Dumper	Coal	0.6 Mt per year

Vijay Kumar Singh
(Recognised Competent Person)
[Recognition No. [illegible]/2014-CPAM
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Rajesh Ranjan
ESE (P & S)
TVNL, Hinoo, Ranchi-834002
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5.13.5 Requirement of Major Equipment for the Mine

The table below provides for loading equipment and matching transporting equipment. For meeting the average annual output of 10 Mt of coal and 52 Mm^3 of waste rock, the assessed population of loading and transporting equipment is given below.

Table No. – 5.24

Assessed Population of Cutting, Loading & Transporting Equipment

Figure in Mbcm for Waste & Mt for Coal

Shovel/ Loader Type	Bucket Capacity in Cum/ Spec	Material to be Handled	Annual Cap/Equipt in Mbcm/ Mt	No of Shovel/ FEL	Annual Capacity of Equipt Mbcm/ Mt	Matching Dumper Capacity in t	Annual Capacity of Dumper in Mbcm	No of Dumper	Annual Output	Material wise Total Output
Hyd. Backhoe	40	OB	11.60	3	34.80	360	1.75	20	35.00	
Hyd. Backhoe	12	OB	3.24	6	19.44	120	0.57	34	19.38	52 Mbcm
				9	**54.24 Mbcm**			**54**	**54.38**	
Surface miner	3.8m Drum	Coal	5.00	4	20.00					
Front End Loader	18	Coal	3.00	4	12.00					
Coal Body Dumper	100t	Coal	0.60	20	12.00	100	0.60	20	12	10 Mt
	Total				**44.00 Mt**			**20**	**12**	

Rajesh Ranjan
TVNL, PHQ, Ranchi-834002
ESE (Mining)
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Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
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5.13.6 LIST OF MAJOR HEMM

The list of major mining equipment up to 40th year has been given in Table No.- 5.25 for covering population and auxiliary jobs.

Table No. – 5.25
List of HEMM

Operation	Item	Mining Equipment	Equipment Capacity	Total No. of Eqpt.	Year 1	Year 3	Year 5	Year 10	Year 20	Year 30	Year 40
Waste Removal	i. Drilling	Blast Hole Drill	383 mm	3	-	1	2	3	3	3	3
		Blast Hole Drill	250 mm	6	2	3	6	6	6	6	6
	ii. Loading	Hydraulic Backhoe	40 Cum	3	-	1	3	3	3	3	3
		Hydraulic Backhoe	12 Cum	6	2	4	6	6	6	6	6
	iii. Transport	Rear Dumper	360 t	20	-	7	20	20	20	20	20
		Rear Dumper	120 t	34	12	23	34	34	34	34	34
	System Capacity				**6.48**	**24.56**	**54.24**	**54.24**	**54.24**	**54.24**	**54.24**
	Target Capacity				**5.5**	**22**	**44**	**54**	**52**	**50**	**47**
Coal Production	i. Drilling	Blast Hole Drill	250 mm		*						
	ii. Coal Cutting	Surface Miner	3.8 m drum	4	*	1	2	3	4	4	4
	iii. Loading	Front End Loader	18 Cum	4	1	2	3	4	4	4	4
	iv. Transport	Coal Body Dumper	100 t	20	3	7	14	20	20	20	20
		Trunk Belt	2000 tph	2 sets	*	1	2	2	2	2	2
		Mobile Belt	2000 tph	10 sets	*	2	4	10	10	10	10
		Mobile Hopper & Apron Feeder	2000 tph	5 sets	1	2	3	5	5	5	5

Rajeev Ranjan
ESE (P & S)
TVNL, Hatia, Ranchi-834002
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Vijay Kumar Singh
[Recognised Qualified Person)
[Recognition No. 3402/(03)/2014-CPAM
Dated- 29.05.2015]

Operation	Item	Mining Equipment	Equipment Capacity	Total No. of Eqpt.	Year 1	Year 3	Year 5	Year 10	Year 20	Year 30	Year 40
	System Capacity				3.24	4	8	12	12	12	12
	Target Capacity				1	4	8	10	10	10	10
Road , Drain & Culvert	i.	Wheel Dozer	350 Kw (45 t class)	1	1	1	1	1	1	1	1
	ii	Track Dozer with Ripper	300 Kw	4	1	1	2	3	4	4	4
	iii	Motor Grader	16 Ft Blade (200 Kw)	4	1	1	2	3	4	4	4
	iv	Vibratory Compactor	25 t	4	1	1	2	3	4	4	4
	v	Water Sprinkler	40-45 Kl	4	1	1	2	3	4	4	4
	v	FE Loader	5 Cum	1	1	1	1	1	1	1	1
	vi	FE Loader	2 Cum	1	1	1	1	1	1	1	1
	vii	Diesel Back hoe (20 t class)	1 Cum	1	1	1	1	1	1	1	1
Maintenance & Safety Equipment	i	Crane	100 t	1	1	1	1	1	1	1	1
	ii	Crane	40 t	1	1	1	1	1	1	1	1
	iii	Crane	8 t	1	1	1	1	1	1	1	1
	iv	Boom Truck		4	1	1	2	3	4	4	4
	v	Heavy Duty Toe Truck		2	1	1	1	1	2	2	2
	vi	Tyre Handler		2	1	1	1	1	2	2	2
	vii	Mobile Maint. Van		4	1	1	2	3	4	4	4
	viii	Fire Tender		2	1	1	1	1	2	2	2

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
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Operation	Item	Mining Equipment	Equipment Capacity	Total No. of Eqpt.	Year 1	Year 3	Year 5	Year 10	Year 20	Year 30	Year 40
Supplies & Transport	i	Diesel Bowser		4	1	1	2	3	4	4	4
	ii	Fork Lift	8 t	2	1	1	1	1	2	2	2
	iii	Line Truck	20 t	2	1	1	1	1	2	2	2
	iv	Tipping Truck	8 t	6	3	3	3	5	6	6	6
Reclamation & Envt. Mgt	i	Motor Grader	16 Ft Blade 200 Kw	2	1	1	1	1	2	2	2
	ii	Dozer	300 Kw	4	1	1	2	3	4	4	4
	iii	Water Sprinkler	40-45 Kl	4	1	1	2	3	4	4	4
	iv	Farm Tractor		4	1	1	2	3	4	4	4

* - It is envisaged that surface miner would not have sufficient exposed coal layer during the 1st year stage. One of the 250 mm drills provided for OBR, would be temporarily diverted to drill hole over exposed coal bench to prepare coal by blasting. Coal would be loaded by 18 cum wheel loader into 100 t CBD to meet the target of 1 Mt production of coal during 1st year stage. From 2nd year onwards surface miner would take over preparation of coal as alternative to drilling blasting in coal for the entire balance life of the mine.

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 3401/2/03/2014-CPAM
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5.14 STAGE WISE OPERATIONAL DETAILS

1st year of mine operation

During the 1st year of mine operation, access trench would be made and mine would start from the North-East corner in the incrop area of III B Seam. The excavated area reaches to 20 ha. During 1st year, 1.0 Mt of coal would be extracted and 5.5 Mm^3 of overburden would be removed. Two 12 m^3 Hydraulic Back Hoe (HBH) in combination with 12 nos. of 120 t dumpers would be deployed for waste removal. One 18 m^3 Front End Loader (FEL) in combination with 3 nos. of 100 t Coal Body Dumpers (CBD) would be deployed for coal extraction and transport to coal crusher at CHP. Coal would be broken using 250 mm drill meant for waste removal and acquired 6 months before its schedule of commissioning. The mine is expected to reach a maximum depth of 60 m. This stage is shown on Plate No. – 15 A.

3rd year of mine operation

During 3rd year of mine operation, mine would go deeper and haul road along Northern edge would proceed, from East to West, in the apparent dip direction (1in 14) as shown on the 3rd year stage plan, Plate No. – 15 B. During 3rd year, 4.0 Mt of coal would be extracted and 22 Mbcm of overburden would be removed. By 3rd year, 1 no. of surface miner such as 2200 SM 3.8 m of Wirtgen would be deployed at the end of first year itself in windrowing mode. An average UCS coal bed of 15-20 MPa would enable cutting of 1000 m^3/hr (1500 t/hr) of coal. This coal would be loaded by 18 m^3 wheel loader (FEL) in combination with 7 nos. of Coal Body Dumpers (CBD). One no. 40 m^3 Hydraulic Backhoe (HBH) and four nos. of 12 m^3 HBH would be deployed with 7 no. of 360 t and 23 no. of 120 t dumpers respectively. By 3rd year end, cumulative quantity of 7.0 Mt of coal would have been extracted after removing 38.5 Mbcm cumulative waste rock. The mine reaches a depth of 123 m. The excavated area goes up to 96 ha. Total waste of 38.5 Mm^3 would be placed over coal bearing area as temporary dump. This stage is shown on Plate No. – 15 B.

Vijay Kumar Singh
(Approved Person)
(Reg. No. 2014-CPAM
...15.2019)

Rajesh Rahan
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5th year of mine operation

During 5th year of mine operation, Quarry will advance towards dip side as shown on Plate No. – 15 C. During 5th year, 8.0 Mt of coal would get extracted and 44 Mbcm of overburden would be removed. At this stage, 2 no. of 1000 m^3/hr (1500 t/hr) surface miner, 3 nos. of 18 m^3 FEL would be deployed for coal winning in combination with 14 no. of 100t CBD. Further, 2 nos. of 40 m^3 Hydraulic Backhoe & 6 nos. of 12 m^3 hydraulic BH in combination with 20 nos. of 360 t and 34 nos. of 120 t dumpers would be deployed for overburden. By the end of 5th year, 22 Mt of coal would have been extracted after removing 121 Mbcm of waste. The maximum depth of mine remains at 123 m as metamorphic floor rises towards South. Out of 121 cumulative waste generated, 96 Mbcm would be dumped over temporary waste dump over 172 ha in one layer of 30 m height. Balance 25 Mm^3 would be backfilled as internal dump. The excavated area covers 153 ha. The details are shown on Plate Nos. – 15 C & 15 I. The green belting of infra areas, barrier areas, office & township would get completed by 5th year.

10th year of mine operation

Plate no. – 15 D shows the position of mine at the end of 10th year. The mine reaches a capacity of 10 Mt for coal & about 55 Mbcm for waste rock. Coal production deploys 3 surface miners, 4 -18 m^3 FEL to achieve rated capacity of 10 Mt for coal. The cumulative coal production at the end of 10th year would be 69 Mt. Removal of waste would require deployment of 3 nos. of 40 m^3 & 6 nos. 12 m^3 HBH. The cumulative waste removal at end of 10th year would be 379 Mbcm. Mine would reach a depth of 301 m. Mine would have exposure of about 3123 m North-South & 990 m in East-West. The excavated area reaches 439 ha. After 10th year, mine would continue to progress in West direction. Out of 379 Mbcm cumulative waste generated, about 233 Mbcm would go to as internal dump. The balance 146 Mbcm is proposed to be put in temporary dump over an area of 262 ha in three layers each of 30 m. Of this 262 ha, about 100 ha starting from East side shall be covered by perennial green grasses to improve the ecology. Stage plan for 10th year is shown in Plate No. – 15 D.

Rajesh Rajbar
TVNL Hmkg.
21 DEC 20

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The perennial greening of temporary dump covering about 100 ha gets completed by 10th year. Greening of top soil dump, would also be covering about 11.6 ha completed within 7th – 8th year of mine life.

20th year of mine operation

The mine remains operating at 10 MTPA of coal production from 8th year to 20th year. The waste remains at 52 Mbcm PA from 11th year onwards. One more surface miner would be added during 20th year to make up for loss due to unproductive movement for numerous thin coal benches. Coal at this stage would be loaded by four 18 m^3 FEL into 20 nos. of CBD. For waste three nos. of 40 m^3 & 6 nos. 12 m^3 HBH continue to be deployed loading into 20 nos. of 360 t and 34 nos. of 120 t dumpers. Cumulative coal extracted till 20th year stage is planned to be 169 Mt. Cumulative waste reaches 899 Mbcm at this stage. The mine excavation extends to 3069 m along North-South and 1142 m along East-West. Maximum depth increases to 316 m. The excavated area goes up to 617 ha. Temporary dumped waste covers 384 ha. 250 ha area of temporary waste is proposed to be covered with perenial grass during this stage between 11th year and 20th year. This stage plan is shown in Plate no.–15 E.

30th year of mine operation

The mine remains operating at its peak rating of 10 MTPA coal and 50 Mbcm PA waste during this stage.

Till 30th year stage, 269 Mt of coal production and 1399 Mbcm of waste generation is estimated. Temporary dumping continues till 22nd year. Rehandling of 229 Mm^3 temporary dump would start from 23rd year and continue till 39th year. By 39th year rehandling of 229 Mm^3 would be complete. Till 30th year, the rehandled waste from temporary dumped area comes to 84 Mbcm. The excavated area goes up to 916 ha extending 3072 m along North-South and 3369 m along East-West. A depth of 474 m is reached which is maximum for the mine. The temporary dump area during 20th – 30th year stage reaches peak of 410 ha by 22nd year end. The 60 ha of this dump (410 – 350) would be perennially greened during 23rd year, for ecological compatibility. The stage is shown on Plate No. – 15 F and 15 J.

Rajesh Ranjan
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Vijay Kumar Singh
(Person)
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40th year of mine operation

After 30th year South end mine face has taken a swing towards North. This allows ultimate mine void to stay along the rise most edge of excavation. Thus ultimate void is kept at the minimum depth and therefore at minimum volume. This strategy has the effect on achieving maximizing of backfill volume. A road at the floor of the mine is maintained at highest level in well drained condition.

Peak production of 10 MTPA starts tapering down from 41st year and waste removal also tapers down. A cumulative rehandling of 229 Mbcm temporary dump would have been completed by 39th year. Cumulative coal production up to this stage is 369 Mt and cumulative waste is 1893 Mbcm excluding rehandling. Therefore, total waste backfilled remains at 1893 Mbcm. The depth decreases to 364 m as mine goes in rise area. Excavated area would become 1138 ha. The mine extends to 3124 m along North-South and 4490 m along East-West. The stage plan for this is shown in Plate No. – 15 G. A 20 ha 5 m high 1 Mm^3 capacity soil dump is created temporarily over 450 m R.L. ground level backfill to serve till post mining top soil spreading.

48th year – Final year stage of mine operation

The total coal produced from the mine would be 420.22 Mt. Total waste removal would be 2119 Mbcm. This total waste would be getting backfilled in excavated area. A void area of 280 ha would get created along the Northern boundary at minimum possible depth. This void volume is estimated at 220 Mm^3. The stage plan is shown in the final dump plan in Plate No. – 15 H & 15 K.

5.15 SCOPE OF HIGH WALL MINING FROM COAL RESERVE LOCKED IN BATTER

The mine is starting from East side and progresses in dip direction towards South and West side till 30th year. The dip most level of R.L. 474 m is reached in 30th year. Thereafter, mine workings turn towards North, for working the shallower reserves, for keeping the ultimate void along Northern edge with minimum depth. North side has metamorphic high areas and hence shallow batters. The batter coal is mainly concentrated in West side (dip side) where about 75% of batter coal exists.

Rajesh Ranjan
ESE (P&S)
TVNL, Hindo, Ranchi
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Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012(03) 2013-CPAM
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However, the extremely high stripping ratio of 1:5.04 for the mine, does not allow any void area to be left near high walls for establishing a system for high wall mining. The backfilling of available mine void is continuously required to keep the mine running. Therefore, possibility of high wall mining in this situation appears infeasible.

5.16 WASTE MANAGEMENT

General

Waste management in open pit mining is an important and basic activity. In the instant mine, a very high ratio of 1:5.04 has been estimated as can be seen from the calendar plan of production on pages V – 27 & 28. In first 22 years of the mine life, part of the excavated waste rock is proposed to be accommodated as temporary dump in the proposed excavation area itself. From 1st year to 22nd year, temporary dumping of part of removed waste continues. Its volume has been assessed at 229 Mbcm and it covers an area of 410 ha. From 23rd year onwards temporary dump would be rehandled back to decoaled area. It continues till 39th year. Backfilling starts from 5th year itself and continues till 48th year, the last operating year of this mine. These details are given in table no. – 5.26.

Now waste management principles and other aspects are discussed in detail in subsequent paragraphs.

5.16.1 Waste Dump Design

5.16.1.1 The guiding principle of designing an overburden dump is to minimize use of land area for dump accommodation. In the first 22 years, part of the generated waste will be accommodated in temporary dump area, over the West side of the proposed quarry. Back filling of waste into mine void is envisaged from 5th year itself. The initial top soil would be stacked on North-West side over the coal bearing area. Temporarily dumped waste would be rehandled from 23rd year onwards for being finally placed in the decoaled areas. From 5th year itself back

Rajesh Ranjan
ESE(P&S)
NTPC, Ranchi-834002
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filling would be done in two layers **agl** & **bgl** with 60 m gap in between the **agl** & **bgl** dumps. The **agl** dumping will start in the de coaled area, from East side, once the **bgl** dumping covers sufficient area upto ground level profile, for allowing **agl** dumping.

The quarry, has been started in N-E quadrant from seam III B incrop area. During the initial years of mine operation, working benches have been kept nearly along North – South direction. During 1st to 5th year period, quarry keeps moving with thrust towards South side to reach excavation limit on South side. By 6th year of mine operation, the quarry advance changes direction and pushes towards West direction, keeping South edge upto excavation limit. This decision to progress in the West direction has been taken for following reasons:

i. For establishing sustainable internal dumping space in the excavated area.
ii. The North-South alignment of the face, in initial years helps to reach the South limit of the quarry and allow adequate volume of void for backfilling with solid metamorphic wall to support the waste on South side.
iii. Provides an in seam gradient of 1 in 15 to facilitate truck movement on benches and occasionally on the floor of the mine.

5.16.1.2 The temporary dump is planned to be located beyond estimated quarry advance till 22nd year. This would minimize cost of re handling during 23rd year to 39th year as mine void area would be adjacent to temporary dumps.

Each deck of internal waste dump is planned to be of 30m height and berm width has been planned to be 25 m. Thus overall slope of dump has been planned at 24.8^0 while the slope of individual dump bench would be at 37^0 i.e. natural angle of repose of waste rocks. Quarry face alignment continues till 30th year stage.

After 40th year of mine life South end face would swing towards North and North end of face would remain anchored. The face would progress towards North to finally reach the East edge of incrop region. An open area of about 280 ha is left out as **bgl** area (void area), with minimum depth possible at close of mining operation at 48th year end.

Rajesh Ranjan
ESE (P & S)
TVNL, Hindpi, Ranchi-834002
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Vijay Kumar Singh
(Recognised Competent Person)
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5.16.1.3 Management of Rain Water

For safety of mine from rain water, garland drain around dump area would be created to arrest water from dumps. The slopes and the berms would be vegetated. Gullies would be provided to guide water from higher deck to lower deck without causing any erosion and deformation.

5.16.1.4 Precaution for Stability of Temporary Dump

Before temporary dump formation, it would be ensured to excavate the top soil, sub soil and Weathered Mantle (W.M.) from the surface which is to accommodate the temporary dumps. Some ripping to create rugged floor surface, before start of dumping would also to be undertaken with the help of dozer fitted with ripper where the ground is plain.

5.16.2 Nature of Waste Rock

The bulk of the overburden rocks are represented by sandstone and shale followed by their intermediate varieties, i.e. carbonaceous shale, intercalation of shale and sandstone and sandy clay.

The rocks are fine to medium grained sandstone, siltstone, sandy shale, carbonaceous shale & coal seams of Barakar & Raniganj Formation. Presence of greenish, medium to coarse grained feldspathic sandstone with predominant black shale of Barren Measure formation is also seen. Rocks of Barakar Formation are grey to greyish white, fine to coarse-grained cross-bedded and laminated arkosic sandstone, pebble beds, conglomerate and grey to carbonaceous shale, coal seams and fire clay.

Shale is normally a combination of argillaceous and arenaceous varieties and occur both as in-seam burden and seam partings.

The coal block is also seen to be covered by mixed type of soil i.e. sandy, clayey and loamy varieties.

There are no rock layers showing signs of acidity etc.

Rajesh Ranjan
ESE (P&D)
TVNL, Tenughat, Ranchi-834002
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Vijay Kumar Singh
(Competent Person)
[Reg. No. 3/2014-CPAM
Dated- 2[illegible]2015]

5.16.3 Sequence of Mining/ Excavation

It has been proposed to open the face of the mine, starting from North-East Sector of the block with face along North South close to metamorphics after leaving a corridor 30 m to 20 m for coal tube belt, garland drain, peripheral plantation and a 7.5 m wide peripheral road. Seam III B would be the lowest workable seam in North-East segment, where mine is starting. The quarry continues to progress towards South till 5th year of the quarry progress. Having opened the North-South alignment of quarry face; from 6th year the quarry advances in the West direction. This helps to initiate internal dumping from 5th year of mine life. The internal filling upto ground level forms the **bgl** back dump bench. Another layer of waste rock is formed with 30 m height of each bench and such three benches are formed above ground level (**agl**). These two layers, one **agl** and another **bgl**, together absorb the increasing quantity of waste rock as the quarry advances towards West with increasing depth. The rehandling of temporary dump continues till 39th year, till total temporarily dumped waste gets backfilled.

Final stage dump plan, as well as other stage plans show the location of internal & temporary dumps in respective stages showing height of dump and area of coverage along with quantity of waste in the dumps. The table no. 5.26 being shown here after, gives the detailed dumping schedule of waste rock over the 48 years of mine life. From the table it can be seen that the temporary dump of 229 Mbcm, put during 1st year to 22nd year, cover an area of 410 ha. This is being rehandled and finally disposed in the backfilled area of the mine from 23rd year to 39th year of the mine life.

5.16.4 A Mass Balance of Waste Rock

Average grade of coal is G11 and therefore specific gravity of coal has been taken as 1.65. As waste is proposed to be compacted by dozer and roller, the expansion factor has been taken at 1.13.

Bank Volume of Coal = 420.22/1.65 = 255 Mm^3.

Bank Volume of Waste = 2119 Mm^3.

Total volume of excavation = 2119 + 255 = 2374 Mm^3.

Expanded volume of waste dump = 2119 X 1.13 = 2394 Mm^3.

Rajesh Ranjan
TVNL, Hinoo, Ranchi-834
27 DEC 2024

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 3402/(03)/2014-CPAM
Dated- 29.05.2015]

If the mine is filled up completely at ground level, there is spill over of 20 Mm^3 of waste. However, there is a final void volume of 220 Mm^3 to be left at the close of the mine for water lagoon. The agl layer of waste is 90 m high above ground level covering about 502 ha area accommodates these 240 Mm^3. Thus entire bank volume of 2119 Mm^3 is accommodated as internal dump in two layers, first being bgl i.e. upto ground level (450/420 RL) and second 90 m above ground level (540 RL). Therefore accommodation of O.B. is balanced. Further, there is sufficient cushion of extending agl dump beyond present limit. Therefore, accommodation of overburden has been duly considered in the mine layout.

5.16.4 B Phased Programme of Dumping

The phased programme of waste removal, showing its disposal as temporary dumping and internal dumping is given in the table hereafter. The table also shows rehandling of temporary dumps for its internal backfilling.

Table No. – 5.26
Dumping Schedule (Figure in Mbcm)

Years	Temporary Dump		Rehandling		Internal Dump		Total	
	Annual Waste in Mbcm	Cum Waste in Mbcm	Annual Waste in Mbcm	Cum Waste in Mbcm	Annual Waste in Mbcm	Cum Waste in Mbcm	Annual Waste in Mbcm	Cum Waste in Mbcm
1	2	3	4	5	6	7	8	9
Y-1	5.5	5.5					5.5	5.5
Y-2	11	16.5					11	16.5
Y-3	22	38.5					22	38.5
Y-4	38.5	77					38.5	77
Y-5	19	96			25	25	44	121
Y-6	10	106			34	59	44	165
Y-7	10	116			40	99	50	215
Y-8	10	126			45	144	55	270
Y-9	10	136			45	189	55	325
Y-10	10	146			44	233	54	379
Y-11	7	153			45	278	52	431
Y-12	7	160			45	323	52	483
Y-13	7	167			45	368	52	535
Y-14	7	174			45	413	52	587
Y-15	7	181			45	458	52	639
Y-16	7	188			45	503	52	691
Y-17	7	195			45	548	52	743
Y-18	7	202			45	593	52	795
Y-19	7	209			45	638	52	847
Y-20	5	214			47	685	52	899

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 2012/(03)/2014-CPAM
Dated- 29.05.2015]

Rakesh Ranjan
27 DEC 2024

Years	Temporary Dump		Rehandling		Internal Dump		Total	
	Annual Waste in Mbcm	Cum Waste in Mbcm	Annual Waste in Mbcm	Cum Waste in Mbcm	Annual Waste in Mbcm	Cum Waste in Mbcm	Annual Waste in Mbcm	Cum Waste in Mbcm
Y-21	9	223			41	726	50	949
Y-22	6	229			44	770	50	999
Y-23			5	5	50	825	50	1049
Y-24			7	12	50	882	50	1099
Y-25			10	22	50	942	50	1149
Y-26			10	32	50	1002	50	1199
Y-27			12	44	50	1064	50	1249
Y-28			12	56	50	1126	50	1299
Y-29			14	70	50	1190	50	1349
Y-30			14	84	50	1254	50	1399
Y-31			16	100	50	1320	50	1449
Y-32			16	116	50	1386	50	1499
Y-33			18	134	50	1454	50	1549
Y-34			18	152	50	1522	50	1599
Y-35			16	168	50	1588	50	1649
Y-36			16	184	50	1654	50	1699
Y-37			16	200	50	1720	50	1749
Y-38			16	216	50	1786	50	1799
Y-39			13	229	47	1846	47	1846
Y-40					47	1893	47	1893
Y-41					47	1940	47	1940
Y-42					45	1985	45	1985
Y-43					40	2025	40	2025
Y-44					40	2065	40	2065
Y-45					26	2091	26	2091
Y-46					16	2107	16	2107
Y-47					10	2117	10	2117
Y-48					2	2119	2	2119

5.16.5 Temporary Dumping

The status of temporary dumping may be seen in stage plans. Final status of the temporary dump (by 22nd year) is given below:

Table No. – 5.27
Details of Temporary Dump

Peak Height (m)	No of decks	Height of each deck (m)	Quantity of Waste in the dump (Mbcm)	Spread Area in ha
90 agl	3	30	229	410

Rajesh Ranjan
ESE
TVNL Hindi
21 DEC 2015

Vijay Kumar Singh
(Recognised Qualified Person)
(Recognition No. ...(03) 2014-CPAM
Dated- 20.05.2015)

5.16.5.1 Management of Temporary Waste Dump

The temporary dump, generated from 1st year to 22nd year would accumulates to about 229 Mbcm. It would be rehandled from 23rd year. This waste covers about 410 ha of land. All this 410 ha of land would be grassed with perennial green grasses to make it environmentally compatible. Greening would be completed in stage of 6th – 10th year; 11th year to 20th year and 21st to 23rd year with area of 100 ha, 250 ha and 60 ha in three stages.

5.16.6 Top Soil Storage & Spreading

A temporary space of 20 ha has been earmarked at North-West region of coal bearing area beside temporary dump for temporary storage of about 2.2 Mm^3 of top soil. The stage plans from 1st year to 30th year may be seen for the location of top soil storage. After 30th year stage the place of storage of top soil has been changed to ground level (450 m R.L.) backfill over an area of 20 ha. This may be seen in the plan for 40th & 48th year stage (Plate No. – 15 G & 15 H). Stage wise spreading of top soil has been given hereafter. Table no. 5.28 provide stage wise breakup of rock waste and top soil. Table no. 5.29 provides further detail of generation and spreading of top soil for all the stages and post mining period also.

Table No. – 5.28

Waste Management covering Top Soil Management (Figures in Mm^3)

Year/ Stage	Cumulative OB Removal			Temporary Dump (Cumulative)		Internal Dump/ Backfilling (Cumulative)		Embankment & Green Belt (Cumulative)	
	Top Soil	OB	Total Waste	OB	Top Soil	OB	Top Soil	OB	Top Soil
1st Year	0.1	5.4	5.5	5.0	–	–	–	0.4	0.05
3rd Year	0.4	38.1	38.5	38.15	0.25	–	–	–	0.10
5th Year	0.6	120.4	121	96	0.45	25	–	–	–
10th Year	1.8	377.2	379	146	1.45	232.8	0.2	–	–
15th Year	2.1	636.9	639	181	1.58	457.5	0.5		
20th Year	2.5	896.5	899	214	1.70	684.2	0.8	–	–
25th Year	3.1	1145.9	1149	207	1.85	940.8	1.2		
30th Year	3.7	1395.3	1399	84	2.00	1252.3	1.7	–	–
35th Year	4.1	1644.9	1649	61	1.95	1585.8	2.2		
40th Year	4.6	1888.4	1893	–	1.90	1890.0	2.7	–	–
45th year	4.8	2086.2	2091	–	1.45	2087.7	3.3		
48th Year	5.0	2114.0	2119	–	1.00	2114.0	4.0	–	–

Vijay Kumar Singh
(Recognised Certified Person)
[Recognition No. 3504(VM)2014-CPAM
Dated- 29.05.2015]

Brijesh Ranjan
Scientist 'E'
Addl. Director, Ranchi
21 DEC 2024

Further detail of spreading of top soil alone is given hereafter:

Table No. – 5.29

Top Soil Management – (Including Action plan for Top Soil management)

Year/ Stage	Top Soil Removal "Mm^3" (Cumulative)	Top Soil Used "Mm^3"								Total utilized Top Soil (Cumulative)
		Embankment		Spreading over the Backfilling Area in Sq. Km. (Cumulative)		Spreading over the OB Dump Area in Sq. Km.		Using for Green Belt Area (Cumulative)		
		Area (Sq. Km.)	Top Soil (Mm^3)	Area (Sq. Km.)	Top Soil (Mm^3)	Area (Sq. Km.)	Top Soil (Mm^3)	Area (Sq. Km.)	Top Soil (Mm^3)	
1st Year	0.08	0.065	0.020					0.10	0.030	0.050
3rd Year	0.384							0.317	0.0951	0.1151
5th Year	0.612									0.1151
10th Year	1.756			0.42	0.1768					0.2919
15th Year	2.112			0.93	0.4248					0.5399
20th Year	2.468			1.44	0.6728					0.7879
25th Year	3.066			1.8055	1.1571					1.2722
30th Year	3.664			2.171	1.6414					1.7565
35th Year	4.108			3.5955	2.0876					2.2027
40th Year	4.552			5.02	2.5338					2.6489
45th Year	4.408			6.21	3.2485					3.3636
48th Year	5.048			7.40	3.9632					4.0783
Post Mining			0.020	9.93	4.7878			0.417	0.1251	5.0480

5.16.7 Status of Excavation Area at Cessation of Mining

The excavation area of 1262 ha is envisaged to accommodate about 2119 Mbcm of the internal dumps. The excavation area can be divided into three different segments as per the status of voids etc. at the end of mining period i.e. at 48th year end.

Excavated Area – 1262 ha

Sl. No.		Segment		Area in ha
1.	-	High dump area (RL 540 m) **agl**	-	502
2.	-	Ground Level area (RL 450 m) **gl**	-	330
	-	Ground Level area (RL 420 m) **gl**	-	150
3.	-	Void High Wall area	-	59
	-	Void Waste dump area	-	163
	-	Void floor area	-	58
			Total	**1262**

These waste dump top areas would be subjected to post mining reclamation activities.

Rajesh Ranjan
ESE (P&S)
TVNL Hqrs
27 DEC 2021

Vijay Kumar Singh
(Competent Person)
(Recognised under Rule 15)
(Recognition No. 2011/(03)/2014-CPAM
Dated- 29.05.2015)

5.16.8 Reclamation of Excavation Area

Table no. 5.30 shown below gives proposed reclamation of excavation area with break up into agriculture, plantation and water body after completion of progressive and final mine closure activities.

Table No. – 5.30

Reclamation of Excavation Area (All fig. in ha)

Sl. No.	Land before Mining		Mining Segment with RL	Mining Segment with Area	Proposed Land Use after Reclamation			
	Non Forest	Forest			Agricul-ture	Plantation	Water Lagoon	
							Forest Land	Non Forest Land
1.	300	202	High dump area +90 m (agl)	502 (361 Level + 141 Slope)	173	329		
2.	272.48	57.52	High Ground Level Area (gl) (RL - 450 m)	330 (313 Level + 17 Slope)	240.48	89.52		
3.	84	66	Ground Level Area (gl) (RL 420 m)	150	84	66		
4.	141.57	138.43	Void area (bgl)	280 #	0	11	133.19	135.81
	798.05	**463.95**	**Total**	**1262**	**497.48**	**495.52**	**133.19**	**135.81**
	Total - 1262				**Total - 1262**			

- 280 = (58 Floor + 59 Batter + 163 Dump)

5.16.9 Stage wise Backfilling Waste

As already discussed, the waste volume of 2119 Mbcm has been disposed of entirely in the excavation area. The sterile internal dumps would be reclaimed as plantation area or as agriculture area. In post mine period, the **bgl** area in the quarry would mostly be developed as water lagoon except small rim portion as plantation area. Therefore, the excavation would be reclaimed as plantation area, agriculture area and as water lagoon area. The details of present, proposed and post mining land uses of the project, including the reclaimed dump areas, are shown on page no. XIII – 3 & 4 under tables 13.3 & 13.4.

The stage wise management of internal and temporary dumps for this 2119 Mm^3 waste during the mine life, is given hereafter in table no. 5.31 on next page.

Rajesh Ranjan
27 DEC 2024

Vijay Kumar Singh
(Recognition Person)
(Recognition No. - 2014-CPAM
Dated- 29.01.2015)

The table no. 5.31, given below, shows the stage wise status of backfilling and reclamation of dump areas till end of mine life (48th year).

Rajesh Ranjan
ESE (P & C)
TVNL, Hehal, Ranchi-834002
21 DEC 2015

Table No. – 5.31
Stage wise Waste Disposal

All area in ha

Stage Year	Internal Dump	Temporary Dump		Excavated Area in ha	Stage wise, Level wise Breakup of backfilled Area					
	Cumulative Quantity in Mbcm	Area in ha	Quantity in Mm^3		Above Ground Level (R.L. – 540 m)			High Ground Level (R.L. – 450m)	Ground Level (R.L. – 420m)	Below Ground Level
					Sterile	Moving	Total			
1st year	Nil	24	5.5	20	Nil	Nil	Nil	Nil	Nil	Nil
3rd year	Nil	165	38.5	96	Nil	Nil	Nil	Nil	Nil	Nil
5th year	25	172	96	153	Nil	9	9	39	Nil	38
10th year	233	262	146	439	42	57	99	18	Nil	105
20th year	685	384	214	617	140	61	201	21	Nil	144
30th year	1254	260	145	916	224	157	381	25	Nil	210
40th year	1893	Nil	Nil	1138	502	Nil	502	137	Nil	216
48th year	2119	Nil	Nil	1262	502	Nil	502	330	150	163 dump + 58 floor + 59 batter = **Total 280 ha**

Total Area = 502 ha (agl) + 330 ha (high gl – 450 m RL) + 150 ha (gl – 420 m RL) + 280 ha (bgl) = 1262 ha.

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated 29.05.2015]

5.17 ACTION PLAN FOR MAJOR ACTIVITIES

An action plan for major activities has been prepared for viewing the entire coal project at a glance. Time taken for each major activity has been shown through a coloured chart with sequence and timing. This chart appears at the end of all plates as Plate No. – 17.

Major activities are listed below:

1. Construction of Approach road and Service roads
2. Establishment of Power Supply for construction and mine operation
3. Arrangement of Water Supply
4. Establishment of Electrical Substation of capacity 2 x 5 MUA and Operational Power Supply
5. Construction of Pit office and Administrative office
6. Construction of Store and Workshop
7. Construction of other buildings

7A. Construction of Service Building

7B. Construction of Residential Colony

8. Fabrication of Coal Handling Plant and Transfer Point for supply to Railway Siding
9. Erection and commissioning of Mining Equipment
10. Erection and commissioning of Conveying system for Coal
11. Construction of Haul Road
12. Waste Removal
13. Coal Production

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Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 3401:2(03)/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
ESE (P&S)
TVNL Hindo, Ranchi-834002
27 DEC 2021

CHAPTER – VI

BLASTING

6.1 NEED FOR DRILLING & BLASTING

Drilling & Blasting would be required both in waste and Coal benches (during first year only) before handling of coal/waste by shovels. The strata is generally soft to compact and waste would need blasting before shovel operation. Coal would be broken during first year through conventional drilling and blasting. 250 mm waste drill acquired in advance, would be used for the first year coal blasting. Later on surface miner would cut coal in windrowing mode.

6.2 OVERBURDEN & INTERBURDEN (WASTE) BLASTING DETAILS

Top waste benches would be up to 20 m in height, where 383 mm blast hole drill would be used for drilling. For inter burden, specially between seam VII Top & seam R1, where parting is 97 to 150 m, same sizes i.e. 20 m bench height and 383 mm drills would be deployed. For lesser thickness, 250 mm drills would be utilized. One of the Expert agencies from among CMPDI, CMRI, IIT–ISM (Dhanbad) etc. would be engaged to design best suited blasting pattern after field trials.

For thin seams and inter seam partings less than 2 meters, surface miner/ ripper dozer would be a choice for excavation.

6.3 WASTE BLASTING

For waste blasting some basic calculations are shown below.

Normative Annual Waste Removal	:	50 Mm^3
Avg weekly Waste Removal (52 weeks)	:	About 1 Mm^3 (0.96 Mm^3)
Type of Explosives	:	Bulk Explosives/ slurry/emulsion
Powder Factor assumed – Waste rock	:	0.3Kg/Cum
	=	3.33 Cum/Kg
Weekly Explosive Required for Waste	:	289 tes.

Rajesh Ranjan
ESE (P & S)
TVNL, Mines, Ranchi-834009
27 DEC 2016

Suggested Pattern for drill holes is given below:

	20 m x 0.383 m drill	15 m x 0.250 m drill
Blast Hole Spacing	17	11
Blast Hole Burden	12	8

Drilling should be suitably distributed in all waste benches to provide requisite work load for each shovel/ backhoe.

6.4 COAL BLASTING (DURING 1ST YEAR ONLY)

250 mm drills would be used for drilling blast holes in Coal benches. Field trials would be required by expert agency for designing best suited pattern in coal as well, as suggested for waste rock.

Annual Coal Production	: 1 Mt
Type of Explosives	: Bulk Slurry/Emulsion.
Powder Factor (assumed)	: 0.25 Kg/cum
	: 4 Cum/Kg = 6.5 t/Kg
Weekly Explosive Required for Coal	: 3 t

Suggested pattern for blasting in coal is given below:

Blast hole spacing	: 8 m to 9 m
Blast hole Burden	: 5 m to 6 m

Drilling equipment would be suitably distributed in all waste and coal benches to provide requisite work load for each shovel/ loader.

6.5 STORAGE OF EXPLOSIVES

It is envisaged that the blasting operation will be carried out by SMS (Site Mixed Slurry) and it would be transported to the mine site by the explosive agency. Magazine would be required only for storage of detonators, detonating fuse, cast boosters, cord-relays, etc. A cluster of 2 magazines, each of 4 Te capacities is proposed at NE peninsula near South bank of Sukri river for storing detonating fuses, detonators and other explosives for secondary blasting.

Vijay Kumar Singh
(Recognised Person)
(Recognition No. ... -CPAM
Dated- 29.08.2015]

Rajesh Ranjan
27 DEC 2024

6.6 GROUND LEVEL VIBRATIONS

Vibrations due to blasting may cause damage to nearby structures, if appropriate control measures are not adopted.

Fly rock is another concern, as an outcome of blasting. There are many factors, which influence the fly rock phenomenon, like longer explosive column with lower stemming column, high burden, loose material or pebbles near holes and long water columns in the holes. However, precautions would be taken to ensure proper blasting pattern so that fly rocks stay well within safety limits.

6.6.1 The Suggested Measures to contain Vibrations

Following control measures would be executed to reduce ground vibratory conditions within required statutory limits.

1) The peak particle velocity (PPV) of ground vibration would be kept below 10mm/s for 8-25 hz frequency range through optimally controlled blasting techniques , after necessary field trials by Blasting Experts.
2) Drilling and charging pattern would be optimally designed, with less explosive charge, etc., after field trials by experts on blasting such as CIMFR, IIT (Dhanbad), CMPDI, Ranchi.
3) Use of suitable initiating sequence and millisecond delay electronic detonators.
4) Reduction of amount of explosives charged per delay optimally.
5) To contain fly rocks, stemming column would not be less than burden of the hole. Blasting area would be muffled, if necessary, to stop fly rocks propagation.
6) Blasting would not be carried out when strong winds are blowing towards the inhabited areas. Blasting would be done during midday time and never at night.
7) Surrounding villages would be regularly inspected for any visual cracks on walls and feed backs would be gathered to investigate the reasons for these and for reassessing the charge per delay from time to time.
8) Vibration study would also be carried out at appropriate times to obtain most optimal blasting parameters.

Rajesh Ranjan
Engg. & Sy.
TVNL, Hindpi, Ranchi-834002.

Vijay Kumar Singh
(Recognised Competent Person)
[Recognition No. 3[illegible](93)/2014-CPAM
Dated- 29.05.2015]

9) Controlled blasting technique would be used to avoid tension cracks which may endanger the stability of bench slopes in the mine.

10) Short delay detonators to be used in preference to detonating fuse.

11) Proper care and supervision during blasting by a competent, experienced and qualified person.

By adoption of above measures, it would be ensured that the ground level vibrations due to blasting are maintained within the limits prescribed by DGMS, Dhanbad, in the mining areas, vide Circular No. 7 dated 29 -08-1997 as given in Table below.

6.6.2 Permissible Peak Particle Velocity

In the table below, ppv according to DGMS guidelines for designing the blasting have been indicated.

Table No. – 6.1
Permissible Peak Particle Velocity (PPV) at the Foundation Level of Structures in Mining Areas in mm/sec.

Type of structure	Dominant excitation frequency Hz		
	<8 Hz	8-25 Hz	>25 Hz
A. Buildings/structures not belonging to owner			
Domestic houses /structures (Kuchha brick and cement)	5	10	15
Industrial buildings (RCC and framed structures)	10	20	25
Objects of historical Importance and sensitive structures.	2	5	10
B. Building belonging to owner with limited span of life			
Domestic houses/structures (Kuchha brick and cement)	10	15	25
Industrial buildings (RCC and framed structures)	15	25	50

Vijay Kumar Singh
...erson)
...J.I.-CPAM
(R...
(Re... Dated- 29-...-2015]

Rajesh Ranjan
...Ltd.
...Hinoo, Ranchi-834002
21 DEC 2024

CHAPTER - VII

VENTILATION

7.1 VENTILATION OF OPENCAST MINE AT SHALLOW DEPTH

The ventilation in opencast mine, as such, is not required to be done mechanically. However, this mine goes upto 474 m. as peak depth by 30th year stage. The exposure area of the mine to atmosphere and depth in that stage is given below for 10th, 20th and 30th year stage.

Table No. – 7.1
Depth & Exposed Area at Stages of Mine

Sl. No.	Stage of Mine	Peak Depth in meters	Surface Area Exposed to atmosphere in ha
1.	10th Year	300	322 ha
2.	20th Year	306	394 ha
3.	30th Year	474	510 ha

7.2 VENTILATION OF DEEP OPENCAST MINE

It would be seen that surface area exposure at 30th year at a depth of 474 meters comes to 510 ha. With such wide exposure to atmosphere and ambient temperature at working faces being higher than surface, the air will become warmer and will tend to come up. There will be air movement due to wind & other factors and it will move the inside air also as the exposure is as high as 510 ha.

7.3 VENTILATION OF DEEP OPENCAST MINE DURING WINTER

As may be seen in the Chapter – V on Mining, coal is being cut by surface miner. Blasting in coal is being totally avoided except during 1st year. The surface miners being deployed would be provided with dust suppression system which would reduce air borne coal dust. However, during winter inversion takes place. As a result hot air laden with dust is not able to rise beyond certain height. It is therefore, anticipated that mechanical means of ventilation would have to be arranged from 20th year to 40th year.

Rajesh Ranjan
Asst. Manager (P & S)
TVNL, Hindgir, Rajbar
27 DEC 2024

Vijay Kumar Singh
(Recognised Qualified Person)
(Recognition No. 34012 ... OPAM
Dated- 29.05.2015)

7.4 ARRANGEMENT FOR VENTILATION AT DEPTH

Arrangement for exhaust ventilation would be made with the help of 1.2 m dia steel tubes. These tubes would follow the path of water pipe lines and reach the mine near pump house over the mine sump. An axial flow fan such as PV120 from Voltas would be installed at surface which would suck air through 1.2 m dia steel tubes. The blade angle of the fan would be adjusted to suite resistance value of the tube which may be 750 m long at its maximum during 30th year stage. The ventilation system installed may be utilized only while facing dust problem at the depth area of the mine particularly during winter and possibly during summer.

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Vijay Kumar Singh
(Recognized Competent Person)
[Recognition No. [illegible] 2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
Agent
27 DEC 2024

CHAPTER - VIII

PUMPING & MINE DRAINAGE

8.1 MINE DRAINAGE & PUMPING

The drainage and pumping system of this Opencast mine has been designed to dewater the inflow of water due to precipitation falling within the active pit area during the monsoon season. Besides, ground water inflow is planned to be dealt on routine basis with ongoing mine operations. The inpit pumping station would be located near the Southern edge of the lowest working bench of Seam III Bottom. Some pumps would also be located on higher benches also at South edge of the mine face to dewater the benches during monsoon.

8.2 THE RAINS

The average annual rainfall at the nearest IMD Station i.e. Medninagar (Daltonganj) comes to about 1118 mm based on C.G.W.B. report. For planning the dewatering capacity, a peak rainfall of 150 mm in a day, would be taken for this part of the coalfields, in the Palamu plateau.

8.3 THE DRAINAGE

In the project area, the drainage is mostly of the 1st & 2nd order water channals. These flow for a few weeks during the rainy season. During winter the flow starts decreasing and it practically ceases in post winter. In the project area, other than one 3rd order stream, no water flow exists needing any diversion, except guiding them into garland drains. Project area is relatively free from drainage problem. However, one 3rd order stream runs in the project area, coming from East side. This will need to be guided into the garland drains on East side for its flow into Sukri Nadi in North side of the area. The construction of garland drain in East side, from start of the 3rd order stream upto Sukri Nadi, shall be done so as to accommodate the monsoon flow of this stream.

Rajesh Kr. Bilas
ESE
TVNL, Hindpi, Pa
21 DEC 2021

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognised vide ...2014-CPAM
Dated- 29.05.2015]

8.4 PLANNING FOR DRAINAGE & PUMPING

8.4.1 Drainage Planning

The strategies for managing the precipitation water and laying out the drainage system are envisaged below:

- Construction of Garland drains around quarry and infrastructural units.
- Construction of Cross drainage systems where the haul road and other access roads cross the garland drains.
- Assess water accumulation during likely continuous rain and match mine water storage and pumping capacity to keep water inflow under control during monsoon.
- Normally, bottom most bench is allowed to get submerged for 2–3 months of rainy season. Machines work on the higher benches. This is an important monsoon preparation to be undertaken from say 3rd year, when excavation area on surface becomes large.
- Provide drainage channels on dump slopes and berms, so that water drains to garland drain with minimum silt load.
- As monsoon preparation, cleaning of all drainage during pre-monsoon period.

8.4.2 Planning for Pumping

The intake of rainwater to the opencast mine is non-uniform during the year. The maximum rainwater intake will be during the period of about three months (July to September) in a year. During dry season, seepage from strata is expected to be moderate and the same can be dealt by running a few of the pumps, provided for monsoon pumping. During this period, repair & overhauling of the pumps will be done by rotation, as preparation for handling the incoming monsoon inflows.

The main pumps will handle the quantity of water inflow during likely peak rainfall during monsoon in excess of sump capacity. The accumulated water in the sump has to be pumped in about 10 days time to ensure accommodation of peak rainfall, which are cyclic and are likely to peak every 10 – 15 days.

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 2(33)/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
DGM (P & S)
TVNL, Hinoo, Ranchi-834002
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8.4.3 General Considerations

The general criteria of determining the number of pumps, lay-out and design of the pumping installation are as under:

- General climatic conditions, surface features of the terrain beyond the boundary of the mine.
- The rainy season sumpage at bottom most bench of the pit for taking 10–12 days cushion, to pump out water accumulate due to heavy rains.
- Meteorological data of nearest rain-gauge stations.
- Catchment areas, mined out areas, areas beyond excavation, areas backfilled up to surface in excavation area and maximum depth of the quarry.
- Desired location at surface where quarry water can be discharged after desilting considering the surface drainage system.

8.5 ASSESSMENT OF VOLUME OF WATER LIKELY TO HANDLED IN 10–12 DAYS

Volume of rain water entering into the mine and accumulating in the quarry (make of water) has been assessed on the basis of the following formula:

$$Q = A \times H \times \square \quad m^3/day$$

Where, A - Catchment area in m^2

H - Maximum daily precipitation considered – 150 mm

□ - Run-off co-efficient

8.5.1 Estimated Quantity of Water to be Handled

The wet season dewatering system consists of the overall pit dewatering operations during the peak monsoon season. Peak single day rain of 150 mm, has been assumed for estimation. The mine has final excavation area of 1262 ha. During the mine life, peak open area of about 390 ha is coming in approximately 35th year of mine life. About 565 ha is getting filled up to surface and 307 ha remains untouched. Hence in the 35th year, out of total excavated area of 1262 ha, about 390 ha will be open. Taking 390 ha as direct precipitation, 565 ha of filled up area with 40% infiltration and 307 ha of undisturbed area with 10% infiltration, total volume of water comes to 970050 m^3. Total volume of water comes to:

(i)	$390 \times 10^4 \times 0.15$	=	585,000 m^3
(ii)	$565 \times 10^4 \times 0.15 \times 0.4$	=	339,000 m^3
(iii)	$307 \times 10^4 \times 0.15 \times 0.1$	=	046,050 m^3
	Total		970,050 m^3

Rajesh Ranjan
DGE (P & S)
TVNL, Hexa, Ranchi
21 DEC 2024

Vijay Kumar Singh
(Recognised Competent Person)
Certificate No. [illegible]/CPAM/2014-CPAM
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Taking evaporation loss of 4% over 10 days for pumping out this water – water to be pumped comes to about 931,250 m^3 to be pumped out in 10 days. Daily pumping comes to 93125 m^3. With 20 hrs daily pumping, volume comes to about 4656 say 4650 m^3/hr.

8.5.2 Required pumping capacity

The ultimate depth of the quarry goes up to about 474 m. It is coming in 35th year. However, in the first 5 years & 10 years depth goes up to 110 m and 130 m respectively in seam III and remains within the range up to 15th year. The head of the pumps up to 20th year will remain up to 200 m. The capacity of pumps would be 280 m^3/hr. After 20th year onwards head of pumping will increase. By 30th year it comes to 320 m and by 35th year it touches 400 m.

8.6 SELECTION OF PUMPS

Maximum capacity of pumping has been determined at 4650 m^3/ hr based on operating time of 20 hours a day.

- Pumps of 80 cum/hr, 100 m head, 40 KW have been selected for initial stage of quarry working. These pumps would work as Main pumps in the initial years of mining and would be replaced by higher head pumps after expiry of their life.
- From 5th year to 20th year, bigger pumps of 280 m^3/ hr with 200 m head 280 KW will be used. From 30th year onwards, 540 Cum/hr pumps with 400 m head and 1080 KW will be deployed for the main pumping. This main pumping would be done from level higher than quarry floor of 474 m lowest level.
- During heavy rainfall, overburden may be washed away from the edges of slopes and internal dumps, needing pumps capable of handling slime/slurry. Pumping of clear water and slime will be from the upper and lower part of the sump respectively. For pumping slurry/sludge containing solid particles, portable pumps up to 55 kW equipped with one or two wide channel impellers with free flow passages varying from 40 mm to 190 mm in width are available. Such pumps, i.e. 80 Cum/hr, 60 m head with 25kW motor are proposed for transfer of slime from main sump to slime ponds at suitable location in the mined out area.
- Self priming pumps of 30 cum/hour capacity, 40 m head driven by 6 KW electric

motors have been provided for priming.

- Face pumps of 60 cum/hr capacity, 40 m head driven by 12 KW electric motors have been provided for carrying water from local depression in the face area to main sumps.
- Diesel pump sets of 280 Cum/hr are suggested for use in emergency during the period having electrical power failure during peak monsoon season. This diesel pump would be kept mounted on a pontoon base (a floating base) so that it floats while pumping plant has no chance of drowning.

8.7 PIPES AND FITTINGS

The delivery pipelines from the pumping station are proposed to be taken out through the side batter of the quarry. These pipes are eventually brought to the surface, from where water will be discharged to the natural drainage system after the solids have been allowed to settle in a settling pond.

Each pump would be provided with independent delivery pipe. The dia. of the delivery pipes would be 250 mm, 150 mm, 100 mm and 80 mm nominal diameter.

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Vijay Kumar Singh
(Recognised Competent Person)
[Regd. No. 31/24/(01)/2014-CPAM
Valid upto 20.05.2015]

Rajesh Ranjan
ESE (P & S)
TVNL, Hindpiri, Ranchi-83...
27 DEC 2024

CHAPTER – IX

COAL HANDLING, WASHING & MODE OF DISPATCH

9.1 COAL HANDLING

9.1.1 Initial 5 years of Mine Life

The mine will be opened from incrop side at North-East corner with shovel dumper combination for coal production and waste removal. During first year, coal would be transported by CBD to CHP area. At the end of first year, the face length of III B seam (basal seam) would be good enough for operation of a surface miner.

At the end of first year, main trunk belt in the north corridor would be installed for coal transport from pit to CHP area. All the coal transport by the end of 1st year would be through trunk belt and all the coal would be extracted by surface miner from 2nd year onwards.

9.1.2 Coal handling after first years of Mine Life

Coal at the face would be extracted by surface miner from 2nd year onwards.

9.1.3 Cutting at Face, loading and Transport

The surface miner would cut coal and size it to –100 mm to –250 mm size. Four surface miners with 3.8 m cutting width 0.35 m cutting depth would be deployed. Cut coal left on floor in windrowing mode would be loaded by 18 cum wheel loader into 100 t CBD, and transported to mobile hoppers, stationed in the north side of the five seams i.e. R1, VII Middle, VI Middle, IV Bottom & III Bottom seams.

From these hoppers, apron feeder would collect and reach coal to main trunk belt running along the north corridor up to CHP area.

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. [illegible]/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
ESE (P&S)
TVNL Hydro, Ranchi-834002
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9.2 CHP AREA

Coal picked up from the pit faces would be conveyed to CHP Area as stated previously. The CHP Area would have the following segments for coal preparation & storage.

9.2.1 Coal Handling Plant (Area Occupied – 3.2 ha)

The proposed Coal Handling Plant (CHP) would have the following operating details:

- Production capacity in Million tones/yr - 10
- No. of working days / annum - 330
- No. of working shifts / day - 3
- Duration of each shift (hours) - 8
- Effective working hours per day - 18
- Feed size of coal from face - –250 mm
- Output product from CHP - –50 mm
- Belt conveyor to convey coal to proposed railway siding - 2500 tph conveyor

9.2.2 Storage of Coal in CHP Area

The storage of ROM coal coming from faces and of prepared –50 mm coal in the CHP area has been envisaged to store in the event break down/ non supply of railway wagons.

9.2.2.1 Storage of ROM Coal (–250 mm)

At 10 MTPA, monthly production of ROM Coal comes to about nearly 0.84 Mt. To provide for say 2 weeks storage, the quantity of coal comes to 0.42 Mt. Storage area for this ROM Coal has been provided over 9 ha area. Hence with about 4.7 meter height of storage, ROM Coal can be accommodated.

9.2.2.2 Storage of Prepared Coal (–50 mm)

After sizing the ROM to –50 mm, it is ready to be sent to railway siding by tube conveyor. However, a 7000 t ground storage bunker has been provided as cushion for prepared coal for 2 rakes. The tube conveyor would pick up the sized coal & convey upto railway siding.

Rajesh Ranjan
TVNL Hinoo, Ranchi-834002
21 Dec 2015

Vijay Kumar Singh
(Recognised Competent Person)
[As per Notification No. S.O. 2014-CPAM dated- 29.08.2015]

9.3 SYSTEM CAPACITY

The handling capacity of the system has to match with the production capacity of the mine. In order to achieve the planned output from the mine, the designed total capacity of surface miners is required at 4000 tph for effective production of 2000 tph. It is planned to have four (4) surface miners with rating of 1000 tph for giving required 33,000 tpd production.

9.3.2 CHP Capacity

This has already been covered in detail, under item 9.2.1 & 9.2.2. The CHP has to handle & dispatch at nearly 2000 tph. From the CHP area, long distance tube conveyors would move the coal to Chetar railway siding for onward transport by Indian Railway.

9.3.3 Electrical System

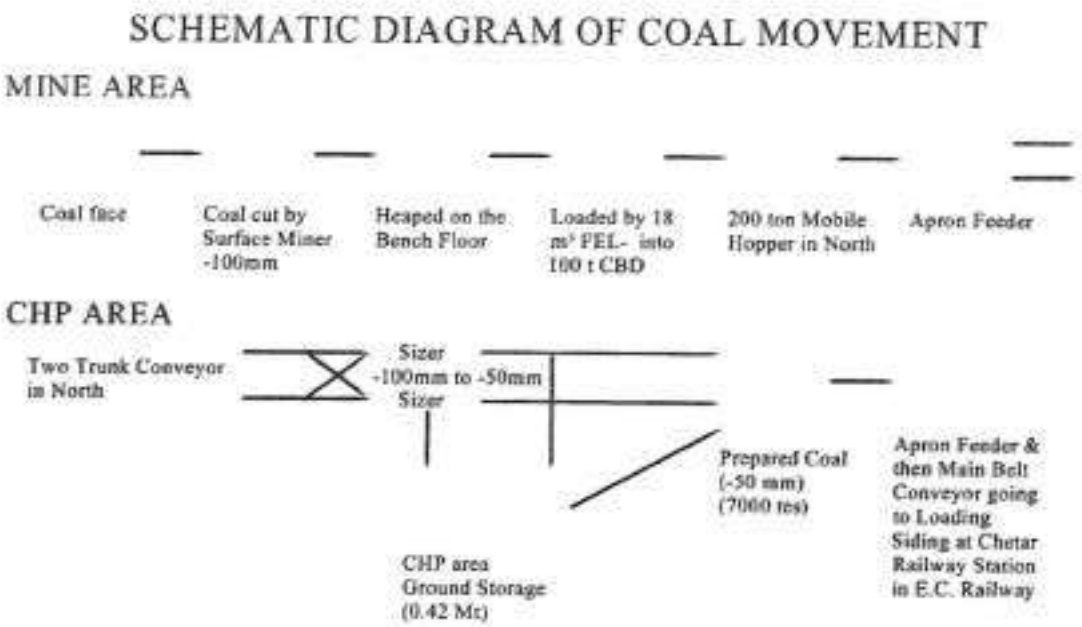
The electrical system of CHP would have following facilities:

- Power reception and distribution system
- Control Panel for switching on/off power to sizers.
- Illumination of plant and adjacent area
- Earthing

9.3.4 Weighment System

For the purpose of weighing the coal, a belt weigher has been envisaged to be installed in CHP area; before loading coal into long distance conveyor for reaching Railway Siding. It is envisaged to weigh the coal moving to Railway Siding.

9.4 SCHEMATIC LINE DIAGRAM FOR MOVEMENT OF COAL



9.5 ENVIRONMENT MANAGEMENT & MAINTENANCE SYSTEM

9.5.1 Dust Control System

Dust suppression system would be installed to control the dispersion of dust during sizing of coal and discharging it into hopper/ transfer from one conveyor to other conveyor at the transfer houses. This will be installed at pit top and then onwards, up to loading on to the long distance conveyors.

The objective of the system is to minimise the air born coal dust by its effective at suppress generation point. The system involves confinement of the dust within the dust producing area by a curtain of moisture and wetting the coal dust by direct contact between the particles and droplets of water. Adequate number of precision anti-clog nozzles shall be installed at required locations for suppressing dust by spraying water mixed with suppressant. To ensure minimisation of dust the conveyor system shall be so inter-locked that it definitely functions when the conveyor system is operating or the loading operation is on.

Rajesh Ranjan
EE (P & S)
TVNL Hinoo Ranchi-834002
21 DEC 2021

Vijay Kumar Singh
(Recognised Qualified Person)
(Recognition No. ...(03)/2014-CPAM
(Recognition Dated: 29.05.2015)

9.5.2 Fire Fighting System

Necessary fire fighting system is also envisaged for the CHP area. It would includes fire hydrant tees at strategic locations at equal spacing of 60 - 70 m with suitable water supply pipelines. Portable type fire extinguishers to deal with electrical / oil /ordinary fires shall be provided at all strategic locations in the plant.

9.5.3 Preventive Maintenance

For effective maintenance of all the equipment, there shall be sufficient working space around the equipment/machinery. All the equipment and conveyor discharge drums/transfer points etc. shall have covered and well ventilated housing complete with access stair ways, hand rails, platforms, cross-over ladders etc. as required.

A belt replacement winch & belt slit warning system has been envisaged for handling and maintenance of belts.

9.6 COAL BENEFICIATION

No coal beneficiation has been proposed.

9.7 COAL DISPATCHES

A pucca road exists East of Rajbar E & D Coal block and runs to NH-75 and further onward to Chetar Railway Station. Chetar Railway Station located between Tori and Latehar Stations on Barkakana-Dehri-on-Sone loop line of East Central Railway. Plate No. – 11 B may be seen, which shows the route over Survey of India Toposheet enlarged to 1:25000 scale. A tube conveyor is proposed to follow this route so that the conveyor remains accessible throughout its coal route. A tube conveyor can adjust to road bends and minimize dust emission. Tube conveyor would be installed on trestles at about 6 m height to spare road traffic with minimal hindrance. At one place it would cross NH-75 where a conveyor bridge would be provided with approval of Highway Authorities. The route length of tube conveyor from CHP to Chetar Railway Station siding is approximately 13.7 km long. A railway siding about 900 m long and 45 m wide would accommodate a platform with wharf wall

Rajesh Rajan
27 DEC 2024

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

and a ground bunker of 10000 ton free flowing coal capacity. A tunnel underneath this ground bunker would reload this coal for being transported to a flood loading concrete silo over railway siding track so that a 3000 ton capacity rake can be loaded. This loaded rake of Indian Railway System would transport coal from Chetar Railway Station to Dumri Bihar Railway Station over a distance of 138 km. From Dumri Bihar coal would move to TVNL power plant through 8 km long Merry go round rail transport system.

Total distance of coal movement thus comes to 13.7 +138 + 8 = 159.7 km say 160 km from pit head to power plant.

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CHAPTER - X

MANPOWER, SAFETY & SUPERVISION

10.1 MANPOWER

The proposed Rajbar E & D Coal Mine open cast project will be coming up in a remote area. For smooth and effective operation of the mine and optimum productivity, sufficient skilled and unskilled personnel will be required for manning the project. Implementation of the project will help in improving the social and economic scenario of the area including the life style of the people living in the vicinity. The estimate of manpower required has been made assuming that the mine would be operated departmentally.

10.2 ESTIMATE OF THE MANPOWER REQUIRED

The estimate has been made for departmental operation of the entire project. However, sweeping, cleaning, light vehicle driving and welfare activities may be outsourced.

Direct employment of 1461 persons will take place. More than 5000 persons will get indirect engagement in various services, which will develop due to the project and the persons employed in the project.

The total manpower required for Rajbar OCP for 10 MTPA coal production along with its corresponding waste removal, is assessed at 1461. The requirement of manpower is on the basis of 330 working days in a year and 3 shift operation per day of the mine.

Number of local personnel including land losers will be mostly recruited in unskilled, semi skilled, office assistant categories etc if found suitable for the job. These personnel will need training and orientation before absorption in the project. Besides, some I.T.I qualified youth from the region can be recruited for operation and maintenance job of plant and machinery after proper training. Skilled and highly skilled personnel will be required to be brought from outside.

Rajesh Ranjan
21 DEC 2021

Vijay Kumar Singh
(Qualified Person)
[Reg. No. 4312/(03)/2014-CPAM
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The Manpower list includes:-

1. Operational manpower for coal extraction, OBR removal, coal sizing, loading coal, sales/ dispatch.
2. Manpower for Maintenance of HEMM, power supply & other equipment.
3. Manpower for Project/ GM office.
4. Manpower for Maintenance of Environment & Bio reclamation.

The designations and relevant categories of the manpower have been adopted in accordance with prevailing norms in coal industry.

While estimating the manpower, following activities are proposed to be outsourced.

1) Security: - Entire security manpower is required to be arranged through outsourcing except skeletal manpower for supervision.

2) Welfare Facilities: - Canteen, Rest house services, Residential Colony maintenance services, Transport & logistics, Road & building repair including horticulture & its maintenance are proposed to be outsourced. Hence only skeletal manpower is provided for this purpose.

3) Water supply & Sanitation.

4) Light Vehicles: - Drivers are provided for Senior Executives only, for others, it is outsourced.

Rajesh Ranjan
ESE (P & S)
TVNL, Hindi, Ranchi-834002
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The facilities which are mentioned above have been envisaged to be outsourced to bring in more efficiency and optimize the cost of mine operation and associated activities.

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
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The projected manpower in detail for departmental operation for coal, overburden, coal handling, railway siding, wagon loading and coal dispatches is given in the tables that follow, department wise and skill wise. Manpower strength to match with equipment to be deployed for mine development has been given. Post mining operation is expected to be out sourced completely.

Table No.-10.1

Manpower Required for Mine Operations, Planning & Monitoring

Operation	Item	Mining Equipment	Equipt Capacity	No.	Man power						
					Operators	Helpers	Clerical/ Techl/ Supervisory		Executive		Line Total
							Design.	No.	Design.	No.	
1. Waste Removal											
							Time Keeper	4	Dy CME	1	5
i	Drilling	Blast Hole Drill	380mm	3							
		Blast Hole Drill	250 mm	6	34						34
		Drill Helper				34					34
ii	Blasting	Blasting Helpers				10	Sr OM	2	Asst. Mgr	1	13
iii	Loading	Electric Rope Shovel	40 Cum	3							
		Hydraulic Shovel	12 Cum	6	34		Sr OM/ OM	20	Mine Supt	1	55
iv	Transport	Rear Dumper	360 t	21			Mining Sardar	6	Dy Mgr	4	10
		Rear Dumper	100 t	34	206		Steno	1	Asst Mgr	4	211
v	Dumping						Dump men	17			17
Sub Total					**274**	**44**		**50**		**11**	**379**
2. Coal Production											
i	Coal Cutting	Surface Miner	Drum Length 3800 mm	4	16						16
ii	Coal Loading	Wheel Loader	18 Cum	4	16						16
iii	Transport	Trunk Conveyor	2000 tph	2	7	20					27
		Mobile Belt Conveyor	2000 tph	10	20						20
		Mobile Hopper & Feeder	2000 tph	5							
iv	Pumping	Pump		3	11						11
Sub Total					**70**	**20**					**90**

Vijay Kumar Singh
(Recognised Qualified Person)
[Recog. No. 3012/(03)/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
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Road , Drain & Culvert			Capacity	No.	operator	Helper					
3	i	Wheel Dozer	350 Kw (45 t class)	1	4		Sr. OM	3			7
	ii	Track Dozer	300 Kw	8	30						30
	iii	Motor Grader	16 Ft Blade (200 Kw)	4	15						15
	iv	Vibratory Compactor	25 t	4	15						15
	v	Water Sprinkler	40-45 Kl	4	15						15
	v	FE Loader	5 Cum	1	3						3
	vi	FE Loader	2 Cum	1	7						7
	vii	Diesel Back hoe (20 t class)	1 Cum	1	4						4
Sub Total					**93**			**3**			**96**
Maintenance & Safety Equipment	i	Crane	100 T	1							
	ii	Crane	40 T	2							
4	iii	Crane	8 T	3	13						13
		Crane helpers				13					13
	iv	Boom Truck		4	12						12
		Boom Truck helpers				12					12
	v	Heavy Duty Toe Truck		2	7	7					14
		Riggers/ Tyndal				8					8
	vi	Tyre Handler		2		8					8
	vii	Mobile Maint. Van		4	15						15
	viii	Fire Tender		2	8	8					16
Sub Total					**55**	**56**					**111**
Supplies & Transport	i	Diesel Bowser		4	15						15
		Helper				15					15
5	ii	Fork Lift	8 t	2		8					8
	iii	Line Truck	20 t	2		3					3
		Helper									
	iv	Tipping Truck	8 t	6		18					18
Sub Total					**15**	**44**					**59**
Reclamation & Envt. Mgt	i	Motor Grader	16 Ft 200 Kw	2	7		Sr. OM	3	Min Engr	1	11
6	ii	Dozer	300 Kw	4	15				Env. Engr	2	17
	iii	Water Sprinkler	40-45 Kl	4	9		Steno	1			10
	iv	Farm Truck		4	10						10
Sub Total					**41**			**4**		**3**	**48**

Rajesh Ranjan
ESE (P&S)
TVNL, Lohardaga

Vijay Kumar Singh
(Recognised Qualified Person)
Regd. No. 34012/(03)/2014-CPAM
Dated- 29.05.2015

Table No.-10.2
Coal Handling Dispatch & Mine Planning

Coal Handling & dispatch	Designation	Opr.	Help.	Clerical/ Techl/ Supervisory		Executive		Line Total
7	CHP Operators	11		OM	4	Supt. Engr.Min	1	16
	Helpers/Cleaners		9	Disp Supr	4	Asst Mgr.	3	16
				Loading Clerk	4			4
	sub-total	**11**	**9**		**12**		**4**	**36**

Planning Monitoring & Survey		Trades-men	Helpers	Designation	Techl, Supr & Clerical	Executives Designation	Ext	
8				Surveyor	2	SE Planning	1	3
				Survey Assistant	2	Mgr Plg	1	3
				Draftsman	2	Dy. Mgr Plg.	1	3
				Steno	1	Asst. Mgr Plg.	1	2
						Computer Engr	1	1
	Surv Helpers		2			Sr Survey Officer	1	3
						Survey Officer	1	1
	Sub Total		**2**		**7**		**7**	**16**

Table No.-10.3

Power Supply, Electricals & Maintenance								
	Tradesmen & Helpers			Techl, Supr & Clerical		Executives Designation		Line Total
9	Designation	Opr.	Help.	Designn	No	Designn	No	
Power Supply, Electricals & Maintenance	Mechanical Fitter	8	8	Sr FM	3	Supt. Engr. (Electrical.)	1	20
	Electrician	8	8	FM	4	Sr Ex Engr. (Mech)	1	21
	Helper			Clerk	2	Ex. Engr. (Elec.)	4	6
	Welder	4		Steno	2	Asst. Engr. (Elec.)	5	11
	Turner	2		Draftsman	2			4
	Machinist	2						2
	Black smith	2						2
	Hammer man		2					2
	Tyndel	8						8
	Carpenter	2						2
	Sub Station Attdt.	4						4
	Sub-total of maintenance	**40**	**18**		**13**		**11**	**82**

Rajesh Ranjan
ESE (P&S)
TVNL, Hinoo, Ranchi-834002
27 DEC 2024

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. M-12/(03)/2014-CPAM
Dated- 29.05.2015]

Table No.-10.4
Maintenance and Repair of Equipment

	Tradesmen & Helpers			Techl, Supr & Clerical		Executives Designation		Line Total
10	Designation			Designn	No	Designn	No	
Maintenance and Repair of Equipment	Mechanic	20				Supt. Engr. (Mech)	1	21
	Fitter Gr I	20		Sr FM	8	Sr Ex Engr. (Mech)	4	32
	Fitter Gr II	30		FM	16	Ex Engr. (Mech)	8	54
	Fitter Gr III	40		Draftsman	4	Asst. Engr.	10	54
	Electrician Gr I	8		Clerk	4			12
	Electrician Gr II	14		Steno	2	Sr Ex Engr. (Elec.)	1	17
	Electrician Gr III	20		MTK	4	Ex. Engr. (Elec.)	4	28
	Welder Gr I	8				Asst. Engr. (Elec.)	4	12
	Welder Gr II	14						14
	Welder Gr III	20						20
	Turner Gr I	4						4
	Turner Gr II	6						6
	Turner Gr III	6						6
	Machinist I	4						4
	Machinist II	4						4
	Machinist III	6						6
	Black smith	4						4
	Hammer man		4					4
	Carpenter	2						2
	EOT Crane opr	4						4
	Wash m/c opr	4						4
	Helper/Greaser		60					60
	Sub-total	**238**	**64**		**38**		**32**	**372**
GM Office, Security, Material Mgt & Financial Mgt								
11	Helpers		2	Store Clerk	5	Material Mgr	1	8
				Steno	1	Asst. Mat Mgr	1	2
				Accountant	4	Finance Mgr	1	5
				Steno	1	Asst Fin Mgr	2	3
				Office Supt	1	General Mgr	1	2
	LV drivers	15		Steno	3	Dy GM	1	19
	Peon		2			Adm Officer	1	3
				Sec Inspector	4	Security Officer	1	5
	Sub Total	**15**	**4**		**19**		**9**	**47**
Personal, Training, Medical Services & Township Management (Human Resources Management)								
12				Clerk	15	Personnel Mgr	1	16
				Steno	3	Ind Rel Dy Mgr	3	6
						Welfare Officer	3	3
	Crafts Men	8		Sr OM	4	Training Mgr	1	13
				Sr FM	4	Trg Asst. Mgr	2	6
				Clerk	6			6
				Steno	2			2
	Filter Pit Opr	8		Overseer	2	Township Mgr (Civil Engr)	1	11
	Mason	2				Ex Engr Civil	3	5
	Carpenter	2		Steno	2			4
	Electrician	2						2
	Plumber	2						2

Rajesh Ranjan
ESE (P & S)
TVNL, Kumhar Parao, Bokaro
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Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
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	Tradesmen & Helpers			Techl, Supr & Clerical		Executives Designation		Line Total
	Helpers		10	Nurse	4	Medical Superintendent	1	15
	Sweeper		10	Pharmacist	4	Sr Medical Offr	2	16
	Aya		4	Dresser	6	Lady MO	2	12
	Ambulance Driver	4		Steno	2			6
	Sub Total	**28**	**24**		**54**		**19**	**125**

Table No.-10.5
Skill wise Summary of Man Power

Sl. No.	Division	Workers (Daily rated)		Techl, Supr & Clerical		Executive	Line Total
		Skilled	Unskd	T & S	Clerl		
1.	OB Removal	274	44	28	22	11	379
2.	Coal Production	70	20				90
3.	Road, Drain & Culvert	93		3			96
4.	Maintenance & Safety Equipment	55	56				111
5.	Supplies & Transport	15	44				59
6.	Reclamation & Environment Mgt.	41		3	1	3	48
7.	Coal handling & Dispatch	11	9	4	8	4	36
8.	Planning Monitoring & Survey		2	6	1	7	16
9.	Power Supply Electricals & Maintenance	40	18	9	4	11	82
10.	Maintenance & Repair of Equipment	238	64	28	10	32	372
11.	GM Off, Security	15	4	4	15	9	47
	Finance & Accounts						
	Material Mgt						
12.	Human Resource Mgt	28	24	24	30	19	125
	Training & HRD						
	Personnel & Welfare						
	Town Administration						
	Health & Sanitation						
	Total	**880**	**285**	**109**	**91**	**96**	**1461**

10.3 PRODUCTIVITY

Assuming about 264 attendance per head with coal industry norms of absence due to leave, sickness and otherwise.

Annual Man Shifts available	-	3,85,704
Annual Coal Output	-	10,000,000
Output per Man Shift	-	25.9

Level of productivity is considered optimal under difficult geological conditions and matching level of mechanization.

Rajesh Ranjan
CE&SE (P&S)
TVNL, HQ, Ranchi-834002
27 DEC 2024

10.4 SAFETY

Extraction of coal through opencast mining is generally taken as safer than underground mining. However, the following are considered as areas of danger in opencast mining.

1. Safety of non employees moving around the mine workings.
2. Failure of advancing benches due to faults, slips & back breaks.
3. Slope failure of waste dumps.
4. Accidents due to blasting in the benches.
5. Fire in Coal Benches/ Coal Stock Yard.
6. Flooding of the mine.
7. Accidents due to lack of proper space for movement of men & equipment in mine and workshop.

These are discussed hereafter.

10.5 SAFETY OF NON EMPLOYEES MOVING AROUND THE MINE WORKINGS

Mine excavation is proposed over 1262 ha. Coal bearing area 1320 ha. Project area covers 1351 ha including 31 ha of metamorphic on South side. These 31 ha accommodate most of the infrastructure except CHP complex and Incline mouth complex. All around these 1320 ha, it is proposed to have peripheral plantation to arrest dust and sound, garland drain to prevent rain water entering into the mine, road and barbed wire fencing at the outer most project boundary of 1320 ha. Normally this arrangement would not allow any outsider/ villager/ non employee to enter into project area. However, in practice it may not be possible to acquire all the pieces of land within 1st two years of construction. Therefore, the mine excavation edge would have additional moveable barbed wire fencing located 50 m away from excavation edge. Waste dumps would have its own garland drain. All around the dump a safety wall would be made out of boulders rolling down the dump slope and a moveable barbed wire fencing all around would be erected 50 m away from safety wall.

Rajesh Ranjan
ESE (P & S)
TVNL Hinoo, Ranchi-834002
21 DEC 2024

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 38012/(03)/2014-CPAM
Dated- 29.05.2015]

10.6 FAILURE OF HIGH WALLS

The high walls have two likely causes of their failure.

- Due to operational situations
- Due to rock quality & depth of deposit

10.6.1 Due to operational situations

The operational benches may have chances of failure for the following reasons:

- Loose blasted faces.
- Primary slip planes in the blasted benches, some distance behind open face.
- Secondary cracks in the blasted benches behind the open face.

While excavating the blasted material, a portion of the face may give way in the situation detailed above. It could affect men & equipment on the higher bench and on the bench excavating the blasted material.

The following precautions would be taken to avert such accidents.

- The face after blasting shall be thoroughly dressed by shovel bucket so that loose materials do not fall in unsuspecting manner.
- Bench height of Coal/ Waste shall be in match with the bucket reach of the shovel. This will prevent any sudden flow of blasted material to operating benches.
- Before start of drilling, the benches shall be thoroughly inspected for the presence of any slip plane in the targeted blasting area and a few meters behind.
- Blast drill holes must be made for proper sub grade drilling.
- Toe of bench being blasted must be cleaned properly before drill.
- Blast drill holes pattern must be designed, initially supervised by experts for desired fragmentation and avoidance of back breaks.
- After blasting, top surface of the blasted benches shall be thoroughly inspected for presence of any back break.

In either case blasting/ re-blasting will be designed to cover the slips/ cracks and make excavating activity safe and smooth.

Rajesh Ranjan
27 DEC 2021

Vijay Kumar Singh
(Recog. ... Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

10.6.2 Due to rock quality & depth of deposit

The mine has been planned for a maximum depth of 474 m. At this depth of high wall the pressure to the exposed layers, at depth, is appreciable.

The Rock Quality Designation (RQD) of the roof & floor of the seams has been assessed. The analysis of results show that range of RQD is >50 to 100. The Rock Mass Quality (RMQ) has accordingly been found to be FAIR to EXCELLENT. It is, therefore, concluded that chances of strata failure are remote.

When mine would be operated and signs of weakness, if any, are observed, re-testing could be taken up with mined out rock slabs for the revised assessment of Rock Mass Quality.

10.7 FAILURE OF DUMP SLOPES

The temporary and internal dumps have been benched at 30 m. height. Although individual OB bench slopes would stand at its natural angle of repose i.e. 37^0 the overall slope gets reduced to 24.8^0, by leaving a 25 m. wide berm between two successive benches. This reduces the chance of OB slope failure and subsequent damages. The dumps, once sterile, shall be stabilized by bio-reclamation for its permanent sustenance. This will obviate any chances of dump failure.

The following precautions would be taken to avert accidents from dump failure.

- No rain water would be allowed to enter dump base. Garland drain around dumps shall be kept clean and effective to ensure it.
- Any sign of tensile cracks would be consolidated by dozing & reducing the slope angle to angle less than 37^0.
- Dump base shall be prepared by removing all soil, weathered mantle and by undertaking mild digging to make a rugged dump base for better foot hold of the dump.
- The top soil & weathered mantle would always be placed only at the top of a dump for its reclamation. These lubricating materials would not be placed in lower horizons to ensure no adverse effect on the cohesive strength of the waste dumps.

Rajesh Ranjan
E.E. (P&S)
TVNL, Hindpiri, Ranchi-834002
27 DEC 2021

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

- During rainy season, dumps should be inspected by safety officer and experienced mining officials to detect signs of weakness in dumps.

10.8 BLASTING IN THE BENCHES

Blast design would be made carefully so that fragmentation is achieved with desired features. By regulating the burden, spacing, column of explosives, proper sequencing & proper stemming of charged holes and specific combination of explosives, any danger of fly rocks and dangerous ground vibration in built up area would be controlled. During blasting, safety precaution for removing men and machines out of danger zone, would be ensured.

10.9 FIRE IN COAL BENCHES/ COAL STOCK YARD.

Spontaneous heating of coal may cause fire in its coal benches, coal yard etc. if these remain idle covering incubation period of the coal. However, in the instant mine, the work area remains concentrated and therefore, benches would remain active during most of the operational periods. The mine would progress in routine manner, each faces moving in sequence. Therefore large stretch of mine does not remain idle and exposed for oxidation of coal or carb shale. The backfilling would be regular. Therefore, idle face scenario would not take place. Hence chances of fire would be rare. Never the less, if any coal bench is to remain idle for some season, the same shall be periodically inspected and properly dressed and cleaned from all loose coal or fines at regular intervals. This precaution and regular progress of faces would prevent chances of fire.

There would not be any sizable coal in the stock yard as coal would continuously be dispatched to linked power house within the State of Jharkhand. Hence, wagon availability would be better as transfer circuit is within the state and haul distance is about 160 Km only. However, provision of pumped water supply, with permanently laid pipe lines shall be ensured in the coal stock yard to deal any eventuality. To prevent stock fire, the axiom of first come first go would be maintained, so that old coal stocks do not remain sterile.

Rajesh Ranjan
TVNL, Mines, Ranchi-834002
27 DEC 2024

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

10.10 FLOODING OF THE MINE

The proposed excavation area would be encircled by garland drains all around its perimeter. Water from precipitation would be duly guided into the drains, to avert entry of outside water into mine.

In the North-Central region of the coal bearing area, a patch of 150 ha over Metamorphic High (MH) has been excluded from coal extraction due to poor coal occurrence and dense population. As a result mine boundary has gone further deep into South instead of staying close to river bank of Sukri. The mine boundary had to detour 150 ha MH area. South bank of river Sukri is high and rocky except West end region. There is no history of flooding of the villages on its South bank. However, as abundant precaution, an embankment with road on its top has been proposed at a level, more than 1.5 m above highest flood level (HFL), to protect the opencast mine against flooding. Conceptual plan (Plate No. – 11) and Stage Plans show this HFL. All monsoon preparation activities shall be completed before on set of monsoon to prevent any risk of flooding.

10.11 ACCIDENTS DUE TO LACK OF PROPER SPACE FOR MOVEMENT IN MINE

Workers around shovel, dumper, dozer, drill and cranes must be warned to keep out of blind area so that operator may be able to see them clearly. Audio visual alarm would be used for pre-warning persons around these machines. To overcome shortage of space, strict discipline would have to be inculcated amongst workmen and supervisors, who would be required to work in such areas.

10.12 DISASTER MANAGEMENT PLAN

The disaster is an event which takes place without warning and confronts in an unforeseen manner. The following disasters can be imagined in the proposed project.

1. Bench failure
2. Dump failure

Therefore a plan would be in place to deal with bench failure and dump failure. Mock rehearsal would be held periodically for training and preparedness.

Rajesh Ranjan
CSE (P & S)
TVNL Hindi, Ranchi
21 DEC 2015

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CHAM
Dated- 29.05.2015]

10.12.1 Bench failure

The benches in the overburden rocks are proposed upto a maximum of 20 metre in height and upto a maximum of 40 m in width. On these horizontal benches, regular movement of dumpers and shovels would take place. Any sudden failure of the vertical face would cause dangerous situation to the top horizontal bench and would move large quantity of debris to the lower benches, thereby causing serious mishap to the equipment & persons deployed at the two benches. Following actions would be taken to avert this mishap/ disaster.

i. Thorough inspection of the surface of benches to detect signs of cracks, slips or fault lines. The failure along these fault lines/ slips may be sudden and may result into disaster.

ii. Study of fault planes to record geo investigation details and marking the same on the working plans. This will help to plan blasting in the Faulted area so that the fault planes and sympathetic weak planes are taken care of through scientific interpretation and analysis.

iii. Benches would be continuously inspected, results of survey and inspection to be monitored, to detect any impending movement of the bench which might result into its failure.

10.12.2 Dump failures

The waste dumps, till these have been stabilized and have become old or settled, are likely to fail and cause disasters. Failures can be averted by:

i. Designing the height of external dumps up to a maximum of 90 meters above ground level. Each 30 m high bench would have minimum berm width of 20 m. This design keeps overall slope at 27^0.

ii. Keeping dumps so graded at the top, that water does not accumulate at the top and drains back in direction opposite to advancing OB dump edge.

iii. Ensuring that during dump formation, soil/ sub soil does not get mixed up with rocks, at say below 10 meters from proposed dump top. The dumps should be having only hard rocks below 10 meters from their surface level.

iv. Soil/ sub soil would be put only on sterile dump tops, which would be ready for bio-reclamation.

Rajesh Ranjan
17 DEC 2024

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

v. Dump base shall be prepared by removing soil, loose weathered mantle and by mild digging to ensure to make a rugged dump base.

vi. Any sign of tensile cracks would be consolidated by dozing & reducing the slant angle to milder slope.

vii. During rainy season, dumps should be inspected by safety officer and experienced mining officials to detect signs of weakness in dumps.

10.12.3 Disaster Management Preparation

Each Coal Mine prepares an emergency operational plan to be activated in case of major accidents or disasters. This plan is to be vetted by DGMS and is governed by the provisions of the Mine Act - 1952. This is to be prepared & submitted for approval by DGMS just after opening a mine. It is known that in case of any mishap, DGMS is the organization which is first to be informed. The emergency plan for disaster management is executed under the guidance of the best brains of the industry and senior officers of the regulator, the Directorate General of Mines Safety, GoI.

10.13 SUPERVISION

10.13.1 First Level of Supervision

A structure of executives have been suggested for supervision of this large opencast project. A General Manager would head the mine. He will also shoulder the responsibility of Agent for the mine. He will coordinate the following departments:

i. Dy. Chief Mining Engineer (Mine Manager)

ii. Supt. Engr./ Senior Manager (Civil Engineering & Town Administration)

iii. Senior Manager (Personnel)

iv. Senior Manager (Finance)

v. Senior Manager (Material)

vi. Security Officer

vii. Administrative Officer (Head of the Office Administration of General Manager)

Rajesh Ranjan
ESE (P & S)
TVNL, Hindo, Ranchi-834002
27 DEC 2021

Vijay Kumar Singh
(Re... ...rson)
(Recog... ...CPAM
Dated...

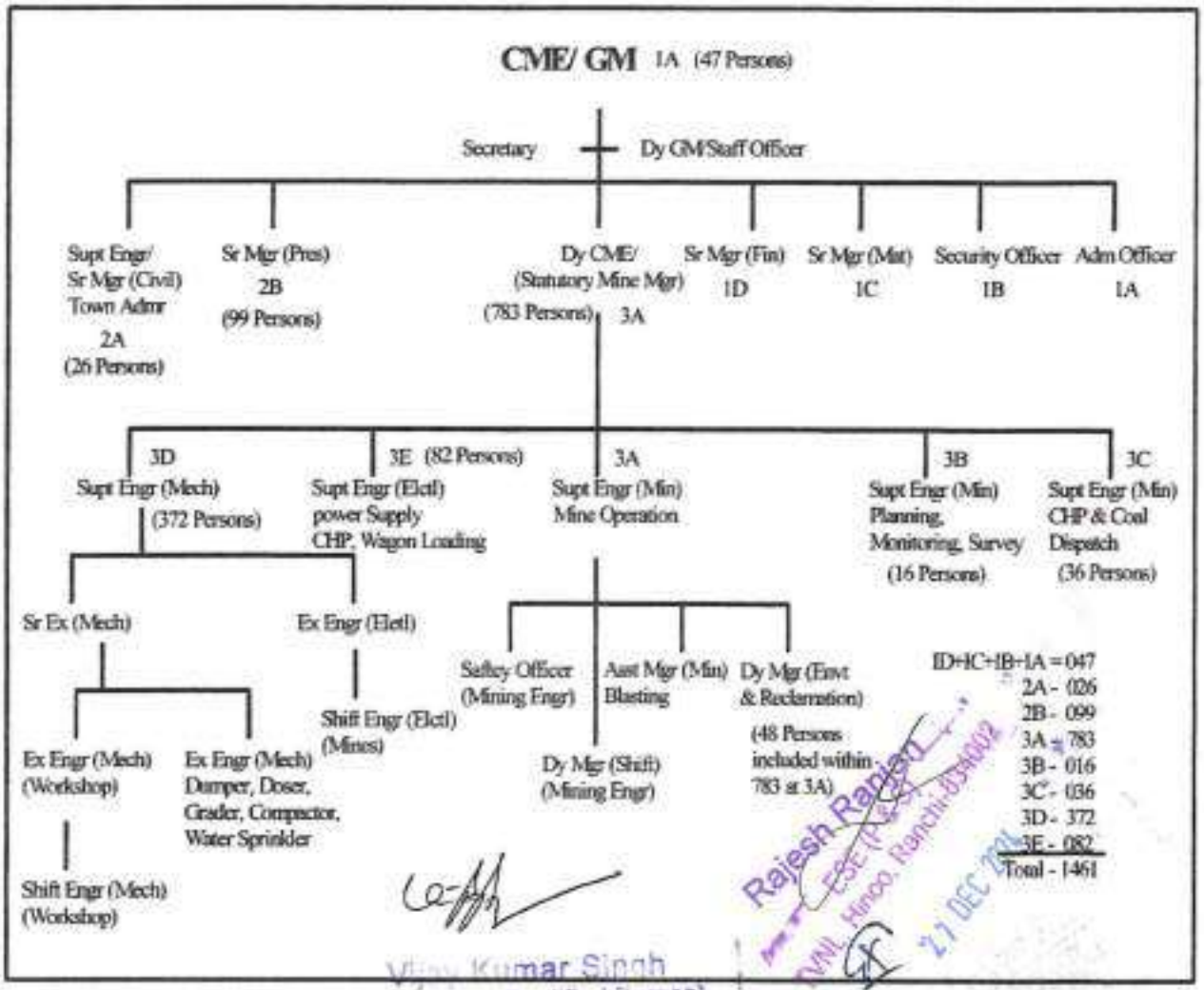
10.13.2 Second Level of Supervision

The Dy. Chief Mining Engineer (Mine Manager) would have the following departments under his supervision.

i. Mechanical Engineering and Maintenance of Opencast Mining Equipment in the Mine Field and Workshop
ii. Electrical Engineering, Power Supply, CHP and Wagon Loading
iii. Mining Engineering, Mine Operation, Safety and Blasting
iv. Mine Planning
v. Coal Dispatch

The number of levels in the structure for supervision besides inter relationship between various departments may be seen in the structure diagram given below:

10.13.3 Organization Structure



Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM Dated- 29.05.2015]

Rajesh Ranjan
CSE (R&D)
TVNL, Hinoo, Ranchi-834002
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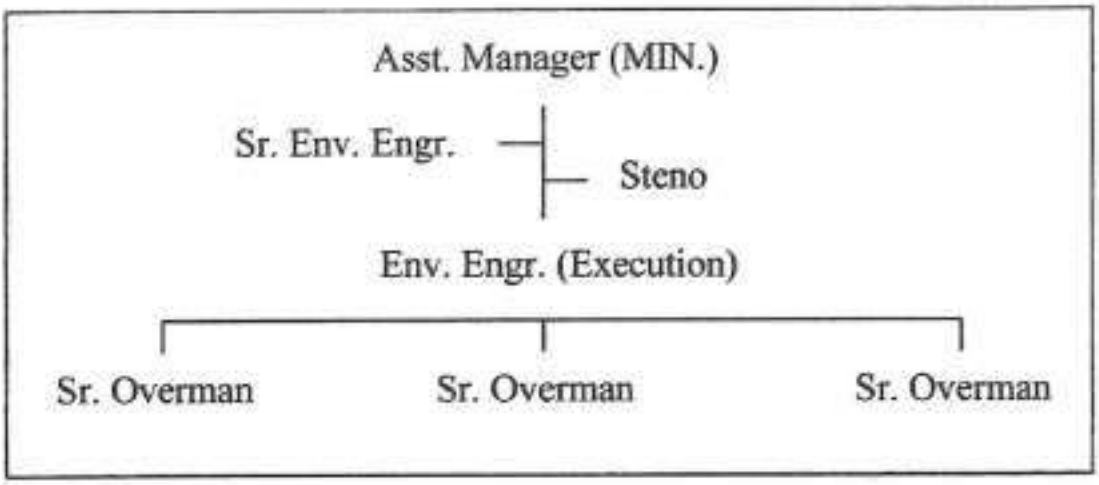
10.13.4 Manpower for Environment Mitigative Measures including Land Reclamation

Supervisory Manpower Chart



10.13.5 Manpower details for Major Structural Positions

Structural chart given above may please be seen. Major structural positions have been identified as 1A, 1B, 1C, 1D, 2A, 2B, 3A, 3B, 3C, 3D & 3E. Manpower details in terms of workers, supervisors and executives have been given hereafter in table no. – 10.6.

Table N. – 10.6
Manpower details for Major Structural Positions

Position in Organization Chart	Identity No. of Position	Workers (Skilled & Unskilled)	Staff (Technical, Supervisory & Clerical)	Executives	Total
GM/ CME	1A	17	4	3	
Security Officer	1B	*	4	1	
Sr. Mgr./ Mgr (Materials)	1C	2	6	2	
Sr. Mgr./ Mgr (Finance)	1D	*	5	3	
	Sub Total	**19**	**19**	**9**	**47**
Supt. Engr. (Civil)/ Town Manager	2A	16	6	4	26
Sr. Mgr./ Mgr (Personnel)	2B	36	48	15	99
Dy. CME/ Mine Mgr.	3A	712	57	14	783
Supt. Engr. (Mining)/ Planning	3B	2	7	7	16

Vijay Kumar Singh
(Recognised Competent Person)
[Recognition No. 3402(13)/2014-CPAM
Dated- 29.05.2015]

Position in Organization Chart	Identity No. of Position	Workers (Skilled & Unskilled)	Staff (Technical, Supervisory & Clerical)	Executives	Total
Supt. Engr. (Mining)/ CHP & Coal Dispatch	3C	20	12	4	**36**
Supt. Engr. (Mechanical)	3D	302	38	32	**372**
Supt. Engr. (Electrical) Power Supply, CHP & Wagon Loading	3E	58	13	11	**82**
	Sub Total	**1146**	**181**	**87**	**1414**
	Grand Total	**1165**	**200**	**96**	**1461**

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Rajesh Ranjan
27 DEC 2024

CHAPTER – XI

TRANSPORT OF COAL, MEN & MATERIAL

11.0 GENERAL

Rajbar E & D Coal Mine is proposed to be an opencast mine where in transport of coal, transport of waste (OB/ IB), transport of material and transport of men need to be detailed.

11.1 TRANSPORT OF COAL

Coal would be cut by surface miner in windrowing mode i.e. coal would be dropped on floor in rows. It would be loaded by 18 m^3 wheel loader into Coal Body Dumper (CBD) of 100 t capacity. CBD would transport it to mobile hopper and apron feeder/ belt which in turn transfers coal to trunk belt at the Northern edge of the advancing face.

11.2 MOBILE HOPPER FITTED WITH APRON FEEDER/ BELT

The entire outfit of mobile hopper fitted with apron feeder/ belt is mounted on a set up of wheel chassis for its easy transportability. Usually the hopper is located on lower bench, it is mobile and fitted with an apron feeder/ belt for transfer of dumped coal to trunk belt. A series of mobile trunk belt kept in tail to head mode would feed on to a permanent belt on the floor of the mine at the Northern Edge. These trunk belts would carry coal upto CHP at its built in capacity of 2000 tph of coal.

11.3 TRUNK BELT FROM MINE TO CHP

The trunk belt would be laid along the Northern edge of working faces. It would collect coal from five major coal seams such as R1, VII M, VI M, IV B & III B. The working benches would have mobile short length conveyors on wheels kept in tail to head fashion so that coal could be transferred from one belt to the other moving towards the main trunk belt laid on the floor of the mine. After 10th year, one additional trunk belt would be laid by the side of the

Rajesh Ranjan
ESE (P & S)
TVNL Hindi, Ranchi-834002
27 DEC 2024

Vinay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

previous one to take care of any interruption to the movement of one of the two belts and maintain continuous movement of coal to CHP.

11.4 MOBILE TRUNK BELTS

Mobile short length trunk belts are required at the Northern edge of working faces moving towards West to allow drilling and blasting at the place where these are located. These trunk belts would be mounted on wheel chassis and could be moved out of the place required for drilling and blasting. These could be placed back after the blasted material has been moved out and bench has been made clean to receive the short length trunk belts back. The movement of these mobile belts is managed with the help of a dozer or a tractor.

11.5 TRANSPORT OF WASTE (OB & IB)

There are two sizes of trucks proposed for transport of waste. 40 m^3 HBH would load 360 t rear dumpers and 12 m^3 HBH would load 120 t RD. Till 4th year of mine operation both types of trucks would transport waste to temporary dump located on West side of advancing benches. From 5th year onwards the trucks would have two destinations. The trucks would be distributed between temporary dump and back fill dump.

11.6 APPROACH ROAD FOR TRUCKS FROM FACE TO BACK FILL WASTE DUMP

On the South and North side, after reaching the mine limit, the benches would be merged to create final slope of the bench. Whereas North benches would be at 45^0 final slope, South side benches would have a final slope between 37^0 to 40^0. For nearly every 40 m height of bench, a 25 m wide bench would be left out for transport of waste trucks. These benches would connect face to different levels of waste dump roads. The selected bench for this purpose would have matching reduced levels for comfortable movement of trucks from face to waste dump. Incidentally backfill road of waste dump are also 25 m wide to enable waste trucks to move smoothly. Mine stage Plates No. from 15 A to 15 H may be seen for better clarity of connectivity between face and backfilled benches. Connectivity between infrastructure establishment on the

South, peripheral road temporary dump and CHP may also be seen on these drawings.

11.7 WORKING BENCHES ON A SLOPE OF 1 IN 15

Most of the working benches are grading at about 1 in 15 being on an apparent dip, 60^0 off from main dip of floor being at 1 in 7.5. The working benches, therefore rise towards North and dip towards South. At 40^{th} year stage and later, gradient goes upto 1 in 11. However, these gradients can be negotiated comfortably with a little lighter truck load (possible due to reduced work load for trucks after 40^{th} year stage). Ramps at a gradient of 1 in 12 or flatter connect all the benches from mine floor to surface. The upper benches rise at a gradient of 1 in 15 to reach the surface. It may therefore be seen and would be evident from the study of stage plans that all the establishments such as temporary dumps, infrastructure area, peripheral road, mine floor and CHP are well connected.

11.8 TRANSPORT OF MATERIAL

Equipment configuration provides diesel bowser for fuel supply to diesel mining equipment. Maintenance vans have been provided for lubrication and maintenance of mine field based equipment such as shovels (HBH), surface miners, blast hole drills, dozers etc. Tipping trucks provided would take care of the rest of the work concerning transport of materials.

11.9 TRANSPORT OF MEN

Special trucks and four wheelers would be provided for transport of men from time office (Attendance room) to various places of duty in the opencast mine at the beginning and close of each of the three shifts. Executives would have four wheelers suiting to their job profile and status for movement within the project area and outside.

Rajesh Ranjan
ESE (P&T)
TVNL, Hirnoo, Ranchi-834002
27 DEC 2024

***
Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 3012/(03)/2014-CPAM
Dated- 29.05.2015]

CHAPTER – XII

INFRASTRUCTURE FACILITIES PROPOSED & THEIR LOCATION

12.0 GENERAL

Rajbar E & D Coal Mine will have the following major infrastructure for its operations. Among the infrastructure that will be provided are roads, water supply, power supply, office, CHP complex, workshops, sub-station, stores etc. Site facilities are very important for such high capacity mine. Location of some important infrastructure facilities like CHP, Coal conveyor Transfer Point, workshop, substation, project office, colony, approach road to these units has been shown Proposed Surface Layout/ Conceptual Plan (Plate No. – 11).

12.1 ROADS

12.1.1 Connectivity

Connecting roads have been proposed in the project area covering, interalia, the project office, CHP area, Infra area and Residential township etc. Besides, roads have also been provided all along the project boundary, for connection to outside areas.

12.1.2 Colony Roads

The width of colony roads has been envisaged as 5m. Provision for culverts, tree guards, avenue plantation and drains has been made.

12.2 HEMM WORKSHOP

For maintenance and repair of equipment deployed, the following maintenance and repair concept has been envisaged:

a) Daily maintenance, scheduled maintenance, minor repair and replacement of sub assembly are proposed to be carried out in the project maintenance and repair workshop. In case of a Mine operator, this shall be managed by him.

Rajesh Ranjan
27 DEC 2024

V... Kumar Singh
(Recognised Qualified Person)
[No. J-11012/03/2014-CPAM
Dated- 29.05.2015]

b) Capital repair and major overhauling of equipment have been proposed at manufacturers' repair unit or, by outside agency. The mine operator would suitably accommodate this agency. Site has been provided in the infrastructure area for required workshop in the project area.

12.3 ELECTRICAL EQUIPMENT REPAIR SHOP

Scope of work for E&M workshop unit will be

- Minor repair, medium repair, replacement of components, assemblies and sub-assemblies of Mine conveyors, crushers, CHP, pumps and electrical equipment.
- Minor and medium repair of switch gears, motors, self-starters and other electrical equipment. In case of Mine operator, he shall manage it.

12.4 SUB-STATION

An Electrical Sub-station has been proposed for supply of power for the requirements of the Project & township. This will be brick masonry, on RCC beam foundation and slab construction with RCC louvers for ventilation and ducts with proper size for electric cables. Power will be available at 33 K.V. from nearest JSEB or DVC substation.

12.5 WATER SUPPLY AND SEWERAGE MANAGEMENT

12.5.1 Colony Water Supply

It has been envisaged that the requirement for the water demand for the colony shall be met from U/G bore wells or treated mine water. Water will be stored in a ground reservoir envisaged in the colony area. This water is proposed to be treated and supplied to colony through gravity after being pumped to overhead tanks, located within the colony. Since, ground water development in the area is low, water for drinking can be drawn from ground water source also with due permissions of concerned authorities.

Rajesh Ranjan
ESE (P & S)
TVNL, Hinoo, Ranchi-834002
27 DEC 2015

12.5.2 Industrial Water Supply

To meet the industrial water demand of the Project, water pumped out of the mine has been envisaged to be used for industrial water supply. Overhead

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
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tank will be fed with cleaned water. From this tank, water for industrial purposes has also been considered to be delivered to various industrial buildings, administrative complex & quarry sites and is proposed to be distributed by gravity to the point of consumption through a distribution network. For haul road dust control, water tankers will used as mobile sprinklers.

12.5.3 Colony Sewerage

Colony sewage has been proposed to be dealt through septic tanks, soak pits as well as Sewage Treatment Plant as per ground suitability. The system will be firmed up at DPR stage.

12.5.4 Industrial sewerage

It has been considered that the industrial effluents from workshop and other industrial establishments would be led through oil & grease traps. The effluent coming out of the industrial premises is proposed to be treated and led to the settling tank and to be recycled for various industrial uses for this project.

12.6 SERVICE BUILDINGS

Service buildings would include community buildings like dispensary, officer's and staff rest houses, shopping centre, community centre etc. apart from offices, workshop & stores, sub-stations, shovel erection yard, magazine & other statutory buildings. Provision has been made for statutory buildings like canteen, first aid centre, rest shelter, training centre, pit head bath etc.

12.7 ADMINISTRATIVE OFFICE

This would accommodate the office of head of the project along with all staff officers e.g. S.O. (Mining), S.O. (E&M), S.O. (Personnel), S.O. (Finance) and other support services heads. The mine head of the projects under Coal Mine Regulations would also operate from the office.

Rajesh Ranjan
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12.8 PIT CUM TIME OFFICE

This will be put up at the pit top for ensuring the attendance of all pit employees and for keeping statutory mine records.

12.9 RESIDENTIAL BUILDINGS

The proposed project has been envisaged as mechanised mine requiring skilled manpower. This manpower is required to be housed near the project site for smooth and continuous operation of the mine. In case of mine being operated through a mine developer and operator, the residential buildings shall be reviewed, at detailed project report stage, as the mine operators may themselves provide accommodation to their workers.

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Vijay ... Singh
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Dated ... 2015]

Rajesh Ranjan
ESE (P & S)
TVNL Hqrs, Ranchi-834002
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CHAPTER - XIII

LAND REQUIREMENT

13.1 THE ALLOTTED AREA

The allotment of Rajbar E & D Coal Mine Block, was done to TVNL by MoC, GoI vide their Order No. 103/19/2015/NA dated 30-06-2015 (***"Annex – I"***, To be read with Corrigendum No. 1 dated 21.12.2016, placed at ***"Annex. – I A"***). The surface coverage of the allotted block area comes to 1487 ha; which is based on coordinates of terminal points (71 Nos.) given by CMPDI/ MoC. For carrying out the envisaged mining activities, a total of 1320 ha of this allotted area has been firmed up with due considerations. About 167 ha have remained unused due to reasons explained in table no. 13.1. The table no. - 13.1 below shows detailed uses of the allotted area and details of land not used within the allotted area.

Table No. – 13.1
Allotted Area – 1487 ha

I. Land Uses for proposed mining activities in the Allotted Area				
Sl. No.	**Uses**	**Area in ha**	**Non Forest**	**Forest**
1.	Excavation Area	1262	798.05	463.95
2.	Road	7.0	1.90	5.10
3.	Garland Drain	3.5	1.58	1.92
4.	Embankment (14 m wide) including Road (7.5 m wide) #	9.5	5.75	3.75
5.	E.T.P.	1.2	0.6	0.6
	Magazine,	1.0	0.5	0.5
	Sedimentation Tank	0.6	0.6	0
6.	CHP with Coal Storage area	12.7	0	12.7
7.	Green Belting Area : # i. Around Mine Excavation including Mine Barrier - 21.0 ii. Around CHP and Coal Storage - 0.5	21.5	15.89	5.61
8.	Undisturbed (Ear marked for location of pair of inclines)	1.0	0	1.0
	Total	**1320**	**824.87**	**495.13**
II. Land Not Used in the Allotted Area				
Sl. No.	**Reason**	**Area in ha**	**Non Forest**	**Forest**
1.	Area in North-Central portion (Metamorphic high) with extreme poor coal deposits. It has only 7.85 Mt of coal deposit and is covered by a population of about 800 people.	150		
2.	In the River bed & its meanders - (Blocked reserves- 1.18 Mt)	17		
	Total	**167**		
	Grand Total (1320 ha + 167 ha)	**1487 ha**		

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 31/12/03/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
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13.2 PROPOSED PROJECT AREA/ LEASE AREA

The project area of the proposed mine will cover coal bearing land used for proposed mining activities (1320 ha) and non coal bearing land of 31 ha area used for associated mining activities as shown below in table no. – 13.2. The land area outside the block, is covered for the following uses.

Table No. – 13.2

Land Uses for associated mining activities outside Allotted Area

Sl. No.	Uses	Area in ha	Non Forest	Forest
1.	Electrical Substation	2.00	2.00	0.00
2.	Work Shop	2.90	2.90	0.00
3.	Store	1.90	1.90	0.00
4.	Road	4.00	3.22	0.78
5.	Garland Drain	0.80	0.68	0.12
6.	Office	1.90	1.90	0.00
7.	Township	10.10	10.10	0.00
8.	Green Belt Between Mine & Infra Areas	7.40	6.15	1.25
	Total	**31.00**	**28.85**	**2.15**

Total coverage for the proposed Project Area comes to 1320 ha + 31 ha = 1351 ha. For clearance of this 31 ha of land, outside allotted block area, an application from TVNL has been made to State Govt., for issuance of Letter of Intent (LoI) in compliance with guidelines issued by MoC on 8th May 2018. This application has been enclosed as ***"Annex. – XVIII (C)"***.

13.2.1 Land Ownership in the Project Land Area

The following is broad breakup of ownership of the proposed project land area of 1351 ha.

Sl. No.	Land Type	Ownership	Area in ha
1.	Tenancy	Private	581.18
2.	Govt. Non Forest (GM)	Government	272.54
3.	Forest (Notified & Demarcated)	Government	495.20
	Forest (Jungle Jhari)	Government	2.08
		Total	**1351.00 ha**

Rajesh Ranjan
ESE (P&S)
TVNL Hindo, Ranchi-834002
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(Rajesh Ranjan)
Director (Projects)
TVNL, Ranchi
Vijay ... 3h
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13.3 PRESENT, PROPOSED AND POST CLOSURE LAND USES OF THE PROPOSED PROJECT AREA – (1351 ha)

The present, proposed and post closure land uses for the proposed 1351 ha area is given below in table no. – 13.3 (Plate No. – 06, 11 & 15 H).

Table No. – 13.3

Details of Present, Proposed and Post Closure Land Uses for the Project

Area in ha

Present Land Use			Proposed Land Use		Land Uses	
Major Class of Land	**Land Use**	**Area**	**Type of Use**	**Land Area**	**End of Mine Life**	**Post Closure after Reclamation**
Tenancy	Agricultural	553.59	Excavation Area	1262.00		
	Township	–	Backfilled Area		982.00	
	Grazing	–	Excavated Void		280.00	
	Barren	20.09	Top Soil Dump			
	Water Bodies	0.74	External Dump			
	Road	–	Infrastructure	33.90	33.90	
	Community	–	Agricultural			506.48
	Inhabitated	6.76	Plantation Area	28.90	28.90	537.12
	Village	–	Water Body			269.00
Sub Total		**581.18**	Public/ Com Use	11.00	11.00	37.40
Govt. Non Forest	Agricultural	109.40	Other Use	14.20	14.20	
	Township	–	Undisturbed/ MR for UG	1.00	1.00	1.00
	Grazing/Other	–				
	Road	18.20				
	Water Bodies	51.16				
	Barren	88.22				
	Other Devsthan, School, Play ground etc.	5.56				
Sub Total		**272.54**				
Forest	Reserve	–				
	Protected	495.20				
	C-J-B-J	2.08				
Sub Total		**497.28**				
Free Hold	None	–				
Grand Total		**1351**	**Total**	**1351.00**	**1351.00**	**1351.00**

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
ESE (E) SI
TVNL, Hinoo, Ranchi-834002
27 DEC 2021

13.4 POST MINING LAND USES

The project area of 1351 ha will be subjected to reclamation/rehabilitation during and after cessation of mining activities. These reclamation activities will endeavour to reclaim the project area for gainful & productive land uses. The change of proposed land uses, envisaged during mining to improved & productive land uses after completion of reclamation activities during progressive and final mine closure, is also shown in the table no. 13.4 with item wise detailed breakup as Post Closure Land Uses.

Table No. - 13.4

Proposed (End of Mining) Land Uses (Plate No. – 15 H) and Post Mining Land Uses (Plate No. – 16 A)

Proposed Land Uses (At end of Mine life)			Post Mining Land Uses after Mine Closure Area in ha					
Sl. No.	Uses	Area in ha	Agriculture Use	Plantation	Water Body	Public & Other Use	Un-disturbed	Total
1	2	3	4	5	6	7	8	9
1.	Excavation area on Surface	1262	497.48	495.52	269.00			1262.00
2.	Road	11				11.00		11.00
3.	Electrical Substation	2	2.00					2.00
4.	Workshop	2.9	2.90					2.90
5.	Store	1.9	1.90					1.90
6.	CHP & Coal Storage	12.7		12.70				12.70
7.	Garland Drain	4.3				4.30		4.30
8.	Embankment	9.5				9.50		9.50
9.	Green Belt	28.9		28.90				28.90
10.	Sedimentation Tank	0.6				0.60		0.60
11.	Township	10.1				10.10		10.10
12.	Office	1.9				1.90		1.90
13.	ETP	1.2	1.20					1.20
14.	Magazine	1	1.00					1.00
15.	Undisturbed (UG entry)	1					1.00	1.00
Total		**1351**	**506.48**	**537.12**	**269.00**	**37.40**	**1.00**	**1351.00**

Remarks:- Forest Land returned 497.28 ha, is part of plantation, water body and other areas (see table no. – 14.7 in Chapter – XIV).

The details of reclamation activities to bring this envisaged post mining land scenario, has been covered in detail in the next chapters covering Environment Management and Mine Closure Plan.

Rajesh Ranjan
ESE (P & S)
TVNL, Hinoo, Ranchi-834002
27 DEC 2024

Singh
d Person)
3)/2014-CPAM
2015]

CHAPTER – XIV

ENVIRONMENT MANAGEMENT PLAN

14.1 GENERAL

The management of environment in the project area, and in the surrounding impacted areas (buffer zone of the project) is one of the primary activity of the project operator. In mining sector, it is more important as mining is considered a polluting operation. Therefore, before a project can be started, environmental clearance for the proposed project activities is to be had from the concerned regulatory authorities. In case of this project, MoEF & CC, GoI and Jharkhand State Pollution Control Board are regulatory authorities.

A mining plan for the block has to be approved by MoC, GoI for considering the environmental clearance and other approvals of a project, by regulatory authorities. This environment management chapter briefly discusses the management of impacts caused by the envisaged project activities, which is to be covered, in detail, in the EIA/EMP to be submitted to MoEF & CC, GoI for Environment Clearance.

14.2 SALIENT FEATURES OF THE PROJECT

14.2.1 The Allotted & Project Areas

The project is located in the Auranga Coalfield, in Latehar District of Jharkhand State. It lies in the Survey of India Toposheet No. F45A9 RF-1:50,000.

The allotted area of the block is 1487 ha. However, for mining of coal and allied activities, the proposed project area has been planned covering 1351 ha. The land requirement for the project, has been discussed in detail in previous Chapter – XIII. The chapter XIII also gives details of envisaged post mining land uses of the 1351 ha project area.

Kumar Singh
Rajesh Ranjan
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14.2.2 Communication

Connected by an all weather road, the proposed project area lies about 9.5 km north of the NH – 75, which is going from Ranchi to Rewa in the State of Madhya Pradesh. The road distance from the project to Chetar Railway Station is 13.7 km. It lies between Latehar & Tori Railway Stations, situated on the Gomoh-Barkakana-Dehri-on-Sone loop line of East-Central Railway.

14.3 SALIENT FEATURES COVERING THE ENVIRONMENTAL BASELINE STATUS OF THE PROJECT AREA & BUFFER ZONE

14.3.1 Land Regime

The following table no. – 14.1 gives the details of status of present land.

Table No. – 14.1

Major Class of Land	Land Use	Area in ha
Tenancy	Agricultural	553.59
	Township	–
	Grazing	–
	Barren	20.09
	Water Bodies	0.74
	Road	–
	Community	–
	Inhabitated	6.76
	Village	–
	Sub Total	**581.18**
Govt. Non Forest	Agricultural	109.40
	Township	–
	Grazing/Other	–
	Road	18.20
	Water Bodies	51.16
	Barren	88.22
	Other Divsthan, School, Play ground etc.	5.56
	Sub Total	**272.54**
Forest	Reserve	–
	Protected	495.20
	C-J-B-J	2.08
	Sub Total	**497.28**
Free Hold	None	–
	Grand Total	**1351**

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Vikas Kumar Singh Recognised Qualified Person [Recognition No. 34012/(03)/2017-CPAM Dated- 29.05.2015]

The existing land uses of the project area (1351 ha) has 853.72 ha of non forest land & about 497.28 ha of forest land. Of the 853.72 ha of non-forest, it has 553.59 ha of tenancy agricultural land and rest 300.13 ha are covered by habitation & road, water body, waste land etc.

14.3.2 Water Regime

14.3.2.1 Surface water

The Sukri nadi flows on North side of the project area. There are 1st & 2nd order channels, generating in the project area and flowing out in West and North directions. Some 2nd order streams enter the project area from East side and flow out across West side. They are rather, ephemeral channels, flowing in rainy season or a little beyond.

Further, there are some ponds in the project area which get dry with onset of summer. Total surface water bodies cover 51.90 ha in the project area. Surface Water quality report for Sukri nadi, assessed at two sites – S_1 & S_2 in the buffer zone, is given below in table no. – 14.2. Detailed hydrological studies shall be carried out, during formulation of EIA/EMP for the proposed project. The certificate is enclosed as ***"Annex. – XVII"***.

Table No. – 14.2

Surface Water Quality of Sukri Nadi

Standard : IS2296 Class A

Sl. No.	Parameter	S_1	S_2
1.	pH	8.28	8.02
2.	Total Suspended Solids (TSS)	11.7	14.2
3.	Total Dissolved Solids (TDS)	284.5	248.0
4.	Calcium Hardness as $CaCO_3$	15.5	9.4
5.	Magnesium Hardness as $MgCO_3$	34.8	6.6
6.	Total Alkalinity	128	38
7.	Phenolic compound as C_6H_5OH	BDL	BDL
8.	Sulphate as SO_4	7.6	20.1
9.	Chemical Oxygen Demand (COD)	1.78	0.57
10.	Dissolved Oxygen (DO)	6.25	6.44
11.	Bio-chemical Oxygen Demand (BOD) at 20^0C for 5 days	1.1	0.36
12.	Oil and Grease	BDL	BDL

Rajesh Ranjan
ESE (P & S)
TVNL, Hinoo, Ranchi-834002
27 DEC 2014

Vijay Kumar Singh
(Recognised ... Person)
[Recognition No. 3... ...PAM
Dated- 29.05.2015]

Sl. No.	Parameter	S_1	S_2
13.	Fluoride F-	0.5	0.5
14.	Iron (Fe)	0.21	0.12
15.	Copper (Cu)	BDL	BDL
16.	Arsenic (As)	BDL	BDL
17.	Lead (Pb)	BDL	BDL
18.	Zinc (Zn)	BDL	BDL
19.	Boron (B)	BDL	BDL

14.3.2.2 Ground Water

The occurrence of groundwater in Rajbar area is mainly controlled by the topography, physical characteristics and structure of the water bearing formations. The weathered residuum of the hard rocks as well as the fractures, joints, fissures, faults and other zones of discontinuity are the main water bearing formations of the area. The movement of ground water is mainly controlled by presence of natural openings in the rock formations, its continuity and interconnection of joints and fractures. Groundwater in the area is withdrawn usually by means of open dug wells and hand operated tube wells.

Ground water Sample results from some buffer zone villages namely Tubed, Dhobiajharan & Mangra is given below in table no. – 14.3.

Table No. – 14.3
Ground Water Quality of Some Villages in Buffer Zone
Standard : IS10500

Sl. No.	Parameters	Units	GW_1 Tubed	GW_2 Dhobiajharan	GW_3 Mangra
1.	Colour	Hazen	Colourless	Colourless	Colourless
2.	Odour	-	Odourless	Odourless	Odourless
3.	Taste	-	Agreeable	Agreeable	Agreeable
4.	Turbidity	NTU	5.9	17.1	2.2
5.	pH	-	6.62	7.21	6.88
6.	Total Suspended Solids (TSS)	mg/l	3.4	12.5	1.9
7.	Total Dissolved Solids (TDS)	mg/l	442.5	557.1	614
8.	Calcium Hardness as $CaCO_3$	mg/l	34.9	94.8	12.4
9.	Magnesium Hardness as $MgCO_3$	mg/l	25.1	27.2	45.6
10.	Total Alkalinity	mg/l	104.0	80.0	116.0
11.	Chloride as Cl-	mg/l	23.97	18.98	97.90
12.	Sulphate as SO_4	mg/l	31.7	15.1	49.3
13.	Nitrite-Nitrogen (NO^3-N)	mg/l	0.090	0.206	0.124

Rajesh Ranjan

Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

Sl. No.	Parameters	Units	GW_1 Tubed	GW_2 Dhobiajharan	GW_3 Mangra
14.	Chemical Oxygen Demand (COD)	mg/l	2.152	4.384	10.2
15.	Dissolved Oxygen (DO)	mg/l	4.28	3.22	5.3
16.	Bio-chemical Oxygen Demand (BOD) at 20°C for 5 days	mg/l	0.975	1.9	2.4
17.	Oil and Grease	mg/l	BDL	BDL	BDL
18.	Fluoride F-	mg/l	BDL	BDL	BDL
19.	Iron (Fe)	mg/l	0.148	0.23	0.24
20.	Copper (Cu)	mg/l	BDL	BDL	BDL
21.	Arsenic (As)	mg/l	BDL	BDL	BDL
22.	Lead (Pb)	mg/l	BDL	BDL	BDL
23.	Zinc (Zn)	mg/l	BDL	BDL	BDL
24.	Hexavelent Chromium (Cr^{+6})	mg/l	BDL	BDL	BDL
25.	Chromium (Cr)	mg/l	BDL	BDL	BDL
26.	Mercury (Hg)	mg/l	BDL	BDL	BDL
27.	Cadmium (Cd)	mg/l	BDL	BDL	BDL
28.	Selenium (Se)	mg/l	BDL	BDL	BDL
29.	Aluminium (Al)	mg/l	BDL	BDL	BDL
30.	Boron (B)	mg/l	BDL	BDL	BDL
31.	Total Coliform at 37°C	MPN per 100 ml	BDL	BDL	BDL

Detailed water quality analysis in the project area and buffer zone area will be covered during the EIA/EMP formulation of the project.

14.3.2.3 Ground Water Development

Dug wells are the main ground water extraction structures in the project area to meet the demand of water for domestic and agricultural needs. Therefore, overall stage of ground water development is quite low. Thus, there is sufficient scope for development of ground water to meet the future needs. As per CGWB, Latehar district has overall ground water development of less than 20%. In general, ground water is suitable for drinking and other purposes.

14.3.2.4 Water Balance Details

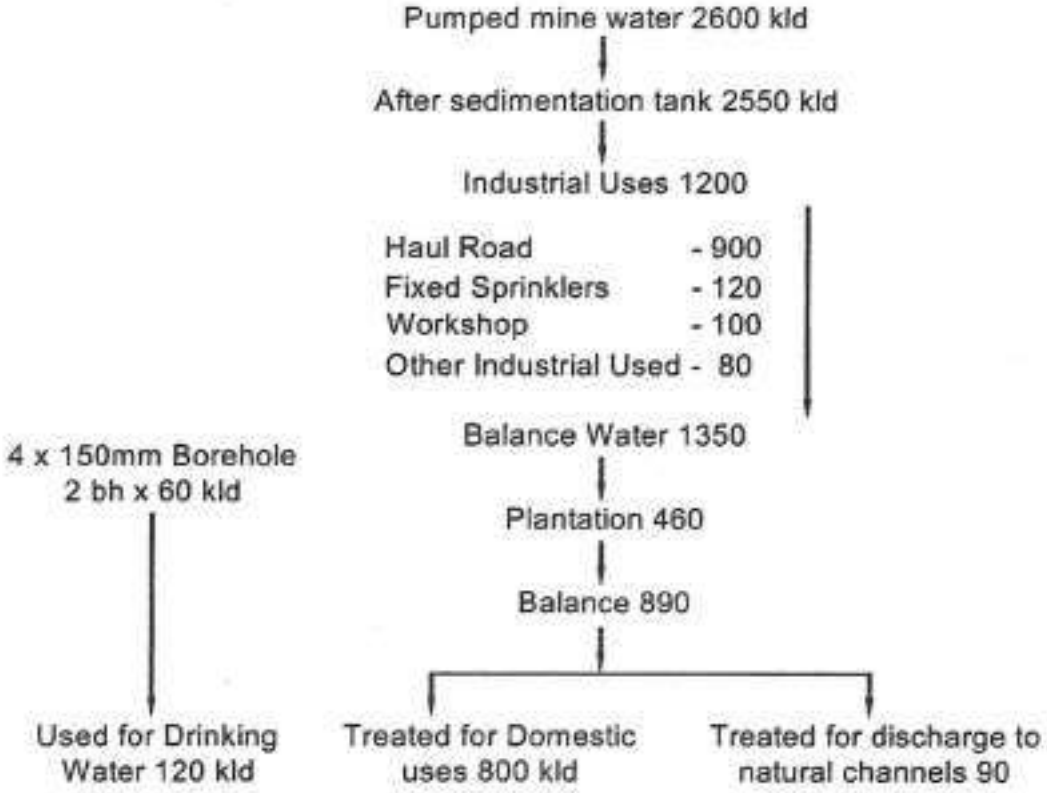
Underneath is given the estimated water balance flow diagram for the proposed mine operations. There is positive water flow from mine to natural

Rajesh Ranjan
ESE (P & S)
TVNL, H.Qrs, Ranchi-834002
27 DEC 2024

V[illegible]iar Singh
(Recogn[illegible] Qualified Person)
[Recogni[illegible] 312/(03)/2014-CPAM
Date[illegible]9.05.2015]

drainage. Further at end of mine life, a water lagoon is getting created which would support the flora/ fauna of the area and also help agriculture sector.

WATER BALANCE FLOW DIGRAM



14.3.2.5 Hydrogeological Study

A detailed Hydrogeological study will be conducted for preparation of EIA/EMP report for the project area. The study will be assimilated for firming up Environment Management Plan for the project area in the EIA/EMP documentation.

14.3.3 Air Regime

The area where project is envisaged to be opened is about 3 Km. away from nearest mine area i.e. Sikni mines of Jharkhand Mineral Development Corporation. Sikni is a medium size mine.

Rajesh Ranjan
ESE (P & S)
TVNL, Hinoo, Ranchi-32
27 DEC 2024

Vij- Singh
(Reco- d Person)
[Reporting V- 3)/2014-CPAM
Dated- 015]

The nearest town is Latehar, which is its district town. It is nearly 28 Km. away. Presently the project and surrounding area is having rural background. Therefore, ambient air in the proposed project area is of rural set up. It, therefore, has high level of assimilative capacity for supporting development. Detailed study will be undertaken during EIA/EMP studies for the project. Pre-mining, ambient air quality data, within project area of a proposed project, namely Tubed OCP, on N.W. Side of Rajbar E & D Coal Mine is given below in table no. 14.4. Air quality for Tubed, Dihi and Simaria villages are given below for an idea of the air quality in the area. The air quality shows enough cushion to allow development of a mine.

Table No. – 14.4
Existing Air Quality data in the neighbouring proposed Tubed Project
Season – Pre Monsoon

All figure in mcg/m^3

Sl. No.	Parameters	Tubed	Dihi	Simaria
1.	SPM	112.4	113.5	118.8
2.	RPM	28.1	26.5	30.2
3.	SO_2	13.5	14.4	12.0
4.	NO_X	15.5	15.5	13.5

14.3.4 Noise and Vibration

Details of noise level in some buffer zone villages, giving maximum & minimum noise level is given below:

Table No. – 14.5
Noise Level in Decibel – Maximum & Minimum

All figure in Decibel

Sl. No.	Village	Maximum Level		Minimum Level	
		Day	Night	Day	Night
1.	Tubed	60.5	40.9	41.7	33.8
2.	Ambajharan	60.9	44.2	43.5	35.6
3.	Hesalbar	58.8	43.3	40.5	34.9

The noise levels are all within permissible limit.

Rajesh Ranjan
ESE (P & S)
TVNL (Nimboo Ranchi)
21 DEC 2024

Singh
ad Person)
(03)/2014-CPAM
5.2015]

14.3.5 Soil Quality

Details of soil quality shall be analysed during EIA/EMP studies. However, soil quality in some buffer zone villages is given in table no. – 14.6.

Table No. – 14.6
Soil Quality in some Buffer Villages

Sl. No.	Parameter	Unit	Tubed Agricultural land	Dhobiajharan Village
1.	pH	-	7.3	7.4
2.	Buik density	gm/c.c	2.5	2.9
3.	Organic matter	%	0.67	0.65
4.	Sand	%	15	19
5.	Silt	%	40	42
6.	Clay	%	45	39
7.	Texture	%	Clayee	Clay Loam
8.	Porosity	%	43	42
9.	Water holding	%	44	41
10.	Organic carbon	%	0.39	0.38
11.	N	ppm	12	11
12.	P	ppm	12	10
13	K	ppm	16	13

The above soil quality indicates adequate support for floral development.

14.3.6 Flora and Fauna

The project area and buffer area are having protected forests. Some of the protected forests in and around the project area are Rajbar, Jerang, Renchi, Darea & Serak. However, forests have become sparse due to social pressure. The following are main plant species namely Sal, Tendu, Mahua, Palas, Sissoo, Amaltas, Arjun, Karanj, Gular, Khair exist in the forests. They are all native species.

The forests have the following Fauna, namely common Langur, Indian Hare, Sambhar, Nilgai, Mongoose, Percupine, wild dogs, Monitor Lizard, Fox etc.

Rajesh Ranjan
ESE (P & S)
TVNL Hinoo, Ranchi-834
27 DEC 2024

Vijay Kumar Singh
(Recognized Qualified Person)
[Recognition No. 12/(03)-CEAM
Dated- 29.05.2015]

It can, therefore, be seen that the flora and fauna found in the forest area are of common type.

Detailed study will be undertaken during EIA/EMP of the project.

14.3.7 Human Settlement

The project area of 1351 ha is having total of 6 revenue villages namely Lejang, Jerang, Rajbar, Renchi, Darea & Serak. Out of this, four villages are likely to get involved in resettlement. The 4 villages, where from people may need relocation are Rajbar, Jerang, Renchi and Darea. Relocation from Rajbar & Jerang will be partial. A total of about 550 families would be getting unsettled. About 3000 persons would have to be settled. R&R plan for these families shall be prepared as per the detailed guidelines of new land act of GoI and norms & guidelines of the Jharkhand State regarding Rehabilitation & Resettlement. These would form part of the EIA/EMP studies.

14.3.8 Historical Monuments

No historical monuments, lie in the project area i.e. core zone and in the study area, covering 10 km radius around the project area.

14.4 ENVIRONMENTAL IMPACT ASSESSMENT

14.4.1 Land Regime

The proposed changes in land use from present set up to the one's envisaged due to mining operations, is shown in the Table No.-13.3 in Chapter-XIII. The proposed changed land uses are being shown below in table no. – 14.7. Most of the changed land uses shall be reclaimed for productive uses. Only some changed uses shall be retained for their public uses. The land uses envisaged, after reclamation and renovation is given here under.

Vijay K... ...gh
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Dated: ...

Rajesh Ranjan

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Table No.- 14.7

Affected & Proposed Reclamation of Land

Sl. No.	Affected (Changed) Land Uses at End of Mine Life	Area in ha	To be Reclaimed	Retained and Renovated for Public Uses	Non Forest	Forest
1.	Excavation area on Surface	1262	1262	-	798.05	463.95
2.	Electrical Substation	2	2	-	2.00	0.00
3.	Work Shop	2.9	2.9	-	2.90	0.00
4.	Store	1.9	1.9	-	1.90	0.00
5.	CHP & Coal Storage	12.7	12.7	-	0.00	12.70
6.	Magazine	1.0	1.0	-	0.50	0.50
7.	ETP	1.2	1.2	-	0.60	0.60
8.	Road	11	-	11	5.12	5.88
9.	Garland Drain	4.3	-	4.3	2.26	2.04
10.	Office	1.9	-	1.9	1.90	0.00
11.	Township	10.1	-	10.1	10.10	0.00
12.	Embankment	9.5	-	9.5	5.75	3.75
13.	Sedimentation Tank	0.6	-	0.6	0.60	0.00
14.	Green Belt	28.9		28.9	22.04	6.86
	Total Impacted	**1350**	**1283.7**	**66.3**	**853.72**	**496.28**
15.	UG entry Area (Undisturbed)	1	-	1 For future use	0	1
	Grand Total	**1351**			**853.72**	**497.28**

Therefore, the reclamation efforts will be described for 1283.7 ha land. The land or infra to be left for public uses covering 66.3 ha shall be renovated for their future uses. This has been discussed subsequently, under item 14.5.1.

14.4.2 Water Regime

14.4.2.1 Surface Water

No beneficiation of the raw coal has been envisaged in this project. This averts a major likely polluter of surface water. The Sukri River in the area is used by the people in the block. Sukri Nadi remains within embankment and no polluting effluent would get discharged into the river. Therefore, adverse impact on main water course is limited.

Rajesh Ranjan
ESE (F & S)
TVNL, Hatia, Ranchi
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Vik Singh
(Rec (Person)
(Recog 2014
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Other likely sources of surface water pollution are enlisted below:

a. Water pumped out of the mine
b. Wash outs from O.B. dumps, coal stock yard etc.
c. Industrial effluents from workshop, CHP etc.
d. Domestic effluents from office and residential township.

The detailed estimation of impacts from these activities shall be covered in proposed EIA/EMP. However, envisaged remedial measures have been suggested in sub chapter 14.5.

14.4.2.2 Ground Water

The ground water will be affected due to opencast mining. Impact on the water table will be seen in the radius of influence. The ground water is used mostly by dug wells. Therefore, deep seated aquifers, affected from mining, will not affect the supply position of ground water in the dug wells. Within the radius of influence some effect on dug wells is likely to be observed. Remedial measures in the affected zone will be called for. The provision of pumped water from lagoon and treated mine water, shall be made to meet shortage of water, if any, in the villages.

14.4.3 Air Regime

As discussed at item 14.3.3 the area is having a rural background. The ambient air will, therefore, have large assimilative capacity. It can be seen from table no. 14.2 that existing ambient air quality is good. The activities in the project area cover drilling, blasting, loading/unloading of coal/OB. The coal is being transported upto dumping ground and CHP by conveyors. CHP will only size the coal for transportation by covered belt conveyor to proposed siding for railway dispatch. Dust generation activities are therefore concentrated inside the pit. Coal from pit will come out by conveyors & taken to CHP area, on surface. Therefore, impact from mine dust is assessed at low level for the ambient air on surface and in outer ambience. However, detailed study will be undertaken during EIA/EMP for the project area and for buffer zone village for air quality impact assessment.

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 3401/RQP/RAM
Dated- 29.05.2015]

Rajesh Ranjan
TVNL, CHPH, Tatisilwai-834002
21 DEC 2021

14.4.4 Noise & Vibration

The noise & vibration are associated with operation of machines and blasting in the mine. The blasting pattern would be designed so that vibration is minimized. No blasting in coal is envisaged. Therefore, expected impacts are marginal. However detailed base line study for existing noise level will be carried out during EIA Studies for managing its impact, if required.

14.4.5 Flora/Fauna

The forest area within the envisaged project area covers 497.28 ha. In the post mining scenario, it is proposed that this forest area will have plantation areas of native trees and part of water lagoon for sustenance of flora & fauna.

14.4.6 Social Regime

Rehabilitation

Six revenue villages are involved under the proposed project area of 1351 ha. Of these, in 4 villages, resettlement is also involved. An estimated 581.18 ha of tenancy agriculture land is involved. A detailed rehabilitation action plan will be prepared for the affected land owners. It will be based on the socio-economic study covering, interalia, the population of project area. It will be guided by the new act of GoI, covering land acquisition and rehabilitation. Guidance will also be taken from states R&R policy while preparing R&R, chapter of EIA/EMP. The post land use scenario shows about 506.48 ha of agro area are envisaged to be rehabilitated for agriculture, against original area of 581.18 ha. hence impact is marginal.

Resettlement

As per estimates, about 550 families would be needing relocation, spread over four villages. The population to be resettled may be around 3000 persons. A detailed socio-economic survey of families, getting affected including needing relocation, will be conducted for EIA/EMP of the project. The resettlement colony will be laid in pursuance of the R&R policy of Jharkhand State and new act of GoI covering this aspect.

Rajesh Ranjan
ESE (P & S)
TVNL, Hehal, Ranchi
27 DEC 2014

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 5512/(03)/2014-CPAM
Dated- 29.05.2015]

14.5 ENVIRONMENTAL IMPACT MANAGEMENT PLAN

14.5.1 Land Regime

As can be seen from table no. 13.3, the area to be reclaimed for agriculture uses cover 506.48 ha. Some 537.12 ha is reclaimed as plantation area and 269 ha as water lagoon which includes 133.19 ha of forest land and 135.81 ha of non forest land. About 37.40 ha is retained for public uses. The reclamation of affected areas is now discussed.

- **Excavation Area**

  The excavation area covers 1262 ha. Status of excavation area before mining and after mining is shown below in table no. 14.8. This helps to firm up proposed reclamation area.

Table No. – 14.8
Status of Excavation Area

Area in ha

Sl. No.	Land before Mining		Mining Segment with RL	Mining Segment with Area	Proposed Land Use after Reclamation			
	Non Forest	Forest			Agricul-ture	Plantation	Water Lagoon	
							Forest Land	Non Forest Land
1.	300	202	High dump area +90 m (agl)	502 (361 Level + 141 Slope)	202	300		
2.	272.48	57.52	High Ground Level Area (gl) (RL - 450 m)	330 (313 Level + 17 Slope)	211.48	118.52		
3.	84	66	Ground Level Area (gl) (RL 420 m)	150	84	66		
4.	141.57	138.43	Void area (bgl)	280 #	0	11	133.19	135.81
	798.05	**463.95**	**Total**	**1262**	**497.48**	**495.52**	**133.19**	**135.81**
	Total - 1262				**Total - 1262**			

- 280 = (58 Floor + 59 Batter + 163 Dump)

1. In 502 ha of **agl** area, 361 ha is level. In this level area, 202 ha is proposed as agriculture area. Balance 159 ha is proposed to be reclaimed for plantation. The slope area of 141 ha will also be plantation area. Total plantation comes to 300 ha.
2. In 330 ha of high **gl** area, 313 ha is level and 17 ha is sloped. In 313 ha of level area, 211.48 ha would be developed for agricultural uses and

Rajesh Ranjan
27 DEC 2014

Vijay Kumar Singh
(Re... Qualified Forest)
[Recogni... No. 3401...
Dated- 29.05.2015]

balance 101.52 ha would be covered with plantation. Including 17 ha of slope area, total plantation area comes to 118.52 ha.

3. In 150 ha of **gl** area, 84 ha will be developed as agriculture land & balance 66 ha which is forest land will be developed as plantation area.
4. The **bgl** area of 280 ha will be developed as water lagoon, at 415 m R.L., covering 269 ha. Rest 11 ha above 415 R.L. will have plantation above the water level.

- **Reclamation of 1262 ha is proposed as follows based on details given above.**

Table No. – 14.9
Reclamation of Excavation Area (1262 ha)

Sl. No.	Final Land Uses	Area in ha	Non Forest	Forest
1.	Plantation Area	495.52	164.76	330.76
2.	Agriculture Area	497.48	497.48	0
3.	Water Body	269.00	135.81	133.19
Total		**1262**	**798.05**	**463.95**

- **Infrastructure Areas (33.9 ha)**

(i) Area proposed to be used for Infrastructure units of the project is 33.9 ha. The breakup of (refer to Table No. - 13.3) infra units to be dismantled and to be retained is given below:

Infrastructure to be Dismantled		Non Forest	Forest	Infrastructure to be retained		Non Forest	Forest
Workshop	2.9	2.9	0	Garland Drain	4.3	2.26	2.04
Store	1.9	1.9	0	Embankment with Road at its top	9.5	5.75	3.75
Electrical Sub Station	2.0	2	0	Sedimentation Tank	0.6	0.6	0
CHP & Coal Storage	12.7	0	12.7				
Total	**19.5 ha**	**6.8 ha**	**12.7 ha**	**Total**	**14.4 ha**	**8.61 ha**	**5.79 ha**

- **Other Areas (25.2 ha)**

In addition to various items of infrastructure, there are other items covering 25.2 ha. out of these 2.2 ha covering ETP and Magazine would be dismantled and 23.0 ha covering Road, Township and office building would be retained.

Rajeev Ranjan
ESE (I/C)
TVNL, Hirnoo, Ranchi
27 DEC 2014

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 2../03)/2014-CPAM
Dated- 2..2015]

Infrastructure to be Dismantled		Non Forest	Forest	Infrastructure to be retained		Non Forest	Forest
ETP	1.2	0.6	0.6	Road	11	5.12	5.88
Magazine	1.0	0.5	0.5	Township (Colony)	10.1	10.1	0
				Office Building	1.9	1.9	0
Total	**2.2 ha**	**1.1 ha**	**1.1 ha**	**Total**	**23.0 ha**	**17.12 ha**	**5.88 ha**

- **Total Infrastructure & Other Areas**

  To be Dismantled – 21.7 ha (19.5 ha + 2.2 ha)

  To be Retained – 37.4 ha (14.4 ha + 23.0 ha)

  Total – 59.1 ha

- Infrastructure and other items to be retained for public use is briefly described hereafter.

(i) Road & Garland Drain

11 ha of road and 4.3 ha of garland drain shall be left for public uses, in the final mine closure plan.

(ii) Office & Township Area

The office covering 1.9 ha shall be renovated for public uses. The township area covering 10.1 ha shall be also be maintained for public uses. In final closure plan these will be renovated.

(iii) Embankment (9.5 ha)

This will be left against the river. The road on the embankment covering 9.5 ha will serve the public of the area.

(iv) Magazine and E.T.P

The Magazine (1.0 ha) & E.T.P. (1.2 ha) shall be dismantled and cleaned for agriculture uses.

(v) Sedimentation Tank (0.6 ha)

It shall be duly fenced for retaining for public uses as water body.

Rajesh Ranjan
RSE (PKSU)
TVNL, Hinoo, Ranchi-834002
27 DEC 2024

Vijay K... h
(Recog...
(Recognition No. ...
...rson)
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- **Other Land Uses**

(i) Green Belt (28.9 ha)

Green belt all over the project area will be left as it is. It may serve as extension of neighbouring forest areas and will be helpful for better ecology.

- **Envisaged Reclamation of Project Land**

As discussed in previous pages, the final reclamation of project land as envisaged is given hereafter in table no. – 14.10 **(Plate No. – 16 A & 16B)**.

Table No. – 14.10

Reclamation of Project Area (1351 ha)

Sl. No.	Final Land Uses	Area in ha			
		Excavated Area	Infra & Other	Green Belting	Total
1.	Plantation Area	495.52	12.70	28.90	537.12
2.	Agriculture Area	497.48	9.00	0.00	506.48
3.	Water Body	269.00	0.00	0.00	269.00
4.	Public & Other uses		37.40	0.00	37.40
Total		**1262.00**	**59.10**	**28.90**	**1350.00**
5.	Undisturbed (Incline area)	0	1		1
Total		**1262**	**(59.1+28.9+1.0) = 89**		**1351**

- **Overall Land Status**

An overall status of land during pre-use, project life and after post mining biological reclamation may be seen in table no. – 14.11 placed hereafter.

Rajesh Ranjan
ESE (P & S)
TVNL, Mecon, Ranchi-834...
21 DEC 2024

Vijay K... h
(Recognised ... rson)
[Recognition No ... I-CPAM
Dated:

Table No. – 14.11
Overall Land Status

Pre Mining Land Use "Ha"			Land use "Ha" (During Mining)							Land Use "Ha" (Post Closure)								
			Type (Land Uses)	Stages of Mining					Land use "Ha"(End of Life)	Agricultural land	Plantation	Water Body	Public/ Company Use	Water Harvesting	Diversion area	Forest Land (Returned)	Undisturbed	Total
				5th Year	10th Year	20th Year	30th Year	40th Year	45th Year									
Tenancy	Agricultural	553.58	Excavation Area	553.0	439.0	617.0	916.0	1138.0	1262.0									
	Township		Backfilled Area	39.0	117.0	322.0	406.0	662.0	662.0	497.48	159.00					329.52		962.00
	Grazing		Excavated Void	154.0	322.0	295.0	510.0	476.0	280.0		5.76	135.81				138.43		280.00
	Barren	20.09	Without Plantation & Agriculture (Part of Backfilled Area)	39.0	76.0	176.0	82.0	36.0	253.0									
	Water Bodies	8.74	Top Soil Dump	Within Excavation Area														Nil
	Road		External Dump	No External Dump														
	Community		Safety Zone/ Rehabilitation	Safety Zone is part of Peripheral road area as it creates at least 20 m barrier from mine excavation to other surface features														
	Inhabitated	5.76																
	Village		Diversion/below River/Nala/Canal	Not Required														
Govt Non Forest	Agricultural	100.40	**Infrastructure Area** • Electrical Sub Station • Workshop • Store • CHP & Coal Storage	2.0 2.9 1.9 12.7	2.0 2.9 1.9 12.7	2.0 2.9 1.9 12.7	2.0 2.9 1.9 12.7	2.0 2.9 1.9 12.7	2.0 2.9 1.9 12.7						2.00 2.00 1.00	 12.70		2.00 2.00 1.90 12.70
	Township		Kashtkut Dhalao	4.3	4.3	4.3	4.3	4.3	4.3				2.20			2.04		4.30
	Grazing/Other		Embankment	9.5	9.5	9.5	9.5	9.5	9.5				5.75			3.75		9.50
	Road	16.20	Water Reservoir near Pit/ Water Body	0.6	0.6	0.6	0.6	0.6	0.6				0.60					6.60
	Water Bodies	51.10	**Infrastructure Sub Total**	**33.9**	**33.9**	**33.9**	**33.9**	**33.9**	**33.9**									
	Barren	99.22	Green Belt	28.9	28.9	28.9	28.9	28.9	28.9		22.04					6.86		28.90
	Other Dhalao, School, Play ground etc.	5.38																
Govt Forest	Reserve		Pit head power plant	Not Required														
	Protected	485.20	Resettlement	Outside Project Area														
	C-J-E-I	7.08	Unalienated/Mining right for UG	1.0	1.0	1.0	1.0	1.0	1.0							1.00		1.00
Pvt Holding	Rivers		**Others** • Road Diversion (Peripheral Rd) • Township • Office • ETP • Magazine	11.0 10.1 1.9 1.2 1.0	11.0 10.1 1.9 1.2 1.0	11.0 10.1 1.9 1.2 1.0	11.0 10.1 1.9 1.2 1.0	11.0 10.1 1.9 1.2 1.0	11.0 10.1 1.9 1.2 1.0				5.12 10.10 1.90		0.00 0.50	6.88 6.88 8.50		11.00 10.10 1.90 1.20 1.00
			Others Sub Total	**25.2**	**25.2**	**25.2**	**25.2**	**25.2**	**25.2**									
Total		1351.00		242.0	526.0	795.0	1065.0	1237.0	1351.0	497.48	186.80	135.81	25.73	0.00	7.00	497.28	0.00	1351.00

Rajesh Pandey
27 DEC 2024

Vijay Kumar Singh
Environment Management Plan
[Recognition No. [illegible] Dated- 22.05.2015]

14.5.1.1 Land Reclamation through Waste Management

14.5.1.1.1 Quality of Rock Waste

The bulk of the overburden rocks are represented by sandstone and shale followed by their intermediate varieties, i.e. carbonaceous shale, intercalation of shale and sandstone and sandy clay.

The rocks are fine to medium grained sandstone, siltstone, sandy shale, carbonaceous shale & coal seams of Barakar & Raniganj Formation. Presence of greenish, medium to coarse grained feldspathic sandstone with predominant black shale of Barren Measure formation is also seen. Rocks of Barakar Formation are grey to greyish white, fine to coarse-grained cross-bedded and laminated arkosic sandstone, pebble beds, conglomerate and grey to carbonaceous shale, coal seams and fire clay.

Shale is normally a combination of argillaceous and arenaceous varieties and occur both as in-seam burden and seam partings.

The coal block is also seen to be covered by mixed type of soil i.e. sandy, clayey and loamy varieties.

There are no rock layers showing signs of acidity etc.

14.5.1.1.2 Quantity of Waste & Dumping Schedule

The waste quantity totals to 2119 Mm^3. The annual schedule of waste disposal/ management is given below in table no. 14.12. Further, waste disposal and its technical reclamation schedule, is given below in table no. 14.13.

Rajesh Ranjan
ESE (P & S)
TVNL, Hinoo, Ranchi
21 DEC 2024

Vijay Kumar Singh
(Recognised Competent Person)
[Recognition No. 3401[illegible]-CPAM
Dated- 2[illegible]]

Table No. – 14.12

Annual Dumping Schedule (Figure in Mbcm)

Years	Total Waste Generated		Disposal details of Generated Waste					
			Temporary Dumping		Rehandling		Internal Dumping	
	Annual Waste in Mbcm	Cum Waste in Mbcm	Annual Waste in Mbcm	Cum Waste in Mbcm	Annual Waste in Mbcm	Cum Waste in Mbcm	Annual Waste in Mbcm	Cum Waste in Mbcm
	1	2	3	4	5	6	7	8
Y-1	**5.5**	**5.5**	**5.5**	**5.5**				
Y-2	11	16.5	11	16.5				
Y-3	**22**	**38.5**	**22**	**38.5**				
Y-4	38.5	77	38.5	77				
Y-5	**44**	121	19	96			25	25
Y-6	44	165	10	106			34	59
Y-7	50	215	10	116			40	99
Y-8	55	270	10	126			45	144
Y-9	55	325	10	136			45	189
Y-10	**54**	**379**	**10**	**146**			**44**	**233**
Y-11	52	431	7	153			45	278
Y-12	52	483	7	160			45	323
Y-13	52	535	7	167			45	368
Y-14	52	587	7	174			45	413
Y-15	**52**	**639**	**7**	**181**			**45**	**458**
Y-16	52	691	7	188			45	503
Y-17	52	743	7	195			45	548
Y-18	52	795	7	202			45	593
Y-19	52	847	7	209			45	638
Y-20	**52**	**899**	**5**	**214**			**47**	**685**
Y-21	50	949	9	223			41	726
Y-22	50	999	6	229			44	770
Y-23	50	1049			5	5	50	825
Y-24	50	1099			7	12	50	882
Y-25	**50**	**1149**			**10**	**22**	**50**	**942**
Y-26	50	1199			10	32	50	1002
Y-27	50	1249			12	44	50	1064
Y-28	50	1299			12	56	50	1126
Y-29	50	1349			14	70	50	1190
Y-30	**50**	**1399**			**14**	**84**	**50**	**1254**
Y-31	50	1449			16	100	50	1320
Y-32	50	1499			16	116	50	1386
Y-33	50	1549			18	134	50	1454
Y-34	50	1599			18	152	50	1522
Y-35	**50**	**1649**			**16**	**168**	**50**	**1588**
Y-36	50	1699			16	184	50	1654
Y-37	50	1749			16	200	50	1720
Y-38	50	1799			16	216	50	1786
Y-39	47	1846			13	229	47	1846
Y-40	**47**	**1893**					**47**	**1893**
Y-41	47	1940					47	1940
Y-42	45	1985					45	1985
Y-43	40	2025					40	2025

Vijay Kumar Singh
(Recognised Qualified Person)
(Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015)

Rajesh Pandey
Env. Engineer
TVNL, Hatia

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Years	Total Waste Generated		Disposal details of Generated Waste					
			Temporary Dumping		Rehandling		Internal Dumping	
	Annual Waste in Mbcm	Cum Waste in Mbcm	Annual Waste in Mbcm	Cum Waste in Mbcm	Annual Waste in Mbcm	Cum Waste in Mbcm	Annual Waste in Mbcm	Cum Waste in Mbcm
Y-44	40	2065					40	2065
Y-45	**26**	**2091**					**26**	**2091**
Y-46	16	2107					16	2107
Y-47	10	2117					10	2117
Y-48	**2**	**2119**					**2**	**2119**

Table No. – 14.13

Dumping Schedule (Figure in Mbcm) at 5 Year Interval

Years	Total Waste Generated		Technical Reclamation of Generated Waste					
			Temporary Dumping		Rehandling		Internal Dumping	
	Annual Waste in Mbcm	Cum Waste in Mbcm	Annual Waste in Mbcm	Cum Waste in Mbcm	Annual Waste in Mbcm	Cum Waste in Mbcm	Annual Waste in Mbcm	Cum Waste in Mbcm
	1	2	3	4	5	6	7	8
Y-1	5.5	5.5	5.5	5.5				
Y-3	22	38.5	22	38.5				
Y-5	44	121	19	96			25	25
Y-10	54	379	10	146			44	233
Y-15	52	639	7	181			45	458
Y-20	52	899	5	214			47	685
Y-25	50	1149			10	22	50	942
Y-30	50	1399			14	84	50	1254
Y-35	50	1649			16	168	50	1588
Y-40	47	1893					47	1893
Y-45	26	2091					26	2091
Y-48	2	2119					2	2119

14.5.1.1.3 Waste Stabilization

Total waste generated is being stabilized within the excavation area. For this temporary dumping has been envisaged, within the proposed excavation area. This waste has been rehandled with a schedule to ensure normal progress of excavation remains uninterrupted. Of total estimated waste of 2119 Mm^3, some 229 Mm^3 has been temporarily dumped during 1st year to 22nd year. From 23rd year to 39th year it has been rehandled & backfilled. The schedule is given in table no. – 14.12 in previous para.

Rajesh Ranjan
ESE (P&P)
TVNL, Hinoo, Ranchi-834002
21 DEC 2014

Vijay K... Singh
(Rec... Person)
...2014-CPAM
Dated- 29.05.2015

14.5.1.1.4 Reclamation of Excavation Area

Table no. 14.8 gives proposed reclamation of excavation area with break up into agriculture, plantation and water body after completion of progressive and final mine closure activities.

14.5.1.1.5 Land Reclamation Activities

The land reclamation activities of excavated area, infra area and green belting is covered during productive life of the mine and also small part as a post closure activity.

- **Sequence of Reclamation**

  Peripheral plantation would be done within 1st year to 5th year. The entire waste generated till 4th year, goes to temporary dump over coal bearing area located in the West side of proposed excavation area. There is no external dumping. Part of waste generated gets backfilled from 5th year onwards. Technical reclamation of backfill dump starts from 5th year itself. Green belts such as peripheral plantation and those surrounding infra areas and habitational areas, covering an area of 28.9 ha, gets fully developed by 5th year. From 6th year onwards biological and agricultural reclamation follows technical reclamation with a gap of 75 m from moving dump edge. The table no. – 14.14 and 14.15 shows 5 year stage wise land degradation, its technical reclamation and then biological reclamation. At the end of productive period of 48 years, a void of 280 ha gets left out. Reclamation of technically reclaimed area of (537.12 – 322) = 215.12 ha gets left out for biological reclamation for post mining phase. Technically reclaimed (506.48 – 447) = 59.48 ha is also left out for agricultural reclamation at the end of 48th year considering 1351 ha of project area. These left out activities are taken up for completion as post mining closure activities. In the 280 ha void area, water from the nearby Sukri River and rain fall over the lease area covers upto level of 415 m R.L. covering 269 ha. Rest area of 11 ha in the void, over the dumps above proposed water level of 415 m R.L. also gets bio reclaimed during post closure as plantation area.

Vijay Ku[illegible] Singh
(Recognized [illegible]d Person)
[Recognition No. [illegible]3)/2014-CPAM
Dated- [illegible]2015]

Rajesh Ranjan
ESE (P & D)
TVNL, Hinoo, Ranchi-834002
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Table No. – 14.14
Stage wise Degraded Land Technically Reclaimed

Area in ha

Production Stage Years		Land Degraded				Technically Reclaimed Area				
		Excv	Dump (Extn + Top Soil)	Infra/ others	Total	Back-filled	Dump (Extn + Top Soil)	Infra & Others	Green Belting	Total
1	2	3	4	5	6	7	8	9	10	11
Y-1	2018-19	20	No external dumping of Waste Rock or Top soil is proposed.	88	108		Not required as explained in Column 3.	59.1		59.1
Y-3	2020-21	96		88	184			59.1		59.1
Y-5	2022-23	153		88	241	48		59.1	28.9 ha	136.0
Y-10	2027-28	439		88	527	117		59.1	28.9 ha	205.0
Y-15	2032-33	535		88	623	174		59.1	28.9 ha	262.0
Y-20	2037-38	617		88	705	222		59.1	28.9 ha	310.0
Y-25	2042-43	772		88	860	318		59.1	28.9 ha	406.0
Y-30	2047-48	916		88	1004	406		59.1	28.9 ha	494.0
Y-35	2052-53	1034		88	1122	525		59.1	28.9 ha	613.0
Y-40	2057-58	1138		88	1226	639		59.1	28.9 ha	727.0
Y-45	2062-63	1195		88	1283	795		59.1	28.9 ha	883.0
Y-48	2065-66	1262		88	1350	982		59.1	28.9 ha	1070.0
Post Closure Y-51	2068-69					982		59.1 + 280 = 339.1 ha	28.9 ha	1350.0 *
Undisturbed					1					1
					1351					1351

- Infrastructure to be retained – 37.4 ha
- Infra Others to be dismantled – 21.7 ha

} 59.1 ha + Green Belt – 28.9 ha
= 59.1 + 28.9 = 88 ha

- Backfilled – 982 ha
- Void – 280 ha
  - ❖ Water Body – 269 ha
  - ❖ Slant Plantation – 11 ha
- Infra & Others – 88 ha
  - ❖ Infra & Others – 59.1 ha
  - ❖ Green Belting – 28.9 ha

Total – 1350 ha

Undisturbed – 01 ha

Total Project Area – 1351 ha

Rajesh Ranjan
ESE (P & S)
TVNL, Hinoo, Ranchi-834002
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Vijay Kumar Singh
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Table No. – 14.15
Stage wise Biological Reclamation

Area In ha

Production Stage Years		Biologically Reclaimed Area					Forest Land (Returned)	Un Disturbed	Total
		Agriculture	Plantation	Water Body	Public/ Company (Infra Retained)	Total			
Y-1	2018-19								
Y-3	2020-21								
Y-5	2022-23								
Y-10	2027-28	3	43			46			
Y-15	2032-33	16	81			97		1	
Y-20	2037-38	30	114			144		1	
Y-25	2042-43	85	152			237		1	
Y-30	2047-48	141	190			331		1	
Y-35	2052-53	177	245			422		1	
Y-40	2057-58	213	300			513		1	
Y-45	2062-63	330	311			641		1	
Y-48	2065-66	447 #	322 #			769		1	
Post Closure									
Y-51	2068-69	506.48	537.12	269	37.4	1350	497.28	1.0	
Undisturbed					1	1351			

- After the end of 48th year, 59.48 ha of agricultural land and 215.12 ha of plantation to be done during post mining reclamation.

- **Stage Plans**

  Technical, biological, agricultural reclamation besides water lagoon may be seen in the stage plans starting from Plate No. – 15 A upto 16 B. The above reclamation activities over specific areas may be seen in different colours.

- **Plantation Area**

  a) Backfilled areas shall be technically reclaimed by dozing & leveling at planned R.L. for the site.

  b) Top soil shall be spread over the area keeping about 75 m distance from edge of the waste dumping.

  c) Plantation of plant saplings shall be undertaken during beginning of monsoon season.

  d) Regular watering and after care, including manuring, shall be undertaken by the hired agency for 3 years period from time of plantation.

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. J-11012/(03)/2014-CPAM
Dated- 29.05.2015]

Rajeev Ranjan
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- **Agriculture Area**
  a) Technical reclamation of backfilled area shall be undertaken, keeping 75 m distance from edge of waste dump, at planned R.L. for the site.
  b) Top soil shall be spread over the above area.
  c) Bunds of soil/ sub soil shall be raised, about 0.9 m high, above the level surface, for retention of soil and water for agriculture purposes.
  d) In initial years, coarse grains shall be raised over the prepared area, having organic waste as residue, to increase the fertility of the soil for better grains in later years.

14.5.1.1.6 Prevention of Siltation, Erosion and Dust Generation from Dumps

Provision of toe wall has been kept around temporary dump to arrest siltation materials and prevent its outflow. To prevent dust generation, provision of greening of temporary dumps has been kept. Perennial green grasses shall be raised over temporary dumps. No toxic matter is present in the waste rock material. Siltation & erosion from internal dumps shall be lead to mine sump. Regular cleaning of the sump shall be ensured. Stabilized dumps shall be covered with systematic plantation to prevent dust generation. No toxic waste is anticipated.

14.5.1.2 Top Soil Management

14.5.1.2.1 Top Soil at Rajbar E & D Coal Mine

Adequate thickness of soil cover is available all over the excavation area of 1262 ha. The top 0.4 m of this cover is being considered as top soil. As proposed in the mining plan this top soil would be separately excavated, transported and temporarily stacked in the North Western part of the block over an area of 20 ha. The location has been shown in the stage plan. After 40th year of mine excavation this location would change to backfilled level area as shown in the stage plan.

Rajesh Ranjan
ESE (P & S)
TVNL, Hatibari
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14.5.1.2.2 Preservation of Top Soil

In order to preserve top soil, timber trees cannot be planted over these dumps, because if planted, their root system would pose problem when top soil would be rehandled for spreading over backfilled area. To prevent deteriorations of the soil, the species to be raised on the top soil dump, should therefore be such that it would not only bind the soil but also contribute

Vijay Kumar Singh
(Recognised Qualified Person)
(Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015)

towards the enrichment of the top soil. Fodder grasses or leguminous crops would be a good choice. Therefore, it would be raised annually. These crops being close to soil and being dense would act as a barrier between rain water flow and the soil. Erosion of soil would thus be prevented.

14.5.1.2.3 Action Plan for Top Soil Management

It pertinent to mention that entire top soil would not be removed in one go, because of two reasons. Firstly the space required for dumping would be large and secondly the top soil stored for a long time would deteriorate in quality. It may get washed away during rains unless protected. Further, leaching of elements from the soil may take place due to continued exposure over the long period of mine life. Therefore, top soil would be removed from the mining area for first 5 years. Backfilling would start in the 5th year. After two years of backfilling, around 7th year biological reclamation of internal dump would commence. The top soil required would be rehandled from the temporary dump of top soil stacked over 20 ha. From 10th year onwards collection of top soil and its spreading over backfill area would go on simultaneously. Surplus top soil only would be stacked over 20 ha top soil temporary dump. This process would continue till the entire top soil is rehandled for biological reclamation. The top soil would be stacked temporarily and would be regularly used and stacked. The top soil dump would be created in North-West segment of excavation area. By 20th year, it is covering about 20 ha area. The soil would be stacked during initial 5 years and then only unused soil gets accumulated after concurrent uses. The soil dump would be greened with grass for retaining the microbes of the soil. A table no. – 14.16 for waste management provides details of top soil generated every five year besides its distribution and spreading over internal dump/ backfilling. Another table no. – 15.16 provides precise detail for the area of embankment, internal dump and green belt besides quantity of soil consumed in spreading over these areas. The estimated cost is ₹ 0.82 crores for greening, storage & utilization of top soil management is detailed in the table no. – 14.16 and 14.17 placed hereafter.

Rajesh Ranjan
ESE (P&S)
TVNL, Hinoo
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Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

Table No. – 14.16

Waste Management (Figures in Mm^3)

Year/ Stage	Cumulative OB Removal			Temporary Dump (Cumulative)		Internal Dump/ Backfilling (Cumulative)		Embankment & Green Belt (Cumulative)	
	Top Soil	OB	Total Waste	OB	Top Soil	OB	Top Soil	OB	Top Soil
1st Year	0.1	5.4	5.5	5.0	–	–	–	0.4	0.05
3rd Year	0.4	38.1	38.5	38.15	0.25	–	–	–	0.10
5th Year	0.6	120.4	121	96	0.45	25	–	–	–
10th Year	1.8	377.2	379	146	1.45	232.8	0.2	–	–
15th Year	2.1	636.9	639	181	1.58	457.5	0.5		
20th Year	2.5	896.5	899	214	1.70	684.2	0.8	–	–
25th Year	3.1	1145.9	1149	207	1.85	940.8	1.2		
30th Year	3.7	1395.3	1399	84	2.00	1252.3	1.7	–	–
35th Year	4.1	1644.9	1649	61	1.95	1585.8	2.2		
40th Year	4.6	1888.4	1893	–	1.90	1890.0	2.7	–	–
45th year	4.8	2086.2	2091	–	1.45	2087.7	3.3		
48th Year	5.0	2114.0	2119	–	1.00	2114.0	4.0	–	–

Vijay K... Singh
(Recognised ... Person)
[Recognition No ... 014-CPAM
Dated- ... 5]

Rajesh Ranjan
ESE (P...)
TVNL ... Ranchi
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Table No. – 14.17

Top Soil Management – (Including Action plan for Top Soil management)

Year/ Stage	Top Soil Removal "Mm^3" (Cumulative)	Top Soil Used "Mm^3"								Total utilized Top Soil (Cumulative)
		Embankment		Spreading over the Backfilling Area in Sq. Km. (Cumulative)		Spreading over the OB Dump Area in Sq. Km.		Using for Green Belt Area (Cumulative)		
		Area (Sq. Km.)	Top Soil (Mm^3)	Area (Sq. Km.)	Top Soil (Mm^3)	Area (Sq. Km.)	Top Soil (Mm^3)	Area (Sq. Km.)	Top Soil (Mm^3)	
1st Year	0.08	0.065	0.020					0.10	0.030	0.050
3rd Year	0.384							0.317	0.0951	0.1151
5th Year	0.612									0.1151
10th Year	1.756			0.42	0.1768					0.2919
15th Year	2.112			0.93	0.4248					0.5399
20th Year	2.468			1.44	0.6728					0.7879
25th Year	3.066			1.8055	1.1571					1.2722
30th Year	3.664			2.171	1.6414					1.7565
35th Year	4.108			3.5955	2.0676					2.2027
40th Year	4.552			5.02	2.5338					2.6469
45th Year	4.408			6.21	3.2485					3.3636
48th Year	5.048			7.40	3.9632					4.0783
Post Mining			0.020	9.93	4.7878			0.417	0.1251	5.0480

14.5.2 Water Regime

Treatment and disposal of water from the mine

The following preventive measures will be adopted to maintain the water quality within statutory sustainable levels, during the project operational stages.

1. Maintaining proper gradient for drainage of water on the bench floors and construction of water drains using local material to prevent soil erosion and uncontrolled descent of water on the dump slopes.
2. Construction of garland drains of suitable size around mine area, with proper gradient, to prevent rain water from entering into excavation area. regular cleaning of these drains from deposited silt etc.
3. Construction of settling and sedimentation pond of adequate size to collect the mine discharge water to allow settlement of suspended solids and its storage after necessary treatment. The treated water will be used for dust suppression, green belt development and other needs of project.
4. Construction of garland drain around coal stock yard/coal bunker.

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 2012/(03)/2014-CPAM
Dated- 29.05.2015]

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5. Desilting of sedimentation ponds/drains at regular intervals.
6. The high dumps will be provided with inner slopes on top flat surface and through a system of drains and masonry chutes and channels. The water will be allowed to descent into surrounding garland drains, so as to minimize the effects of erosion arising out of uncontrolled descent of water.
7. Effluents from workshop, garage or wash areas will be treated through grease / oil traps and then in sedimentation pond and recycled for use again in the workshop/ wash area.
8. Check dams will be provided at vulnerable places to arrest erosion and sudden descent of water, as well as for recharge of ground water.
9. Separate sewage system and treatment plant for domestic sewage & office sewage etc. will be set up for proper treatment of these and for reuse of recovered water in green belt, etc. The solid waste from sewerage plant of the colony & office will be used as manure over the plantation areas.

14.5.3 Air Regime

During the mining operations, impact on air quality will be effectively controlled both by preventive and suppressive measures listed below:

Drilling

- Usage of Drill bits in good condition
- Wet drilling to prevent generation of dust.

Blasting

- Well designed blast by effective stemming and use of milli second delay detonators – Every blast should be properly designed to see that the optimum breakage occurs without generating fines.
- Avoiding blasting during high wind periods where the fine dust is likely to be carried out affecting the ambient air quality.
- Use of delay detonators to keep the noise as well as vibration level within the prescribed limits.
- Conducting muffled blasting to avoid disturbance.

Rajesh Ranjan
ESE (P & S)
TVNL, Hanoo, Ranchi
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Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012(03)/2014-CPAM
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Transportation

- Proper maintenance of haul road and other roads
- Black topping of roads, whose lay is permanent and for longer duration.
- Frequent water spraying / sprinkling on the roads, stock-piles, OB dumps and transfer points where dust is generated. Water sprinkling through Stationary water sprinkling system on permanent haul roads and possible places of dust generation.
- Development of extensive green belt/ barriers around mine, coal handling plant, workshop, along the roads, periphery of the mine etc.

Coal Handling Plant

- The coal sizer –100 mm to –50 mm shall be located in an enclosed area to prevent propagation of dust.
- The plant to be routinely maintained, to avert excessive noise and vibration.
- Shall have inbuilt nozzles for spraying water in the form of mist (Dry fogging) for efficient dust suppression at the feed hopper and transport points.
- All the internal roads in CHP area are to be made pucca.
- Stacking of coal in proper location with proper stack geometry.

From the above description, it is evident that adverse impact on air quality due to these operation in the project will be minimized.

14.5.4 Noise & Vibration

The noise from O.C. working will slightly affect the neighboring villages some of them are within half a km away from proposed quarry edge. A 30 metre green barrier has been proposed to avert entry of dust & noise into the villages. The quarry is quite deep and activities causing noise will remain confined. The green barrier will also avert noise entry.

Mitigational Measures to Control Vibration

Protective measures for control of vibration would be taken as given below:

1) The peak particle velocity (ppv) of ground vibration will be kept below 10 mm/s for 8-25 hz frequency range through optimally controlled blasting techniques after necessary field trials.
2) Fixation of amount of explosives charged per delay optimally.
3) Vibration study will also be carried out at appropriate times to obtain most ideal and optimal blasting parameters.

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
Expert (EP & SC)
TOR, Impact, Ranchi-834002
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4) Short delay detonators to be used in preference to detonating fuse.
5) Loosening of rock mass will be done by the blasting of 7 to 20 m deep and by 250/383 mm diameter blast holes. Millie-second delay detonators have been envisaged to minimize the ground vibration. Use of non electric detonators will be used wherever required. Blast vibration studies will be conducted to optimize the burden & spacing and explosive requirement so as to minimize the vibration effect due to the blasting.

Mitigational Measures in Blasting

1) Blasting will be carried out in a periodical manner so as to minimize the impact on the local habitants and the faunal species.
2) Drilling and charging pattern will be ideally formulated, with less explosive charge, etc. after field trials.
3) Suitable initiating sequence and millisecond delay detonators will be used for blasting.
4) To contain fly rocks, stemming column will not be less than burden of the hole. Blasting area will also be muffled, if necessary, to prevent fly rocks propagation.
5) Proper care and supervision during blasting by a competent and experienced supervisory person of the rank of under/ assistant coal mine manager.

14.5.5 Flora/ Fauna Regime

It is seen that on the project area which is having 497.28 ha of forest cover, would have about 537.12 ha of greenery including plantation in the final closure scenario. This shows sustenance of present green cover. There is also creation of a permanent water lagoon covering about 269 ha area. This will ensure better environment for the flora and fauna in the area during post mining period. The post mining phase appears to be better for environment and for flora/fauna regime in view of a dependable water source.

14.5.6 Social Regime

The relocation of people being affected by this project will be ensured as per new act of GoI and the R & R policy of Govt. of Jharkhand. The policy lays down total guideline for rehabilitation & resettlement. Therefore, a detailed action plan for the PAP's will be prepared under the EIA/ EMP formulation for the project.

Rajesh Ranjan
ESE (P & S)
TVNL Hatia, Ranchi
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Vijay Kumar Singh
{Recognised Qualified Person}
Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015}

14.5.7 C.S.R Action Plan

A detailed action plan would be prepared by the proponent to cover villages within 10 Km, for their overall upliftment. This would form part of EIA/EMP. The broad areas of improvement considered under CSR for neighbouring community would be:

1. Improvement in medical and health care system
2. Improvement in educational services
3. Infrastructural betterment through better roads, lighting and communicational systems
4. Betterment of drinking water facilities.
5. Vocational training facilities for local eligible youth to enable them to seek employment in suitable project operations and other employment agencies like Govt., PSUS etc.
6. Improvement of irrigational facilities for agricultural areas to boost the land productivity in this rural area.

14.6 MONITORING SCHEDULE FOR ENVIRONMENTAL INGREDIENTS

The following schedule for routine monitoring of environmental ingredients in suggested. However, it should be clearly understood that, SPCB while granting Consent to Operate, lays down monitoring guidelines, which are to be complied.

Table No. – 14.18

Monitoring Schedule for Environmental Ingredients

Sl. No.	Component	Frequency of Monitoring
1.	Air Quality	Twice a month
2.	Effluent & Ground Water Quality	Once a month
3.	Ground Water Level in Impact Zone	Pre, Post Monsoon & Pre Summer
4.	Noise Level	Once a month
5.	Buffer Zone Soil Quality	Once in 5 years
6.	Study of Flora & Fauna	Once in 5 years

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Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. J-12/(03)/2014-CPAM
Dated: 29.09.2016]

Rajesh Ranjan
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CHAPTER – XV

PROGRESSIVE & FINAL MINE CLOSURE PLAN

15.1 INTRODUCTION

The Rajbar E & D Coal Mine has been allotted as a coal block to M/s TVNL vide Allotment Order No. 103/19/2015/NA dated 30-06-2015 enclosed as ***"Annex – I"***, to be read with Corrigendum No. 1 dated 21.12.2016, placed as ***"Annex. – I A"***. The coal mine block is located in Auranga Coalfield, in the State of Jharkhand. The coal produced from the block is for use in the proposed extension of the thermal power station of M/s TVNL near Lalpania village adjacent to Tenughat Reservoir area, in the State of Jharkhand. TVNL is a State Govt. Undertaking. Any surplus coal from the block shall be disposed as per the then Central Government's guidelines.

Owner

The proponent M/s Tenughat Vidyut Nigam Ltd. (TVNL) is a State Govt. Undertaking. Their existing power units and proposed units lie in Bokaro District in the State of Jharkhand.

Address of M/s TVNL is given in Chapter-I, page no. – I-1.

Location

The proposed coal project is located in revenue villages of Jerang, Rajbar, Lejang, Renchi, Darea & Serak. They lie in Balumath, Chandwa & Latehar revenue Anchals of Latehar District, in the State of Jharkhand. The nearest railhead is Chetar Railway Station on the Gomoh-Barkakana-Dehri on Sone loop line of East Central Railway.

The block falls in the Survey of India toposheet No.-F45A9. Locational & communicational details are covered in Chapter-III at item 3.1.1 and item 3.2.

Rajesh Ranjan
ESE (P & S)
TVNL Hqrs, Ranchi-834002
27 DEC 2024

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

Present Land Uses of Proposed Project Area/ Lease Area

The present land uses in the proposed project area is given below in Table No.-15.1. Presently there is no granted lease area for the mine.

Table No. – 15.1

Present Land Uses of proposed Project Area

Major Class of Land	Land Use	Area in ha
Tenancy	Agricultural	553.59
	Township	–
	Grazing	–
	Barren	20.09
	Water Bodies	0.74
	Road	–
	Community	–
	Inhabitated	6.76
	Village	–
	Sub Total	**581.18**
Govt. Non Forest	Agricultural	109.40
	Township	–
	Grazing/Other	–
	Road	18.20
	Water Bodies	51.16
	Barren	88.22
	Other Divsthan, School, Play ground etc.	5.56
	Sub Total	**272.54**
Forest	Reserve	–
	Protected	495.20
	C-J-B-J	2.08
	Sub Total	**497.28**
Free Hold	None	–
	Grand Total	**1351**

Land Uses of the project area in three stages of Mining

The proposed project area covers 1351 ha of surface area. However, 1320 ha of coal bearing area is for mining rights and 31 ha is for surface rights. The present land uses, shown in Table No.-15.1, will undergo changes for carrying out the mining and other associated activities. However, during active mine life itself, land reclamation will be started and will continue in the sterile dump areas. Green belts will be developed in the initial years of project life. These

Rajesh Ranjan
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Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012(Da)2014-CPAM
Dated- 29.05.2015]

activities form part of progressive closure as they dovetail into final closure land uses. Then, after cessation of the coal winning, the changed land forms will be subjected to final reclamation activities. After completion of these post mining final reclamation steps, the post mining land uses would get firmed up.

The present & envisaged land uses, covering the three stages of mine life, is shown hereafter in Table No.-15.2.

Table No. – 15.2
Land Uses of the project area in three stages of Mining

All area in ha

Present Land Uses		Proposed Land Uses		Land Uses	
Type of Land	Area	Type of Use	Land Area	End of Mine Life	Post Closure after Reclamation
Tenancy	581.18	Excavation Area	1262.00		
Govt. NF	272.54	Backfilled Area		982.00	
Forest		Excavated Void		280.00	
Reserve		Top Soil Dump			
Protected	495.20	External Dump			
C-J-B-J	2.08	Infrastructure	33.90	33.90	
		Agricultural			506.48
		Plantation Area	28.90	28.90	537.12
		Water Body			269.00
		Public/ Com Use	11.00	11.00	37.40
		Other Use	14.20	14.20	
		Undisturbed/ MR for UG	1.00	1.00	1.00
Total	**1351.00**	**Total**	**1351.00**	**1351.00**	**1351.00**

15.1.1 Reasons for Closure

A. Exhaustion of Reserves

Main reason for closure of a mine would be Exhaustion of Coal Reserves. The cessation of the coal mining operations, i.e. closure of this mine is planned after 48 years of the start of productive mine life. The life envisaged may vary within a few years depending on working conditions and estimated geological reserves.

Rajesh Ranjan
ESE (P & S)
TVNL Manoharpur, Ranchi-834002
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Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 3401/2(03)/2014-CPAM
Dated- 29.05.2015]

B. However, there could be other circumstances causing premature closure of the mine. Some of the possible reasons for likely premature closure are envisaged as follows:

1) **Safety:** "Mine" may have to be closed down, under order of DGMS, on account of unexpected adverse geo-technical condition which may make continuation of the mining operations unsafe.

2) **Economy:** "Mine" may be required to be closed down on account of changes in the economic environment at national/ international level including lack of demand and development of alternative cheaper energy sources.

3) **Regulatory and Policy Issues:** "Mine" may have to be closed down on account of Environmental and other Regulatory considerations where the Proponent is directed to do so by the concerned Govt. Authorities.

4) **Force Majeure:** "Mine" may close down on occurrences of circumstances leading to Force Majeure. These causes or circumstances could include acts of God, acts of war (whether war be declared or not), invasion, insurrection, riot, etc.

5) **Natural Calamity:** There may be such calamity which could damage the mining system and force stoppage of system and result in stoppage of the mine.

6) **Social Pressure:** "Mine" may be forced to be closed down on account of disturbances caused by some Social Elements, where the situations may go beyond the control of Administrative machinery of State Govt. with serious breakdown of law & order.

Nevertheless, in the present scenario in this planned mine, it is not foreseen that any of the above circumstances could lead to mine closure. However, this conceptual Final Mine Closure Plan would be able to guide the final closure activities even for such unforeseen situations and would help to tide over the problem and ensure due closure of the mine.

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
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15.1.2 Statutory Obligations

Some major approvals to be obtained for starting a mine, is shown in table no. – 15.3.

Table No. – 15.3
Statutory Obligations

Sl. No.	Approvals/ Clearanes	Authority	Status
1.	Mining Plan with Mine Closure Plan	MoC, GoI	Submitted to MoC in January 2016, then December 2017 and now being submitted in October 2018. Approval awaited.
2.	Environmental Clearance	MoEF & CC, GoI	To be obtained.
3.	Forestry Clearance	MoEF & CC, GoI	To be obtained.
4.	Consent to Establish	S.P.C.B.	To be obtained.
5.	Grant of Lease	State Govt.	To be obtained.
6.	Consent to Operate	S.P.C.B.	To be obtained.
7.	Approval for Water Uses	Central Ground Water Authority/ State Water Resources	To be obtained.
8.	Approval for Explosive Storage & Uses	Chief Controller of Explosives, Nagpur	To be obtained.
9.	Approval from Coal Controller for Mine Opening	C.C. Office, Kolkatta	To be obtained.
10.	Permissions from DGMS for starting & working the mine	DGMS, GoI	To be obtained.

All above approvals will be taken once the mining plan is approved. At present, no approval exists; therefore, no statutory obligations have arisen. However, the proponent company i.e. M/s TENUGHAT VIDYUT NIGAM LTD. **hereby solemnly undertake to comply with all statutory obligations, which would arise from regulatory approvals, for working the mine.**

15.1.3 Closure Plan Preparation

Mining Plan (including Mine Closure Plan) was submitted to Board of Director of TVNL. Minutes of the meeting of the Board is enclosed as ***Annex. – III*** in

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this Mining Plan. In the minutes, Board resolved under item no. 54/09 as follows:

"**RESOLVED THAT** approval be and hereby accorded for submission of Mining Plan (Including Mine Closure Plan) of Rajbar E & D coal mine, as per the Observations and Guidelines of MoC, GoI and making presentation of the same for its approval from the Ministry of Coal, Govt. of India".

"**RESOLVED FURTHER THAT** Sri Vijay Kumar Singh (associated with M/s Gondwana Geotech Services Pvt. Ltd.), the Recognized Qualified Person (RQP) be and hereby authorized alongwith officers of Nigam for making presentation required for the purpose of approval of this Mining Plan (Including Mine Closure Plan) of the Coal Mine".

"**RESOLVED FURTHER THAT** approval be and hereby accorded for assured support to TVNL for financial provisions estimated at Rs. 475.52 crores for progressive & final mine closure activities of Rajbar E & D coal mine, which is spelt out in the referred Mining Plan (Including Mine Closure Plan) for Rajbar E & D coal mine".

"**RESOLVED FURTHER THAT** MD, TVNL be and hereby authorized to do all needful actions in this regard including other provision required by MoC, GoI for completing the mine closure activities".

15.2 MINE DESCRIPTION

15.2.1 Geology

15.2.1.1 General

The Rajbar E & D Coal Mine is situated in the north eastern part of Auranga Coalfield. The allotted block area to the proponent is spread over 1487 ha comprising formations of Lower Gondwana Group, unconformably overlying the Pre-Cambrian rocks.

The Barakar is the principal coal bearing formation in the block. However, the Raniganj formation also contains two seams and this adds to the coal reserves. There are seven coal seams lying in Barakar formation. These are

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designated as I to VII. The 2 seams of Raniganj formation are named R1 & R2. Most of the coal seams are interbanded in nature and exhibit split section development pattern both in strike and dip directions. There are variations in thickness and lithological characters of inter-seam partings. In total, there are 19 coal horizons, 17 in Barakar measures & 2 layers in Raniganj.

On the basis of relevant geological data of Rajbar E & D Coal Mine, it is found that Talchir, Barakar, Barren Measures and Raniganj Formations of the Lower Gondwana Group lie unconformably over the Pre-Cambrian metamorphics.

A generalized geological succession of this coal block is given in table no. – 4.4 in Chapter IV.

15.2.1.2 Geological Structure

15.2.1.2.1 Fault

A total of seven faults have been interpreted in Rajbar E & D Coal Mine on the basis of core logging, floor contour plan of every seam and disposition of coal seams. The block basin is shallow in the northern and eastern part and deeper in the south western portion. The details of faults are given in Table no. – 4.5 in Chapter IV.

15.2.1.2.2 Strike and Dip

The Rajbar E&D Coal Mine has got dissected due to two systems of normal faults of Auranga basin. The regional trend of the bedding in general, varies from N-S to NNW-SSE. The variation of dip ranges from 6^0 to 14^0 towards South. However the amount of dip, in general varies from 6^0 to 10^0 towards South-West. Deviations in the trend of bedding as well as in the amount of dip are very common, particularly near the faults. In the Northern part of the block the beds strike East-West with Southerly dips.

15.2.1.3 Rock Type

The bulk of the overburden rocks are represented by sandstone and shale followed by their intermediate varieties, i.e. Carbonaceous Shale, intercalation of shale and sandstone and sandy clay.

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CSOE (P & S)
TVNL, Hinoo, Ranchi-834002
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Vij... Singh
...ed Person)
(Recog...
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The block is also seen to be covered by mixed type of soil i.e. sandy, clayey and loamy.

The rocks are non-acidic and non-toxic.

15.2.1.4 Topography

The proposed Rajbar E & D Coal project area of 1351 ha falls in the Palamu plateau of Chhotanagpur Gneissic Complex. In general, the topography of the area is mildly undulating and the general slope is towards NW. Due to undulating nature of the land, a number of natural ponds have got formed. General elevation in the allotted area is around 440 m above MSL. The maximum elevation inside the project area is around 471 m. in the south-eastern part, whereas minimum elevation is around 415 m above the MSL in the north-western part of the block.

Nearly 37% of the project area is covered with forest areas located in Rajbar, Jerang, Renchi, Darea & Serak villages. Rest of the area is covered with agricultural land, habitation area, roads etc. and water bodies.

The drainage pattern of the Coalfield is mainly controlled by Auranga River. The Sukri River, one of the important tributaries of the Auranga, flows from east to west over the entire length of the Rajbar E & D Project area, along its northern boundary. Some 1st & 2nd order channels join the Sukri River. The flow direction of the water channels is generally towards NW. These water channels join Sukri River. They are quite shallow.

15.2.2 Coal Reserves

15.2.2.1 General

In the Rajbar E & D Coal Mine, occurrence of 9 coal seams with splits (19 coal horizons) have been identified and proved. All the 19 identified coal horizons are mineable and hence have been considered for coal reserve estimation. Seams belonging to the Barakar Formation are IT, IB, IIT, IIB, IIIB, IIIM, IIIT, IVB, IVM, IVT, V, VIB, VIM, VIT, VIIB, VIIM & VIIT. The two

younger coal seams i.e. Seam-R-1 & Seam-R-2 belong to Raniganj Formation.

A study of disposition of coal seams, their structure, thickness as well as depth from surface reveals that the coal seams of the block, upto III Seam Bottom are mineable by open cast mining. The estimation of reserve of the coal seams have been done on the basis of data obtained from exploratory drilling and geological mapping. The reserve of the coal is of "Proved" category as per ISP classification.

15.2.2.2 Categorization of Reserves

Reserve of all the 19 coal horizons have been placed in "Proved" category as per ISP norms. Total reserve has been assessed within coal bearing area of 1487 ha. Total geological reserves have been estimated at 706.03 Mt. Of this, reserves in Seam I & II, envisaged to be worked by underground mining comes to 131.17 Mt. Balance 574.86 Mt from Seam III Bottom and above has been assessed for opencastability. The seam wise & grade wise reserve (based on GCV) has been given in table no. – 4.14 in Chapter IV.

15.2.3 Method of Mining

With a view to maximize coal extraction percentage and meet the requirement of End Use Plant, opencast mining method has been selected. In order to extract 420.22 Mt of coal, upto Seam III Bottom, an annual targeted capacity of 10 MTPA has been envisaged. Even with high capacity of 10 MTPA, for this difficult mine, productive mine life goes up to 48 years. For mining, some 2119 Mbcm rock waste would have to be removed at annual rate of about 50 Mbcm. The average stripping ratio comes to 1:5.04.

After studying the nature of Rajbar coal deposit, its high stripping ratio (1:5.31) for all the 19 layers of coal; the bottom 4 layers of Seam I & II have been proposed for underground mining through inclines located near Seam I Bottom incrop in North-East corner. The O.C. pit will be opened from Seam III Bottom seam. To provide accommodation for rock waste within backfill area, a strategy has been adopted to create two level backfill. Further, the mine will be opened more or less, 20^0 to 30^0 off, from the strike and parallel to metamorphic North-South edge. This will allow early backfilling. The first layer

Rajeev Ranjan
ESE (P & S)
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of usual backfill waste would be from the floor of Seam III Bottom upto ground level i.e. **bgl** dump. The second upper layer of backfill would follow it with a horizontal gap of 60 m. This layer goes up to 90 m above ground level i.e. as **agl** dump. Due to high stripping ratio, temporary dumping of waste has to be done, in the mine life upto 22nd years. This temporarily dumped waste would be rehandled from 23rd year onwards & continue up to 39th year of mine life, thereby ensuring clear space for unhindered mining during total mine life.

Shovel dumper mining has been selected for OBR. High capacity shovel of 40 m^3 bucket and 360 t Rear dumper have been chosen for removal of thick overburden and interburden. For average thick rock partings, 12 m^3 bucket shovel and 120 t rear dumper have been chosen. For thinner partings, ripper dozer has also been envisaged. Transport of rock waste would be through rear dumpers only.

Coal would be cut by surface miners of 1000 m^3/hr capacity. The cut coal would be loaded by 18 m^3 FEL on to 100 t CBD. Coal by CBD would move towards North for disposal into main trunk belt running along North corridor. By these trunk belts, coal would be moved to CHP area.

15.2.3.1 Rated Mine Capacity & Working Parameters

The Rajbar E & D opencast mine has been planned for a rated capacity of 10 MTPA of ROM Coal. This output is, prima facie considered technically feasible, because of its geo-mining conditions like:

(i) Large Coal deposits
(ii) Comparatively adequate face length
(iii) Workable strata gradient for shovel dumper combination

Design Criteria for Operations

Based on Indian Practices and Norms, the following operational design criteria have been adopted for this opencast project:

- Number of annual working days — 330
- Number of shifts /day — 3
- Duration of each shift (hours) — 8

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(Recognised Qualified Person)
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ESE (P & S)
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15.2.3.2 Sequence of Project Development including Infrastructure

(a) Construction Activities

It has been envisaged that there would be 2 years construction period, before start of production. During this period, following construction activities would be taken up:

(i) making approach road,
(ii) ground survey
(iii) land acquisition
(iv) ground preparation work
(v) bringing power line to the project and construction of electrical sub-station, power supply
(vi) residential colony
(vii) rehabilitation colony
(viii) Infrastructure like office, store, workshop, coal handling plant etc.

(b) The Mine Layout and Mine Development

Considering the lay and disposition of the deposit and surface features, it has been proposed to open the mine from the north east segment of the mine area. It has been explained in detail in Chapter-V. It has been envisaged to give thrust for development towards South in the initial years. After that, with formation of sustainable back dumping space, progress along West direction has been envisaged to sustain 10 MTPA level.

The stage wise details of mine progress has been covered under item 5.14 in Chapter V.

15.2.3.3 Transport of Coal

Schematic line diagram for coal movement is given below:-

Rajesh Ranjan
ESE (P & S)
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Vijay Singh
(Recognised Person)
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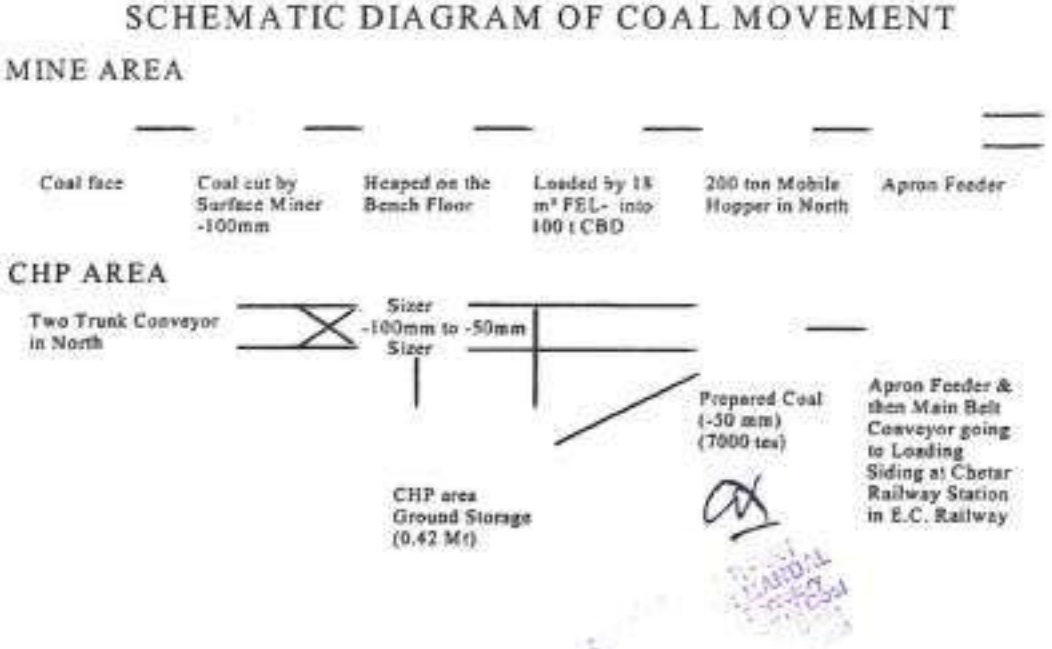
SCHEMATIC DIAGRAM OF COAL MOVEMENT



15.2.4 Coal Beneficiation

The system of mining proposed is **in-seam-mining.** Moreover coal cutting is being done with the help of surface miner which helps in maintaining quality of coal better than obtaining coal through blasting. Coal is meant for use in thermal power house located at about 160 km from pit head. Therefore, no coal beneficiation is envisaged.

15.3 MINE CLOSURE PLAN

The total mine life has three distinct spans. First is the construction period of about 2 years before waste removal and coal production starts. Second is productive mine life. In this project, the production phase is envisaged to cover about 48 years. Third is the period covering final mine closure activities after cessation of coal winning. The final mine closure span is considered immediately after cessation of coal winning. For this mine, the final mine closure activities are planned over 3 yrs. However, during productive mine life also, some activities of land management, green belt development and bio/ agro reclamation of sterile dump areas are carried out. These ultimately dovetail into final land uses of the project. The land management activities, undertaken during constructive and productive mine life, is termed as progressive closure activities. Besides, water quality and air quality management, drain making, top soil management etc. would also be

Vijay Kumar Singh
(Recognised Qualified Person)
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considered. Thus a Mine Closure Plan (MCP) will have Progressive Closure Activities (PCA) executed during productive mine life and Final Closure Activities (FCA) to be carried out after cessation of mining.

15.3.1 Progressive Closure Activities (PCA)

Various items of progressive closure activities are detailed below:

- Mined out Land
- Water quality management
- Air quality management
- Waste management
- Top Soil Management
- Barbed wire fencing around temporary dump
- Barbed wire fencing around the Project Area
- Filling of Void – Rehandling of Crown Dump
- A. Technical and Agro Reclamation of Mined out land
  B. Technical and Bio Reclamation of Mined out land
- Plantation over virgin area including green belt
- Manpower Cost and supervision
- Toe Wall around the temporary dump
- A. Garland drain around Project Area
  B. Peripheral road, gates & View points for the mine
- Greening of temporary dumps

15.3.1.1 Mined Out Land

15.3.1.1.1 Reclamation of Excavated Area

The project is planned to cover 1351 ha of surface area. Of this 1262 ha would be excavated for coal winning.

This 1262 ha mined out area shall be reclaimed, as follows, as final land uses.

Table No. – 15.4

Reclamation of Excavation Area (1262 ha)

Sl. No.	Final Land Uses	Area in ha	Non Forest	Forest
1.	Plantation Area	495.52	164.76	330.76
2.	Agriculture Area	497.48	497.48	0
3.	Water Body	269.00	135.81	133.19
Total		**1262**	**798.05**	**463.95**

Rajesh Ranjan
CGE (P & S)
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15.3.1.1.2 Reclamation of Project Area

The project area of 1351 ha shall have 88 ha of disturbed land for infra and other services. This 88 ha will be reclaimed as suggested below in table no. – 15.5. One ha area remains undisturbed under this OC project area.

Table No. – 15.5

Reclamation of Project Area (1351 ha)

Sl. No.	Final Land Uses	Area in ha			
		Excavated Area	Infra & Other	Green Belting	Total
1.	Plantation Area	495.52	12.70	28.90	537.12
2.	Agriculture Area	497.48	9.00	0.00	506.48
3.	Water Body	269.00	0.00	0.00	269.00
4.	Public & Other uses		37.40	0.00	37.40
Total		**1262.00**	**59.10**	**28.90**	**1350.00**
5.	Undisturbed (Incline area)	0	1		1
Total		**1262**	**(59.1+28.9+1.0) = 89**		**1351**

15.3.1.1.3 Reclamation as Plantation Area & Agriculture Areas

These land reclamation activities proceed during productive mine life and get finalized in final closure period. Table no. – 15.6 and 15.7 give details of stage wise (5 years stage) land degraded, technically reclaimed and biologically reclaimed respectively. The forest land (497.28 ha) returned at end of final closure, equals the total forest land proposed to be used for the project.

Vijay [illegible] Singh
(Recognised [illegible] Person)
[Recognition No. [illegible] 2014-CPAM
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Rajesh Ranjan

Table No. – 15.6

Land Degraded & Technically Reclaimed Area

Area in ha

Production Stage Years		Land Degraded				Technically Reclaimed Area				
		Excv	Dump (Extn + Top Soil)	Infra/ others	Total	Back-filled	Dump (Extn + Top Soil)	Infra & Others	Green Belting	Total
1	2	3	4	5	6	7	8	9	10	11
Y-1	2018-19	20	No external dumping of Waste Rock or Top soil is proposed.	88	108		Not required as explained in Column 3.	59.1		59.1
Y-3	2020-21	96		88	184			59.1		59.1
Y-5	2022-23	153		88	241	48		59.1	28.9 ha	136.0
Y-10	2027-28	439		88	527	117		59.1	28.9 ha	205.0
Y-15	2032-33	535		88	623	174		59.1	28.9 ha	262.0
Y-20	2037-38	617		88	705	222		59.1	28.9 ha	310.0
Y-25	2042-43	772		88	860	318		59.1	28.9 ha	406.0
Y-30	2047-48	916		88	1004	406		59.1	28.9 ha	494.0
Y-35	2052-53	1034		88	1122	525		59.1	28.9 ha	613.0
Y-40	2057-58	1138		88	1226	639		59.1	28.9 ha	727.0
Y-45	2062-63	1195		88	1283	795		59.1	28.9 ha	883.0
Y-48	2065-66	1262		88	1350	982		59.1	28.9 ha	1070.0
Post Closure Y-51	2068-69					982		59.1 + 280 = 339.1 ha	28.9 ha	1350.0 *
Undisturbed					1					1
					1351					1351

- Infrastructure to be retained – 37.4 ha
- Infra Others to be dismantled – 21.7 ha

} 59.1 ha + Green Belt – 28.9 ha = 59.1 + 28.9 = 88 ha

- Backfilled – 982 ha
- Void – 280 ha
  - ❖ Water Body – 269 ha
  - ❖ Slant Plantation – 11 ha
- Infra & Others – 88 ha
  - ❖ Infra & Others – 59.1 ha
  - ❖ Green Belting – 28.9 ha

Total – 1350 ha

Undisturbed – 01 ha

Total Project Area – 1351 ha

Rajesh Ranjan
ESE (P & S)
TVNL Hirak, Ranchi-834002
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Vijay Kumar Singh
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Table No. – 15.7
Biologically Reclaimed Area

Area in ha

Production Stage Years		Biologically Reclaimed Area					Forest Land (Retu-rned)	Un Disturbed	Total
		Agricul-ture	Planta-tion	Water Body	Public/ Company (Infra Retained)	Total			
Y-1	2018-19								
Y-3	2020-21								
Y-5	2022-23								
Y-10	2027-28	3	43			46			
Y-15	2032-33	16	81			97		1	
Y-20	2037-38	30	114			144		1	
Y-25	2042-43	85	152			237		1	
Y-30	2047-48	141	190			331		1	
Y-35	2052-53	177	245			422		1	
Y-40	2057-58	213	300			513		1	
Y-45	2062-63	330	311			641		1	
Y-48	2065-66	447 #	322 #			769		1	
Post Closure									
Y-51	2068-69	506.48	537.12	269	37.4	1350	497.28	1.0	
Undisturbed					1	1351			

- After the end of 48th year, 59.48 ha of agricultural land and 215.12 ha of plantation to be done during post mining reclamation.

The land reclamation activities have been discussed in details at item 14.5.1.1.5 in Chapter – XIV as part of Environment Management. The detail of forest land (497.28 ha) returned is given in table no. – 14.11 in Chapter – XIV.

15.3.1.2 Water Quality Management

The water regime of the project area has been discussed in detail in Chapter on Environment Management (Chapter – XIV). Some salient points are covered here for comprehension.

15.3.1.2.1 Surface water

The Sukri nadi flows on North side of the project area. Further, there are 1st & 2nd order channels, generating in the project area and flowing out in West and North directions. Some 2nd order streams enter the project area from East side and flow out across West side. They are rather, ephemeral channels, flowing in rainy season or a little beyond.

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Further, there are some ponds in the project area which get dry with onset of summer. Total surface water bodies cover about 51.90 ha in the project area. Surface Water quality report for Sukri nadi, assessed at two sites – S_1 & S_2 in a project in the buffer zone, is given hereafter in table no. – 15.8.

Table No. – 15.8
Surface Water Quality of Sukri Nadi
Standard : IS2296 Class A

Sl. No.	Parameter	S_1	S_2
1.	pH	8.28	8.02
2.	Total Suspended Solids (TSS)	11.7	14.2
3.	Total Dissolved Solids (TDS)	284.5	248.0
4.	Calcium Hardness as $CaCO_3$	15.5	9.4
5.	Magnesium Hardness as $MgCO_3$	34.8	6.6
6.	Total Alkalinity	128	38
7.	Phenolic compound as C_6H_5OH	BDL	BDL
8.	Sulphate as SO_4	7.6	20.1
9.	Chemical Oxygen Demand (COD)	1.78	0.57
10.	Dissolved Oxygen (DO)	6.25	6.44
11.	Bio-chemical Oxygen Demand (BOD) at 20^0C for 5 days	1.1	0.36
12.	Oil and Grease	BDL	BDL
13.	Fluoride F-	0.5	0.5
14.	Iron (Fe)	0.21	0.12
15.	Copper (Cu)	BDL	BDL
16.	Arsenic (As)	BDL	BDL
17.	Lead (Pb)	BDL	BDL
18.	Zinc (Zn)	BDL	BDL
19.	Boron (B)	BDL	BDL

15.3.1.2.2 Ground Water

The occurrence of groundwater in Rajbar area is mainly controlled by the topography, physical characteristics and structure of the water bearing formations. The weathered residuum of the hard rocks as well as the fractures, joints, fissures, faults and other zones of discontinuity are the main water bearing formations of the area. The movement of ground water is mainly controlled by presence of natural openings in the rock formations, its continuity and interconnection of joints and fractures. Groundwater in the area is withdrawn usually by means of open dug wells and hand operated tube wells.

Ground water Sample results done in the past for a neighbouring project, from villages namely Tubed, Dhobiajharan & Mangra is given below in table no. – 15.9.

Rajesh Ranjan
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Table No. – 15.9
Ground Water Quality of Some Villages in Buffer Zone
Standard : IS10500

Sl. No.	Parameters	Units	GW_1 Tubed	GW_2 Dhobiajharan	GW_3 Mangra
1.	Colour	Hazen	Colourless	Colourless	Colourless
2.	Odour	-	Odourless	Odourless	Odourless
3.	Taste	-	Agreeable	Agreeable	Agreeable
4.	Turbidity	NTU	5.9	17.1	2.2
5.	pH	-	6.62	7.21	6.88
6.	Total Suspended Solids (TSS)	mg/l	3.4	12.5	1.9
7.	Total Dissolved Solids (TDS)	mg/l	442.5	557.1	614
8.	Calcium Hardness as $CaCO_3$	mg/l	34.9	94.8	12.4
9.	Magnesium Hardness as $MgCO_3$	mg/l	25.1	27.2	45.6
10.	Total Alkalinity	mg/l	104.0	80.0	116.0
11.	Chloride as Cl-	mg/l	23.97	18.98	97.90
12.	Sulphate as SO_4	mg/l	31.7	15.1	49.3
13.	Nitrite-Nitrogen (NO^3-N)	mg/l	0.090	0.206	0.124
14.	Chemical Oxygen Demand (COD)	mg/l	2.152	4.384	10.2
15.	Dissolved Oxygen (DO)	mg/l	4.28	3.22	5.3
16.	Bio-chemical Oxygen Demand (BOD) at 20^0C for 5 days	mg/l	0.975	1.9	2.4
17.	Oil and Grease	mg/l	BDL	BDL	BDL
18.	Fluoride F-	mg/l	BDL	BDL	BDL
19.	Iron (Fe)	mg/l	0.148	0.23	0.24
20.	Copper (Cu)	mg/l	BDL	BDL	BDL
21.	Arsenic (As)	mg/l	BDL	BDL	BDL
22.	Lead (Pb)	mg/l	BDL	BDL	BDL
23.	Zinc (Zn)	mg/l	BDL	BDL	BDL
24.	Hexavelent Chromium (Cr^{+6})	mg/l	BDL	BDL	BDL
25.	Chromium (Cr)	mg/l	BDL	BDL	BDL
26.	Mercury (Hg)	mg/l	BDL	BDL	BDL
27.	Cadmium (Cd)	mg/l	BDL	BDL	BDL
28.	Selenium (Se)	mg/l	BDL	BDL	BDL
29.	Aluminium (Al)	mg/l	BDL	BDL	BDL
30.	Boron (B)	mg/l	BDL	BDL	BDL
31.	Total Coliform at 37^0C	MPN per 100 ml	BDL	BDL	BDL

Detailed water quality analysis in the project area and buffer zone area will be covered during the EIA/EMP formulation of the project.

Vijay Kumar Singh
(Recogn... Qualified Person)
[Recogni... 1012/(03)/2014-CPAM
Dated: ...0.05.2015]

Rajesh Ranjan
ESE (P &D)
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- **Ground Water Development**

  Dug wells are the main ground water extraction structures in the project area to meet the demand of water for domestic and agricultural needs. Therefore, overall stage of ground water development is quite low. Thus, there is sufficient scope for development of ground water to meet the future needs. As per CGWB, Latehar district has overall ground water development of less than 20%. In general, ground water is suitable for drinking and other purposes.

  However, after this Mining Plan is approved and TOR is issued by MoEF&CC for this proposed project; detailed studies on water regime shall be undertaken for EIA/EMP formulation.

- **Treatment of the Mine Water**

  The following preventive measures will be adopted to maintain the water quality within statutory sustainable levels, during the project operational stages.

  1. Maintaining proper gradient for drainage of water on the bench floors and construction of water drains using local material to prevent soil erosion and uncontrolled descent of water on the dump slopes.
  2. Construction of garland drains of suitable size around mine area, with proper gradient, to prevent rain water from entering into excavation area.
  3. Construction of settling and sedimentation pond of adequate size to collect the mine discharge water to allow settlement of suspended solids and its storage after necessary treatment. The treated water will be used for dust suppression, green belt development and other needs of project.
  4. Construction of garland drain around coal stock yard/coal bunker.
  5. Desilting of sedimentation ponds/drains at regular intervals.
  6. The temporarily dumped high dumps will be provided with inner slopes on top flat surface and through a system of drains and masonry chutes and channels. The water will be allowed to descent into surrounding garland drains, so as to minimize the effects of erosion arising out of uncontrolled descent of water.
  7. Effluents from workshop, garage or wash areas will be treated through

Rajesh Ranjan
CSE (P & J)
TVNL, Hinoo, Ranchi-834002
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Vijay Kumar Singh
(Recognised Qualified Person)
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grease / oil traps and then in sedimentation pond and recycled for use again in the workshop/ wash area.

8. Check dams will be provided at vulnerable places to arrest erosion and sudden descent of water, as well as for recharge of ground water.
9. Separate sewage system for domestic sewage and office sewerage etc. will be set up for proper treatment of these in treatment plant. There will be reuse of recovered water in green belt, etc. The solid waste from sewage treatement plant of the colony & office will be used as manure over the plantation areas.

- **Water Balance**

The water balance of the project is detailed at item 14.3.2.4 on page XIV – 5/31 & 6/31 discussing the pumping of water and its various uses. The water balance shows some water from project being discharged to natural channels. Further, a water lagoon is being created for positive support to water uses.

15.3.1.3 Air Quality Management

This is discussed in detail at item 14.3.3 & 14.5.3 in Chapter – XIV, dealing Environment Management. However, it is briefly described here as per mine closure guidelines.

The area where project is envisaged to be opened is about 3 Km. away from nearest mine area i.e. Sikni mines of Jharkhand Mineral Development Corporation. Sikni, a medium size mine.

The nearest town is Latehar, which is its district town. It is nearly 25 Km. away. Presently the project and surrounding area is having rural background. Therefore, ambient air in the proposed project area is of rural set up. It, therefore, has high level of assimilative capacity for supporting development. Detailed study will be undertaken during EIA/EMP studies for the project. Pre-mining, ambient air quality data, within project area of a proposed project, namely Tubed OCP, on N.W. Side of Rajbar E & D Coal Mine is given below in table no. – 15.10. Air quality for Tubed, Dihi and Simaria villages are given

Vijay Kumar Singh
(Recognised Qualified Person)
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Rajesh Ranjan

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below for an idea of the air quality in the area. The air quality shows enough cushion to allow development of a mine.

Table No. – 15.10
Existing Air Quality data in the neighbouring proposed Tubed Project
Season – Pre Monsoon

All figure in mcg/m^3

Sl. No.	Parameters	Tubed	Dihi	Simaria
1.	SPM	112.4	113.5	118.8
2.	RPM	28.1	26.5	30.2
3.	SO_2	13.5	14.4	12.0
4.	NO_X	15.5	15.5	13.5

15.3.1.3.1 Air Regime

During mining operations, some of major air polluting activities, affecting air quality, is listed below.

Sl. No.	–	Activities
1.	–	Drilling in Waste Rocks
2.	–	Blasting in Waste Rocks
3.	–	Loading of Coal & Rocks
4.	–	Transportation
5.	–	CHP Area

15.3.1.3.2 Control Measures

The Control Measures to manage air quality as envisaged for the project are given below:

- **Drilling**

➢ Usage of Drill bits in good condition

➢ Wet drilling to minimize generation of dust.

- **Blasting**

➢ Well designed blast by effective stemming and use of milli second delay detonators – The blast should be properly designed to see that the optimum breakage occurs without generating fines.

➢ Avoiding blasting during high wind periods where the fine dust is likely to be carried out affecting the ambient air quality.

Rajesh Ranjan
ESE (P & S)
TVNL, Barkakana
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Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

- Use of delay detonators to keep the noise as well as vibration level within the prescribed limits.
- Conducting muffled blasting to avoid disturbance.

- **Loading of Coal/ Rock at faces**

- Water sprinkling at surface miner cutting blade (in built in the machine).
- Optimal use of explosive for required sizing of coal/ waste to minimize dust.
- Prevent overloading of dump trucks to minimize spillage and thereby control dust generation on the transport road.

- **Transportation**

- Proper maintenance of haul road and other roads
- Black topping of roads, whose lay is permanent and for longer duration.
- Frequent water spraying / sprinkling on the roads, stock-piles, OB dumps and transfer points where dust is generated. Water sprinkling through Stationary water sprinkling system on permanent haul roads and possible places of dust generation.
- Development of extensive green belt/ barriers around mine, coal handling plant, workshop, along the roads, periphery of the mine etc.

- **Coal Handling Plant Area**

- The coal sizer –100 mm to –50 mm shall be located in an enclosed area to prevent propagation of dust.
- The plant to be routinely maintained, to avert excessive noise and vibration.
- Shall have inbuilt nozzles for spraying water in the form of mist (Dry fogging) for efficient dust suppression at the feed hopper and transport points.
- All the internal roads in CHP area are to be made pucca.
- Stacking of coal in proper location with proper stack geometry.

From the above description, it is evident that adverse impact on air quality due to these operations, in the project will be minimized.

Vi[illegible]mar Singh
(Recog[illegible] Qualified Person)
[Recognition[illegible]34012/(03)/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
GM (P & S)
TVNL, Patratu, Ranchi-834002
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15.3.1.4 Waste Management

15.3.1.4.1 Quality of Waste Rock

Major part of waste rock whether constituting overburden or inter burden are sand stone and shale. However, there are carbonaceous shales, siltstone, sandy shale also. All the varieties of rock types are typical of Barakar and Raniganj formations. Top mantles are soil on top and weathered rocks below the soil.

None of the rocks of Barakar, Raniganj and Barren Measures show sign of acidity.

15.3.1.4.2 Quantity of Waste & Dumping Schedule

The waste quantity totals to 2119 Mm^3. The annual schedule of waste and its disposal/ management is given in table no. – 15.11. Waste generation and its technical reclamation schedule at 5 year interval, is given hereafter in table no. – 15.12.

Table No. – 15.11

Annual Dumping Schedule (Figure in Mbcm)

Years	Total Waste Generated		Disposal details of Generated Waste					
			Temporary Dumping		Rehandling		Internal Dumping	
	Annual Waste in Mbcm	Cum Waste in Mbcm	Annual Waste in Mbcm	Cum Waste in Mbcm	Annual Waste in Mbcm	Cum Waste in Mbcm	Annual Waste in Mbcm	Cum Waste in Mbcm
	1	2	3	4	5	6	7	8
Y-1	5.5	5.5	5.5	5.5				
Y-2	11	16.5	11	16.5				
Y-3	22	38.5	22	38.5				
Y-4	38.5	77	38.5	77				
Y-5	44	121	19	96			25	25
Y-6	44	165	10	106			34	59
Y-7	50	215	10	116			40	99
Y-8	55	270	10	126			45	144
Y-9	55	325	10	136			45	189
Y-10	54	379	10	146			44	233
Y-11	52	431	7	153			45	278
Y-12	52	483	7	160			45	323
Y-13	52	535	7	167			45	368
Y-14	52	587	7	174			45	413
Y-15	52	639	7	181			45	458
Y-16	52	691	7	188			45	503

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
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Years	Total Waste Generated		Disposal details of Generated Waste					
			Temporary Dumping		Rehandling		Internal Dumping	
	Annual Waste in Mbcm	Cum Waste in Mbcm	Annual Waste in Mbcm	Cum Waste in Mbcm	Annual Waste in Mbcm	Cum Waste in Mbcm	Annual Waste in Mbcm	Cum Waste in Mbcm
Y-17	52	743	7	195			45	548
Y-18	52	795	7	202			45	593
Y-19	52	847	7	209			45	638
Y-20	52	899	5	214			47	685
Y-21	50	949	9	223			41	726
Y-22	50	999	6	229			44	770
Y-23	50	1049			5	5	50	825
Y-24	50	1099			7	12	50	882
Y-25	50	1149			10	22	50	942
Y-26	50	1199			10	32	50	1002
Y-27	50	1249			12	44	50	1064
Y-28	50	1299			12	56	50	1126
Y-29	50	1349			14	70	50	1190
Y-30	50	1399			14	84	50	1254
Y-31	50	1449			16	100	50	1320
Y-32	50	1499			16	116	50	1386
Y-33	50	1549			18	134	50	1454
Y-34	50	1599			18	152	50	1522
Y-35	50	1649			16	168	50	1588
Y-36	50	1699			16	184	50	1654
Y-37	50	1749			16	200	50	1720
Y-38	50	1799			16	216	50	1786
Y-39	47	1846			13	229	47	1846
Y-40	47	1893					47	1893
Y-41	47	1940					47	1940
Y-42	45	1985					45	1985
Y-43	40	2025					40	2025
Y-44	40	2065					40	2065
Y-45	26	2091					26	2091
Y-46	16	2107					16	2107
Y-47	10	2117					10	2117
Y-48	2	2119					2	2119

Vija ar Singh
(Recogni... ...cified Person)
[Recognition N... ...12/(03)/2014-CPAM
Dated ...05.2015]

Rajesh Ranjan
Exe (Opg & S)
TVNL, Hinoo, Ranchi-834002
21 DEC 2015

Table No. – 15.12

Dumping Schedule (Figure in Mbcm) at 5 Year Interval

Figure in Mbcm

Years	Total Waste Generated		Technical Reclamation of Generated Waste					
			Temporary Dumping		Rehandling		Internal Dumping	
	Stage Waste	Cum Waste	Stage Waste	Cum Waste	Stage Waste	Cum Waste	Stage Waste	Cum Waste
	1	2	3	4	5	6	7	8
Y-1	5.5	5.5	5.5	5.5				
Y-3	22	38.5	22	38.5				
Y-5	44	121	19	96			25	25
Y-10	54	379	10	146			44	233
Y-15	52	639	7	181			45	458
Y-20	52	899	5	214			47	685
Y-22	50	999	6	229			44	770
Y-23	50	1049			5	5	50	825
Y-25	50	1149				22	50	942
Y-30	50	1399				84	50	1254
Y-35	50	1649				168	50	1588
Y-40	47	1893					47	1893
Y-45	26	2091					26	2091
Y-48	2	2119					2	2119

15.3.1.4.3 Rock Waste Stabilization

Rajbar E & D Coal Mine cannot dispose waste as external dump. For the first 4 years entire excavated waste is planned to be dumped over coal bearing area on the West side forming a 3 layer temporary dump being 90 m high. This dump will have 25 m wide berm and 30 m height for each layer. From 5th year onwards till 22nd year part of waste would go to temporary dump and the rest to decoaled area. From 23rd year onwards entire waste generated would go to backfill. In addition some waste from temporary waste dump would be rehandled to be accommodated in the decoaled area which would by then have enough space to accommodate waste from both the sources. Year wise dumping may be seen at table no. – 15.11. Waste generation and its technical at 5 year interval, reclamation, has been given at table no. – 15.12.

As the temporary waste dump has 25 m berm and 30 m height, it would have an overall slope of 24.8^0 well within safety angle of 28^0. This design along with drainage arrangement for rain water would ensure stability of temporary dump.

Rajeev Ranjan
ESE (P & S)
TVNL, Hindo, Ranchi
27 DEC 2014

Vij[illegible] Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

15.3.1.4.4 Prevention of Siltation, Erosion and Dust Generation from Dumps

Temporary dump would have a toe wall all around the dump to arrest rolling stones. It would also arrest water to be guided to garland drain for final disposal into Sukri River. This dump would have temporary barbed wire fencing all around to prevent inadvertent entry of mine workers. Toe wall and drain at the base of dump would arrest silt. Greening of inactive part of dump would arrest dust from polluting the mine atmosphere. Internal dump or backfill would also have toe wall to arrest rolling stone. The top of the dump would have mild slope in direction opposite to mine progress for being collected into drain at base at surface level. It would be guided to garland drain for final disposal into Sukri River. Rain water and silt flowing with it on the advancing side of backfill would flow into mine sump for pumping and regular cleaning through backhoes. Inactive and sterile top of back fill would be technically reclaimed. Top soil would be spread over it and plantation done as progressive measure of reclamation.

15.3.1.5 Top Soil Management

15.3.1.5.1 Top Soil at Rajbar

Sufficient thickness of top soil is available at Rajbar E & D excavation area of 1262 ha. Top soil upto a depth of 0.4 m is proposed to be collected and spread over backfill or stored over a temporary soil dump as the situation of reclamation demands. North-West part of the block has been earmarked for top soil temporary storage over an area of 20 ha. Location may be seen on Stage plan at Plate No. – 15 A. This location would change after 40th year to backfilled area as shown in Stage plan at Plate No. – 15 G.

15.3.1.5.2 Preservation of Top Soil

It is proposed to preserve top soil stored in temporary dump over 20 ha. Fodder grasses or leguminous crops would be planted to hold top soil from its erosion and loss. These grass type plants would also preserve the fertility of stored top soil.

15.3.1.5.3 Action Plan for Top Soil Management

Collection and storage of top soil would take place before taking up mine excavation in any area. Therefore, top soil would be removed from the mining area for first 5 years. Backfilling would start in the 5th year. After two years of backfilling, around 7th year reclamation of internal dump would commence. The top soil required would be rehandled from the temporary dump of top soil

Rajesh Ranjan
DGM (P&P)
21 DEC 2021

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

stacked over 20 ha. From 10th year onwards collection of top soil and its spreading over backfill area would go on simultaneously. Surplus top soil only would be stacked over 20 ha top soil temporary dump. This process would continue till the entire top soil is rehandled for biological reclamation. The top soil would be stacked temporarily and would be regularly used and stacked. The top soil dump would be created in North-West segment of excavation area. By 20th year, it is covering about 20 ha area. The soil would be stacked during initial 5 years and then only unused soil gets accumulated after concurrent uses. The soil dump would be greened with grass for retaining the microbes of the soil. A table no. – 15.13 for waste management provides details of top soil generated every five year besides its distribution and spreading over internal dump/ backfilling. Another table no. – 15.14 provides precise detail for the area of embankment, internal dump and green belt besides quantity of soil consumed in spreading over these areas. The estimated cost is ₹ 0.20 crores at the rate of ₹ 1.00 lakh/ha for greening generation, storage & utilization of top soil management is detailed in the table no. – 15.13 and 15.14 placed hereafter.

Table No. – 15.13

Waste Management covering Top Soil Management (Figures in Mm^3)

Year/ Stage	Cumulative OB Removal			Temporary Dump (Cumulative)		Internal Dump/ Backfilling (Cumulative)		Embankment & Green Belt (Cumulative)	
	Top Soil	OB	Total Waste	OB	Top Soil	OB	Top Soil	OB	Top Soil
1st Year	0.1	5.4	5.5	5.0	–	–	–	0.4	0.05
3rd Year	0.4	38.1	38.5	38.15	0.25	–	–	–	0.10
5th Year	0.6	120.4	121	96	0.45	25	–	–	–
10th Year	1.8	377.2	379	146	1.45	232.8	0.2	–	–
15th Year	2.1	636.9	639	181	1.58	457.5	0.5		
20th Year	2.5	896.5	899	214	1.70	684.2	0.8	–	–
25th Year	3.1	1145.9	1149	207	1.85	940.8	1.2		
30th Year	3.7	1395.3	1399	84	2.00	1252.3	1.7	–	–
35th Year	4.1	1644.9	1649	61	1.95	1585.8	2.2		
40th Year	4.6	1888.4	1893	–	1.90	1890.0	2.7	–	–
45th year	4.8	2086.2	2091	–	1.45	2087.7	3.3		
48th Year	5.0	2114.0	2119		1.00	2114.0	4.0	–	–

Rajesh Ranjan
TVNL Mines
27/05/2015

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

Table No. – 15.14

Top Soil Management – (Including Action plan for Top Soil management)

Year/ Stage	Top Soil Removal "Mm^3" (Cumulative)	Top Soil Used "Mm^3"								Total utilized Top Soil (Cumulative)
		Embankment		Spreading over the Backfilling Area in Sq. Km. (Cumulative)		Spreading over the OB Dump Area in Sq. Km.		Using for Green Belt Area (Cumulative)		
		Area (Sq. Km.)	Top Soil (Mm^3)	Area (Sq. Km.)	Top Soil (Mm^3)	Area (Sq. Km.)	Top Soil (Mm^3)	Area (Sq. Km.)	Top Soil (Mm^3)	
1st Year	0.06	0.065	0.020					0.10	0.030	0.050
3rd Year	0.384							0.317	0.0951	0.1151
5th Year	0.612									0.1151
10th Year	1.756			0.42	0.1768					0.2919
15th Year	2.112			0.93	0.4248					0.5399
20th Year	2.468			1.44	0.6728					0.7879
25th Year	3.066			1.8055	1.1571					1.2722
30th Year	3.664			2.171	1.6414					1.7585
35th Year	4.108			3.5955	2.0876					2.2027
40th Year	4.552			5.02	2.5338					2.6489
45th Year	4.408			6.21	3.2485					3.3636
48th Year	5.048			7.40	3.9632					4.0783
Post Mining			0.020	9.93	4.7878			0.417	0.1251	5.0480

15.3.1.6 Barbed Wire Fencing around Temporary Dump

The temporary dump of 229 Mm^3 has to be put over the open area of proposed mine in West side. This area has been fenced in North, South & West side. East side is open for movement of vehicles for dumping. The length covered comes to 6 Km.

15.3.1.7 Barbed Wire Fencing around Project Area

This fencing is around the project area of 1351 ha. This fencing will ensure to prevent inadvertent entries to the project area. Length covered comes to about 18 Km.

15.3.1.8 Filling of Void – Rehandling of Crown Dump

The Waste Management activity would not need any rehandling of crown dump. Temporary waste dumps have been rehandled as a routine mine operation for filling the routinely created voids in decoaled area.

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
ESE (P & S)
TVNL, Hinoo, Ranchi-834002
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15.3.1.9A Agro Reclamation of Mined out Land

During progressive closure, about 447 ha backfilled area is reclaimed as agriculture area.

15.3.1.9B Biological Reclamation of Mined out Land

During the operational mine life about 322 ha of land will get planted and thus reclaimed.

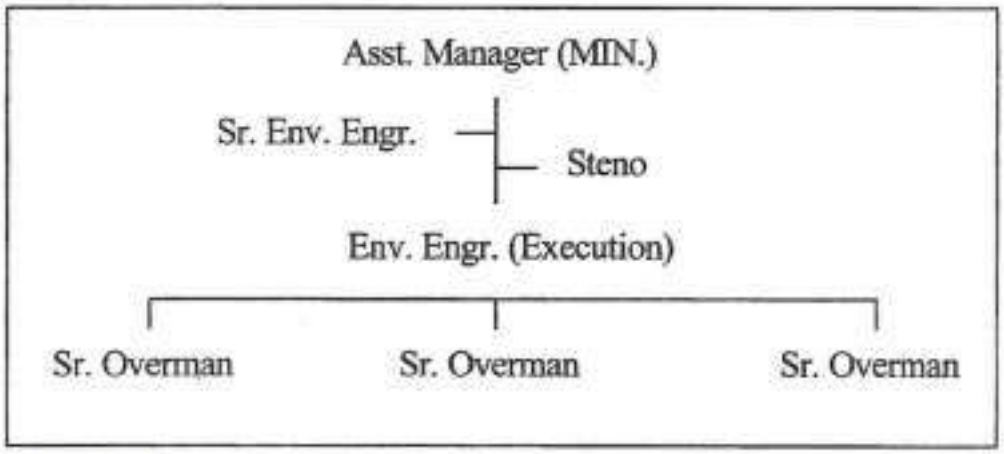
15.3.1.10 Plantation over Virgin area including Green Belt

During initial first 5 years green belting & plantation over other areas would cover 28.9 ha of land. This will cover mine boundary areas and areas around infras etc.

15.3.1.11 Manpower Cost and Supervision

Leveling and grading of waste dump is required for efficient movement of dump trucks and other mining equipment. Dozers, graders and water sprinklers are required for this work. These items fall under routine mining activity and the manpower cost engaged is estimated at 36 persons for this routine job out of total of 48 persons. The cost of remaining 12 persons has been booked under this head for mine closure.

Supervisory Manpower Chart



15.3.1.12 Toe Wall around the Temporary Dump

This activity is called for to ensure stability of dumps and preventing untoward movement of loose rocks from the waste dumps. It covers 17.4 Km around the temporary dump. Making toe wall around the temporary dump is a routine mining operation.

Rajesh Rajan
ESE (P & S)
TVNL, Lohunia, Ranchi
21 DEC 2015

Ku[illegible]r Singh
[illegible]ed Chemical Engineer)
[Recogni[illegible] No. 34012/(93)/2014-[illegible]M
Dated- 29.05.2015]

15.3.1.13A Garland Drain around Project Area

This is a must for preventing entry of outside rain water into mining areas. This covers about 18 Km length around the mine.

15.3.1.13B Peripheral road, gates & View Points

These activities will get covered in 1st 3 years of mine life.

15.3.1.14 Greening of Temporary Dump

The temporary dumps are going to remain for more than 10 years before being rehandled. Hence these will be greened for betterment of ecology. The perennial greening schedule is given below:-

Sl. No.	–	Stage	–	Area Greened in ha
1.	–	6th yr to 10th yr	–	100 ha
2.	–	11th yr to 20th yr	–	250 ha
3.	–	21st yr to 23rd yr	–	60 ha

15.3.2 Final Closure Activities

Activities to be covered for final closure of the mien are discussed below:

15.3.2.1 Management of Infras Areas & Others

A. The following items of infrastructure and other areas would be retained for use by the local community for their public uses.

Infrastructure to be Dismantled		Non Forest	Forest	Infrastructure to be retained		Non Forest	Forest
Workshop	2.9	2.9	0	Garland Drain	4.3	2.26	2.04
Store	1.9	1.9	0	Embankment with Road at its top	9.5	5.75	3.75
Electrical Sub Station	2.0	2	0	Sedimentation Tank	0.6	0.6	0
CHP & Coal Storage	12.7	0	12.7				
Total	**19.5 ha**	**6.8 ha**	**12.7 ha**	**Total**	**14.4 ha**	**8.61 ha**	**5.79 ha**

B. Others

Infrastructure to be Dismantled		Non Forest	Forest	Infrastructure to be retained		Non Forest	Forest
ETP	1.2	0.6	0.6	Road	11	5.12	5.88
Magazine	1.0	0.5	0.5	Township (Colony)	10.1	10.1	0
				Office Building	1.9	1.9	0
Total	**2.2 ha**	**1.1 ha**	**1.1 ha**	**Total**	**23.0 ha**	**17.12 ha**	**5.88 ha**

Rajesh Ranjan
ESE (P & S)
RVNL, Hinoo, Ranchi-834002
17 DEC 2024

Vi... Kumar Singh
(Re... d Quali...
(Recogni... No. 34012/(03)/...TAM
Dated- 29.05.2015)

- The Workshop, Store, Sub Station, Magazine and ETP are as compared, clean areas, covering about 9 ha. These areas will be cleaned & restored as agro-land.
- The CHP and coal storage area covering about 12.7 ha shall be reclaimed as plantation area.
- The Garland Drain, Road, Sedimentation Tank, Residential Township shall be refurbished for use of general public and society unless needed for future coal mines.

15.3.2.2 Disposal of Mining Machineries

The main production equipment i.e. Shovel/ Dumpers/ Surface Minor/ Belt Conveyors would have been replaced during envisaged mine life of 48 years. All mining machine would belong to MDO and these would be taken care by them.

15.3.2.3 Safety & Security

1. Toe wall round dump is made periodically with the help of a dozer to arrest rolling stones and protect mine workers. Barbed wire fencing is second line of protection for public at large, around dump areas.
2. Barbed wire fencing has also been provided around 1351 ha of project area to guard against inadvertent access of non employees.
3. Brick wall fencing around water lagoon has been proposed for its safe use, as and when needed.
4. Stabilization of dumps is inbuilt through three steps dumps above ground level with slope wall height of 30 m and berm width of 25 m. This gives an overall slope of 24.8^0 which is well within the limit of 28^0. By pitching stones, water gullies would be made, to prevent erosion of benches during rains.
5. Garland drain around the mine has been proposed to guide water to Sukri River without erosion and disturbance to mine workings.
6. Bio reclamation of internal dumps on both level and on slope, would closely follow, as the dump progresses with a lag of 75 m only. This plantation would stabilize the dump, providing it strength against erosion by rain and wind.
7. North edge of mine is well above high flood level. However an embankment has been proposed as abundant precaution against flooding by Sukri River during monsoon.

Rajesh Ranjan
ESE (P & S)
TVNL, Hindo, Ranchi-834002
27 DEC 2024

Jay Kumar Singh
Recognised Qualified Person
(Recognition No. 34012(ii) dated 30/08/2018
Dated- 29.05.2019)

15.3.2.4 Technical and Bio Reclamation of Mined Out Area and OB Dump

At end of mining activities i.e. after 48 years, the following activities shall be taken up as post closure activities to reclaim the mined areas.

- Reclaiming 59.48 ha of mined out area as agro-land.
- Reclaiming 215.12 ha of mined out area as plantation area.

This will get completed in period of 3 years.

- Cemented steps on bank of water lagoon – To use water lagoon as resource, approach will be made. This will be completed as a final closure activity.

15.3.2.5 Post Closure Management and Supervision

- For completing aforesaid activities, supervision shall be exercised during post closure period with competent people to complete the jobs.
- Assessment of power cost, water quality & air quality management in post closure period.

These have been provided in the expenses to cover the 3 years period of post closure.

15.3.2.6 Economic Repercussion of Mine Closure

Any economic activity, that too like a coal mine, generates employment & economic upliftment of the area. Upon closure, there will be routine activities like retrenchment of employees and reduction of secondary sector economics, causing socio-economic repercussion.

The possible remedial measures are, here on, being presented briefly as under. The cost of these items may be seen in the Table No. – 15.15 under the subhead Others.

15.3.2.6.1 Entrepreneurship development (vocational/ skill development training for sustainable income of affected people

This shall cover overall skill development for the habitants of the mine area. A fund has provided so that the activities can be continued till final mine closure.

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15.3.2.6.2 Golden Handshake/ Retrenchment benefits to 100 Employees of OC

This has been provided to cover the employees who retire pre-maturely. This will help to tide over difficulty of such employees.

15.3.2.6.3 Golden Handshake/ Retrenchment benefits to 200 Employees of UG

Not Applicable.

15.3.2.6.4 Onetime financial grant to societies/ institutions/ organizations which is dependent upon the project

This is to ensure that social activities started by the owner could continue after mine closure.

15.3.2.6.5 Provide jobs in other mines of the Company

Not possible as no other mine is with the proponent.

15.3.2.6.6 Continuation of other services like running of schools, health Centre etc.

Fund has been provided to continue running the community centres like schools, health centre etc. even after closure of the mine.

15.4 TIME SCHEDULING FOR ABANDONMENT

Time Scheduling for Executing Progressive & Final Mine Closure Activities have been detailed in the Bar Chart under Table No. – 15.16.

15.5 ABANDONMENT COST

A description of progressive and final closure activities, together with cost, have been given hereafter. A bar chart has been given at the end of this paragraph which details all the activities along with time scheduling and cost estimates for execution. The cost estimate have been made covering mine life of 48 years + 3 years closure period and it is mentioned in the Table No. – 15.15.

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15.5.1 Details of Closure Cost

The detailed description of each activity and its cost may be seen in Table No. – 15.15. Subtotal of group cost as given above are also given in the table under corresponding five groups. An activity bar chart placed at Table No. –

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15.16 gives time scheduling for each of the activities under identical heads and group heads.

15.5.2 Total cost of Mine Closure Activities

The progressive cost of items have been escalated at the rate of 5% on the principle of time value of money and the final estimate arrived at for both progressive and post mining costs as given below:-

1. Progressive Closure Cost – ₹ 287.73 Crores
2. Final Closure Cost – ₹ 170.92 Crores

Total – ₹ 458.65 Crores

Thus total mine closure cost is estimated at ₹ 458.65 Crores.

Table No. – 15.15
Cost of Activities to be taken up for closure of the mine

Head			Units	Quantity	Present Rate Rs./Unit	Escalated Amount in 'Rs. Crore'
Progressive Closure	1.	Water quality management	Nos.	One water sample per month	₹ 5000/-	1.19
	2.	Air quality management	Nos.	Two sample per month	₹ 2500/-	1.19
	3.	Waste management	M Cum	Routine activity		
	4.	Barbed wire fencing around temporary dump area in North, South & West side	Km	6	6 Lakh	3.66
	5.	Barbed wire fencing around the Project area	Km	18	6 Lakh	10.97
	6.	Filling of Void – Rehandling of Crown Dump	Mm^3	Void filling is included as a routine mining operation. Crown rehandling is not proposed.		
	7.	Top Soil Management (Rehandling)	LS	–	–	0.82
	8 A.	Agro Reclamation of Mined out land	ha	447	3.50 Lakh	48.07
	8 B.	Technical and Biological Reclamation of Mined out land	ha	322	2.50 Lakh	24.72
	9.	Plantation over virgin area including green belt	ha	28.9	1.20 Lakh	3.31
	10.	Manpower Cost and supervision	Nos.	12	2.0 Lakh/ head/ year	71.07
	11.	Toe Wall around the temporary dump	Km	Making toe wall around the temporary dump is a routine mining operation.		
	12 A.	Garland drain around Mine/ Project Area	Km	18	4.5 Lakh	8.23
	12 B.	Peripheral road, gates & View point	LS	–	LS	89.22
	13.	Greening of temporary dumps	ha	410	1.04 Lakh	25.28
					Sub Head Total	**287.73**

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Head			Units	Quantity	Present Rate Rs./Unit	Escalated Amount in 'Rs. Crore'
Final Closure						
Dismantling of Infrastructure & Disposal/ rehabilitation of Mining Machinery	1.	Dismantling of CHP, workshop, substation, store, magazine, ETP.	ha	19	1.0 Lakh	0.55
	2.	Rehabilitation of the dismantled facilities:				
	a.	Rehabilitation of five infra areas covering 9 ha as agriculture land at ₹ 3.00 lakh/ ha.	ha	9	3.0 Lakh	0.78
	b.	Rehabilitation of 12.2 ha of CHP area as plantation area at ₹ 2.00 lakh/ ha.	ha	12.2	2.0 Lakh	0.69
	3.	Dismantling of pumps and pipes/ other facilities	LS	–	–	0.29
	4.	Dismantling of stowing bunker, provisioning of pumps for borewell pumping arrangement		Not Applicable		
	5.	Dismantling of UG equipment		Not Applicable		
	6.	Rearranging water pipeline to dump top park/ Agriculture land	LS	–	–	1.44
	7.	Dismantling of Power line	LS	–	–	0.29
					Sub Head Total	**4.04**
Safety and Security	1.	Barbed wire fencing around dump		Covered in Progressive Closure at item 4.		
	2.	Barbed wire fencing around the pit (Project area)	m	Already done in Progressive Closure at item 5.		
	3.	Barbed wire fencing with masonalry pillars		Not Applicable for the OC mine.		
	4.	Concrete wall with masonalry pillars around the pit	m	Not Applicable for the OC mine.		
	5.	Securing air shaft and installation of borewell pump		Not Applicable for the OC mine.		
	6.	Securing of Incline		Not Applicable for the OC mine.		
	7.	Brick wall fencing around the water body	100 m	109	4.5 Lakh	14.12
	8.	Boundary wall around the water body		Done at 7 above.		
	9.	Stabilization (viz. benching, pitching etc.) of side walls of the water body	LS	–	–	2.86
	10.	Toe wall around the dump		Done in Progressive Closure at item 11.		
	11.	Garland drain		Done in Progressive Closure at item 12A.		
	12.	Garland drain around the dump		No External Dump.		
	13.	Drainage Channel from main OB dump		Not Applicable – No External O.B. Dump. Backfilled dumps drain to peripheral garland drains or mine workings.		
					Sub Head Total	**16.98**
Technical and Biological Reclamation of Mined out area and OB Dump	1.	Filling of Void	ha	Not envisaged in the post closure period.		
	2.	Top Soil management	Mm^3	Covered in Progressive Closure at item 7.		
	3.	OB Rehandling for backfilling	Mm^3	This activity is not proposed in this Mining Plan.		

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DM (Mining) ESE (P & S)
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Head			Units	Quantity	Present Rate Rs./Unit	Escalated Amount in 'Rs. Crore'
	4.	Terracing, blanketing with soil and vegetation of External OB Dump	ha	No external dump.		
	5 A.	Peripheral road, gates and view point		Covered in Progressive Closure at item 12 B.		
	5 B.	Cemented steps on bank of water lagoon	LS	–	LS	1.08
	6.	Expenditure on development of Agriculture land	ha	59.46	3.50 Lakh	6.28
	7.	Landscaping and Plantation	ha	215.12	2.50 Lakh	17.21
					Sub Head Total	**24.57**
Post Closure Management and Supervision	1.	Power Cost	LS	–	–	1.15
	2.	Post Mining Water quality management	LS	–	–	0.17
	3.	Post Mining Air quality management	LS	–	–	0.11
	4.	Subsidence monitoring for 5 years	LS	Not Applicable		
	5.	Waste Management	LS	No Waste Management is envisaged during final closure.		
	6.	Manpower Cost and supervision	LS	–	–	4.60
					Sub Head Total	**6.03**
Others	1.	Entrepreneurship development (vocational/ skill development training for sustainable income of affected people	LS	–	–	28.75
	2.	Golden Handshake/ Retrenchment benefits to 100 employees of OC	Nos.	100	12 Lakh/ head	34.50
	3.	Golden Handshake/ Retrenchment benefits to 200 employees of UG		Not Applicable		
	4.	Onetime financial grant to societies/ institutions/ organizations which is dependent upon the project;	LS	–	–	28.75
	5.	Provide jobs in other mines of the company		No other mine of the applicant		
	6.	Continuation of other services like running of schools, health Centre etc.	LS	–	–	27.30
					Sub Head Total	**119.30**
					Total (Final Closure)	**170.92**
					Total (Progressive Closure)	**287.73**
					Grand Total	**458.65 Crore**

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ESE (P&S)
TVNL, Hindo Kasi
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Table No. – 15.16

Time Scheduling & Envisaged Resources to Execute the Progressive & Final Closure Activities

Sl. No.	Activity	Schedule	Manpower	Expenditure ₹ in Crores
PROGRESSIVE CLOSURE ACTIVITIES				
1	Water quality management		Job Outsourced	1.19
2	Air quality management		Job Outsourced	1.19
3	Waste management		Routine Activity	
4	Barbed wire fencing around temporary dump		Job Outsourced	3.69
5	Barbed wire fencing around the Project area		Job Outsourced	10.97
6	Filling of Void – Rehandling of Crown Dump	Void filling is included as a routine mining operation. Crown rehandling is not proposed.		
7	Top Soil Management (Rehandling)		Job Outsourced	0.82
8 A.	Agro Reclamation of Mined out land		Job Outsourced	48.07
8 B.	Biological Reclamation of Mined out land		Job Outsourced	24.72
9	Plantation over Virgin area including green belt		Job Outsourced	3.31
10	Manpower Cost and supervision		62 Persons	71.07
11	Toe Wall around the temporary dump	Making toe wall around the temporary dump is a routine mining operation.		
12 A	Garland drain around Mine Project Area		Job Outsourced	8.23
12 B.	Peripheral road, gates & Weir point		Job Outsourced	89.22
13	Grassing of temporary dumps		Job Outsourced	25.26
			Sub Head Total	**287.73**
FINAL CLOSURE ACTIVITIES				
A.	**Dismantling of Infrastructure & Disposal/ rehabilitation of Mining Machinery**			
1	Dismantling of CHP, workshop, substation, store, magazine, ETP.		Job Outsourced	0.55
2	Rehabilitation of the dismantled facilities			
a	Rehabilitation of five mine areas covering 5 ha as agriculture land at ₹ 3.00 lakh/ ha.		Job Outsourced	0.70
b	Rehabilitation of 12.2 ha of CHP area as plantation area at ₹ 2.00 lakh/ ha.		Job Outsourced	0.93
3	Dismantling of pumps and pipes/ other facilities		Job Outsourced	0.29
4	Dismantling of slewing bunker, commissioning of pumps for borewell pumping arrangement.	Not Applicable for OC Mine		
5	Dismantling of UG equipment	Not Applicable for OC Mine		
6	Rearranging water pipeline to dump top (with) Agriculture land		Job Outsourced	1.44
7	Dismantling of Power line		Job Outsourced	0.29
			Sub Head Total	**4.04**
B.	**Safety and Security**			
1	Barbed wire fencing around dump	Covered in Progressive Closure at item 4		
2	Barbed wire fencing around the pit	Already done in Progressive Closure at item 5.		
3	Barbed wire fencing with reasonably pillars	Not Applicable for OC Mine		
4	Concrete wall with reasonably pillars around the pit	Not Applicable for OC Mine		

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Sl. No.	Activity	Schedule	Manpower	Expenditure ₹ in Crores
6	Sensing, air shaft and installation of submersil pump	Not Applicable for OC Mine		
6	Sensing of Incline	Not Applicable for OC Mine		
7	Brick wall fencing around the water body		Job Outsourced	14.12
8	Boundary wall around the water body	Done at 7 above.		
9	Stabilization (viz. benching, pitching etc.) of side walls of the water body		Job Outsourced	2.69
10	Toe wall around the dump	Done in Progressive Closure at Item 11.		
11	Garland drain	Done in Progressive Closure at Item 12.		
12	Garland drain around the dump	No External Dump.		
13	Drainage Channel from main Off dump	Not Applicable – No External O.B. Dump. Backfilled dumps drain to peripheral garland drains or mine workings.		
		Sub Head Total		16.80
C.	Technical and Biological Reclamation of Mined out of land and OB Dump			
1	Filling of Void	Not envisaged in the post closure period		
2	Top Soil management	Covered in Progressive Closure at Item 7		
3	OB Rehandling for backfilling	This activity is not proposed in this Mining Plan.		
4	Terracing, blanketing with soil and vegetation of External OB Dump	No External dump in this mine.		
5.A.	Peripheral road, gates and view point	Covered in Progressive Closure at Item 12.B.		
5.B.	Oversized steps on bank of water lagoon		Job Outsourced	1.08
6	Expenditure on development of Agriculture land		Job Outsourced	6.28
7	Landscaping and Plantation		Job Outsourced	17.21
		Sub Head Total		24.57
D.	Post Closure Management and Supervision			
1	Power Cost		Job Outsourced	1.15
2	Post Mining Water quality management		Job Outsourced	0.17
3	Post Mining Air quality management		Job Outsourced	0.13
4	Subsidence monitoring for 5 years	Not Applicable for OC Mine		
5	Waste Management	No Waste Management is envisaged during final closure.		
6	Manpower Cost and supervision		Job Outsourced	4.60
		Sub Head Total		6.03
E.	Others			
1	Entrepreneurship development (vocational skill development) training for sustainable income of affected people		Job Outsourced	28.75
2	Golden Handshake/ Retrenchment benefits to 100 employees of OC		Departmental	34.50
3	Golden Handshake/ Retrenchment benefits to 200 employees of UG	Not Applicable for OC Mine		
4	One time financial grant to societal/ institutional organizations which is dependent upon the project.		Departmental	28.75
5	Provide jobs in other mines of the company	No other mine of the applicant.		
6	Continuation of other services like running of schools etc.		Job Outsourced	27.30
		Sub Head Total		119.30
			Total	466.65 Crores

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Progressive & Final Mine Closure Plan
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15.6 FINANCIAL ASSURANCE

As per guidelines for Mine Closure Plan, the proponent, i.e. TVNL shall take the following actions for executing the financial assurance to complete the mine closure activities.

15.6.1 Opening of a Escrow account

M/s TVNL, the proponent, shall open an Escrow Account with a Scheduled Bank after approval of this plan. The Beneficiary of this account shall be the 'Coal Controller Organization', an organization of Ministry of Coal, GoI. The proponent shall deposit the amount detailed in Table No.-15.18, on yearly basis for 48 years period into this Escrow account.

15.6.2 Condition for operating the Escrow Account

An agreement, outlining detailed terms and conditions of operating the Escrow account, shall be finalized and executed amongst the project owner, the concerned Bank & the Coal Controller. This is to give effect to smooth operation of the Escrow account.

15.6.3 Release of Funds from Escrow Account

The release of funds shall be guided by the guidelines issued for mine closure plan circulated by MoC, GoI on 07-01-2013. Company will submit its bills at regular stages of mine life, in line with MoC, GoI guidelines in the matter, to get reimbursement, for its progressive closure actions. For final closure activities, bills will be submitted once every half year with progress of closure activities.

15.7 RESPONSIBILITY OF THE MINE OWNERS

The Owner shall be duty bound to carry out the mine closure activities, as envisaged and outlined at para 15.5 and in table no. 15.16 in this chapter. The final closure activities are also shown in table no. 15.16 as bar chart. Yearly statement of the status of the compliance of mine closure activities shall be submitted to Coal Controller's Office (CCO) by 1st July for the previous financial year.

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15.8 PROVISION FOR MINE CLOSURE

The Owner shall obtain a mine closure certificate from Coal Controller, certifying that the reclamation activities as per the approved mining plan covering progressive and final closure activities, have been carried out by the Owner.

The balance amount, if any, in the Escrow A/c shall be returnable to the Owner after certification by Coal Controller. The final closure certificate shall be also show % of coal extracted vs. estimated extractable coal.

Coal Controller, if satisfied, reclamation work is not adequate as per approved plan, can forfeit the funds lying in Escrow A/c after giving an opportunity to Owner to be heard.

15.8.1 Final Closure Fund

WPI Base was changed in 2011-12. The closure fund amount of 6 lakh/ ha have therefore to be updated to the changed base. The calculation covering this change is tabulated below for closure fund.

Table No. – 15.17
Final Closure Fund

WPI			Aug-09	⟶	129.60 WPI
WPI in new Base Year	Base Year 11-12	Old WPI – 156.13 From year 11-12 – 100	July-18	119.90	187.200 WPI (On Old Base)
Escalation rate of Closure Cost from August–09 to July–18					1.44
				UG	OC
Base rate of Closure Cost "Rs. Crs./Ha"				0.01	0.06
Closure Cost "Rs.Crs/Ha"					0.06 x 1.44 = 0.087
Proposed Project Area "in ha"					1351.00
Base Amount for Escrow Account (Rs. in Crs)					1351 x 0.087 = 117.087
Rate of compounding of Annual Closure Cost					5.00%
Balance Life of the Project "in Yrs"					48
Annual Closure Cost					**2.4393**
Amount to be deposited into Escrow Account after compounding @ of 5% "Rs. in Crs"					**458.65**
Amount already deposited into Escrow Account "Rs. in Crs."					
Net Amount to be deposited into Escrow Account "Rs. in Crs."					**458.65**

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15.8.2 Fund Deposition Rate

The estimated life of the mine has been envisaged to be 48 years. Therefore, the annual deposition amount comes to ₹ 2.43930 crores, for total fund amount of ₹ 117.087 crores. With 5% incremental addition, the year wise deposit amount is given below in Table No. – 15.18.

Table No. – 15.18
Annual Amount to be deposited in Escrow A/c

Year	Annual Amount to be deposited in ₹ Crores
1	2.43930
2	2.56127
3	2.68933
4	2.82380
5	2.96499
6	3.11324
7	3.26890
8	3.43235
9	3.60396
10	3.78416
11	3.97337
12	4.17204
13	4.38064
14	4.59967
15	4.82965
16	5.07114
17	5.32469
18	5.59093
19	5.87048
20	6.16400
21	6.47220
22	6.79581
23	7.13560
24	7.49238
25	7.86700
26	8.26035
27	8.67337
28	9.10703
29	9.56239
30	10.04051
31	10.54253

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Year	Annual Amount to be deposited in ₹ Crores
32	11.06966
33	11.62314
34	12.20430
35	12.81451
36	13.45524
37	14.12800
38	14.83440
39	15.57612
40	16.35493
41	17.17267
42	18.03131
43	18.93287
44	19.87951
45	20.87349
46	21.91716
47	23.01302
48	24.16367
	458.65107

Total amount over mine life comes to ₹ 458.65 crores (Rs. Four hundred & Fifty eight crore and Sixty five lakh) only. This will be the amount deposited, ultimately in the Escrow account.

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ESE (Mines)
Deptt. Hqrs.
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Annexures

Government of India

Ministry of Coal

O/o the Nominated Authority

World Trade Tower, New Delhi

Office of the nominated authority constituted under section 6 of the Coal Mines (Special Provisions) Act, 2015.

Allotment order under clause (c) of sub-rule (2) of rule 7 and sub-rule (1) of rule 13

In re: **Rajbar E & D Coal Mine** (the "mine") particulars of which is specified in **Annexure I**

Order no.: 103/19/2015/NA

Date: June 30, 2015

In favour of: **Tenughat Vidyut Nigam Limited** incorporated in India under the Companies Act, 1956 with corporate identity number U40101JH1987SGC013153, whose registered office is at Hinoo, Doranda, Ranchi, Jharkhand - 834002, India (the "Allottee").

For utilisation in: End Use Plant situated at Lalpania, Dist. Bokaro, Jharkhand, as more particularly described below (the "End Use Plant")

S. No.	Name of Specified End Use Plant	Address	Configuration	Capacity
1.	Tenughat Thermal Power Station Extension	Lalpania, Dist. Bokaro, Jharkhand	2 X 660 MW	1320 MW

**MW stands for Mega Watt*

WHEREAS, the nominated authority has, in accordance with the provisions of the Coal Mines (Special Provisions) Act, 2015 (the "Act") and the Coal Mines (Special Provisions) Rules, 2014 (the "rules") conducted the allotment of the mine;

AND WHEREAS the allottee is eligible to receive this allotment order with respect to the mine as described in this allotment order, including, inter-alia -

(a) the coal bearing land acquired by the prior allottee and the lands, in or adjacent to the coal mines used for coal mining operations acquired by the prior allottee; and

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(b) any existing mine infrastructure as defined in clause (j) of sub-section (1) of section 3 of the Act.

AND WHEREAS the allottee was also the prior allottee of such Schedule I coal mine;

AND WHEREAS, the allottee has deposited the additional levy payable under sub-section (3) of section 5 of the Act on or prior to the due date specified under rule 18 of the rules;

AND WHEREAS the allottee has furnished a performance bank guarantee dated April 27, 2015 for an amount equal to INR 1,98,00,00,000 (Indian Rupees One Hundred and Ninety Eight Crore) issued by Allahabad Bank in accordance with the allotment document read with sub-section (6) and sub-section (12) of sections 8 of the Act and sub-rule (4) rule 13 of the rules;

AND WHEREAS the allottee has entered into an Allotment Agreement dated March 30, 2015 (as amended) with the nominated authority in accordance with the provisions of sub-rule (5) of rule 13.

NOW, THE NOMINATED AUTHORITY DOES ORDER:

1. On and from June 30, 2015 ("allotment date") and in accordance with sub-section (4) of section 8 read with sub-section (12) section 8 of the Act, with respect to the mine, the following shall stand fully and absolutely transferred and vested in the allottee, namely: -

(a) all the rights, title, interest and liabilities as were available to the prior allottee;

(b) entitlement to a mining lease to be granted by the State Government with the terms and conditions of the Allotment Agreement forming a part of it on making an application;

(c) all statutory licences, permits, permissions, approvals or consents as per rules, required to undertake coal mining operations in the mine, if already issued by the Central Government, to the prior allottee on the same terms and conditions as were applicable to the prior allottee, as listed in the **Annexure 2**;

(d) entitlement to any statutory licence, permit, permission, approval or consent required to undertake coal mining operations in the mine, if already issued by the Central Government, to the prior allottee on making an application on the same terms and conditions as were applicable to the prior allottee, as listed in the **Annexure 3**;

(e) entitlement to any statutory licence, permit, permission, approval or consent required to undertake coal mining operations in the mine, if already issued by the State Government, to the prior allottee on making an application on the same terms and conditions as were applicable to the prior allottee, as listed in the **Annexure 4**;

(f) rights appurtenant to the approved mining plan of the prior allottee;

(g) in the event the secured creditor elects to continue the facility arrangements and security interest, the Allottee shall continue the credit or banking facilities

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or other lending arrangements to which the prior allottee was a party in terms of clause (a) of sub-section (1) of section 12 of the Act;

2. The Allottee may seek any change in the terms and conditions attached to such licence, permit, permission, approval or consent by making an application in accordance with applicable laws;

3 This Allotment order is liable to be cancelled in accordance with the provisions of sub-rule (6) of rule 13.

Govt. of India
M/o Coal
Nominated Authority

Vivek Bharadwaj

(By the nominated authority)

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
ESE (P&S)
TVNL, Hindalco, Renukoot-231217
21 DEC 2024

Annexures

Annexure 1: Particulars of the mine

Part A – Description of the mine

Name of Coal Mine	Rajbar E & D
Latitude	23°45'19" N to 23°47'59" N
Longitude	84°37'47.4" E to 84°40'51.6" E
Coalfield	Auranga
Villages	Chandwa, Rajbar, Renchi, Balumath, Jerang, Darea, Serak
District	Latehar
State	Jharkhand

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
ESE (P & S)
JVNL, Hinoo, Ranchi-834002
27 DEC 2021

Part B – Description of Land in relation to the mine

Not applicable

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan

DEC 2024

Part C – Description of Mine Infrastructure in relation to the mine

Not applicable

Vijay Kumar Singh
(Recognised Qualified Person)
(Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015)

Rajesh Ranjan
GGM (P&S)
TVNL, Hindpiri, Ranchi-834002
27 DEC 2024

Annexure 2: Particulars of statutory licences, permits, permissions, approvals or consents issued by the Central Government which are being transferred along with this Allotment Order.

Not applicable

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
TVNL, Ranchi-834002
27 DEC 2021

Annexure 3: Particulars of statutory licences, permits, permissions, approvals or consents issued by the Central Government to be obtained on application by the Allottee.

Not applicable

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
ESE (P & S)
TVNL, Hinoo, Ranchi-834002
27 DEC 2021

Annexure 4: Particulars of statutory licences, permits, permissions, approvals or consents issued by the State Government to be obtained on application by the Allottee.

Not applicable

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
21 DEC 2024

ANNEX. - I A

F. No. 103/19/2015/NA
Government of India
Ministry of Coal
O/o the Nominated Authority

131 Ground Floor, World Trade Centre, Babar Road, New Delhi

Corrigendum No. 1 to the Allotment Order no. 103/19/2015/NA dated 30th June 2015.

In re: **Rajbar E & D Coal Mine** (the "mine")

Date: Dec' 21st, 2016

In favour of: **Tenughat Vidyut Nigam Limited** incorporated in India under the Companies Act, 1956 with corporate identity number U40101JH1987SGC013153, whose registered office is at Hinoo, Doranda, Ranchi, Jharkhand -834002, India (the "Allottee").

WHEREAS, The Nominated Authority has, in accordance with provisions of the Coal Mines (Special Provisions) Act, 2015 (the "Act") and the Coal Mines (Special Provisions) Rules 2014 (the "Rules") issued Allotment order No. 103/19/2015/NA dated 30th June 2015.

AND WHEREAS M/s Tenughat Vidyut Nigam Limited, while stating that upon getting the co-ordinates certified by M/s CMPDIL, a deviation in the list of villages and the latitude & longitude, as provided in the Allotment Order, and as furnished by M/s CMPDIL has been observed, has requested this office for amendment in Geographical co-ordinates and village names in respect of Rajbar E & D Coal Mine.

AND WHEREAS considering such request the matter was examined and it was felt necessary to modify the Geographical co-ordinates and village names in the Allotment Order.

NOW THEREFORE, following corrigendum to the Allotment Order is issued:

1. In Annexure I of the Allotment Order, Part A is hereby modified as follows:

Rajesh Ranjan
ESE (P & S)
TVNL, Hinoo, Ranchi-834002
21 DEC 2016

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

Annexure 1: Particulars of the mine

Part A – Description of the mine

Name of Coal Mine	**Rajbar E & D**
Latitude	23°45'27.491" N to 23°48'2.680" N
Longitude	84°37'38.780" E to 84°40'27.119" E
Coalfield	Auranga
Villages	Rajbar, Renchi, Darea, Jerang, Serak, Lejang
District	Latehar
State	Jharkhand

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

(Vivek Bharadwaj)
Nominated Authority

Rajesh Ranjan
ESE (P & S)
TVNL, Hindd, Ranchi-834002
27 DEC 2024

ANNEX. - II

केन्द्रीय खनिज योजना एवं डिजाइन संस्थान लिमिटेड
(कोल इंडिया लिमिटेड के अनुषंगी कंपनी)
Central Mine Planning & Design Institute Limited
(A Subsidiary of Coal India Limited / Govt. of India Public Sector Undertaking)
Gondwana Place, Kanke Road, Ranchi - 834 031, Jharkhand (India)
CORPORATE IDENTITY NUMBER - U10309JH1975GOI001030

A Mini Ratna Company

पत्रांक संख्या:सीएमपीडीआई/डीजी/कैप्टिव/153/ 770 दिनांक 20.07.2016

सेवा में,
श्री अजय कुमार,
सेक्शन आफीसर,
भारत सरकार, कोयला मंत्रालय,
Office of the Nominated Authority,
बल्र्ड ट्रेड सेंटर, बाबर रोड, नई दिल्ली

Sub: Geological Coordinates of Rajbar E & D coal mine.

महाशय,

In continuation to our opt.cit letter dated 13.07.2016 regarding geological coordinates of Rajbar E&D coal block and further to your e-mail dated 15.07.2016 the geographical coordinates of the cardinal points of Rajbar E& D coal block allotted to M/s Tenughat Vidyut Nigam Ltd. is forwarded for your kind perusal and further necessary action.

धन्यवाद,

भवदीय,
20.7.16
(अनिताभ दास)
महाप्रबंधक (गवेषण)

प्रतिलिपी:

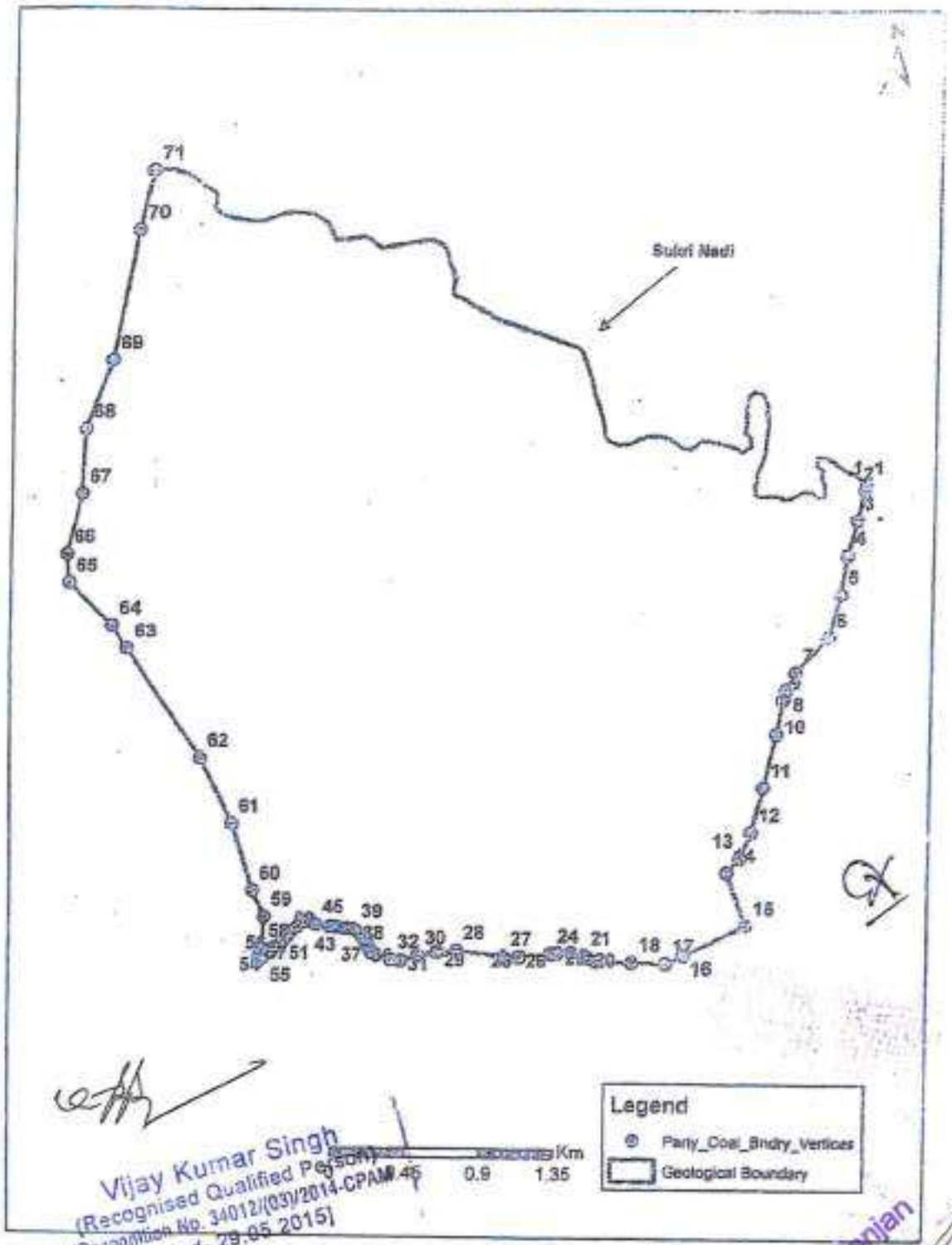
1. अध्यक्ष-सह-प्रबंध निदेशक, सी.एम.पी.डी.आई, रांची को सादर सूचनार्थ।
2. निदेशक (टी/सी.आर.डी.), सी.एम.पी.डी.आई, रांची को सादर सूचनार्थ।
3. महाप्रबन्धक (यु.एम.डी), सी.एम.पी.डी.आई, रांची।
4. महाप्रबन्धक (बी.डी.डी), सी.एम.पी.डी.आई, रांची।

Vijay Kumar Singh
(Recognised Qualified Person)
(Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015)

Rajesh Ranjan
ESE (P&S)
TVNL Hinoo, Ranchi-834002
27 DEC 2016

फोन नम्बर / Phone No. : +91 651 2232637
फैक्स नम्बर / Fax No. : +91 651 2230875
वेब साईट / Website Address : www.cmpdi.co.in

Rajbar 3 & C



Vijay Kumar Singh
(Recognised Qualified Person)
(Recognition No. 34012/(03)/2014-CPAM)
Dated- 29.05.2015

Rajesh Ranjan
Area Manager
TVU (Tubed) Rajbar Area
11 DEC 2024

RAJBAR E & D

Co-ordinates are in WGS 84 datum and UTM Projection

POINT	LATITUDE	LONGITUDE	POINT	LATITUDE	LONGITUDE
1	84° 40' 27.119" E	23° 47' 1.691" N	35	84° 38' 42.032" E	23° 45' 31.975" N
2	84° 40' 26.777" E	23° 47' 0.480" N	37	84° 38' 41.462" E	23° 45' 32.579" N
3	84° 40' 25.165" E	23° 46' 54.604" N	38	84° 38' 40.157" E	23° 45' 33.713" N
4	84° 40' 23.320" E	23° 46' 47.880" N	39	84° 38' 39.765" E	23° 45' 34.003" N
5	84° 40' 21.957" E	23° 46' 40.201" N	40	84° 38' 38.415" E	23° 45' 34.154" N,
6	84° 40' 19.603" E	23° 46' 31.703" N	41	84° 38' 37.266" E	23° 45' 34.248" N
7	84° 40' 12.553" E	23° 46' 24.712" N	42	84° 38' 35.931" E	23° 45' 34.350" N
8	84° 40' 10.674" E	23° 46' 21.410" N	43	84° 38' 34.958" E	23° 45' 34.425" N
9	84° 40' 10.021" E	23° 46' 19.390" N	44	84° 38' 34.437" E	23° 45' 34.484" N
10	84° 40' 8.828" E	23° 46' 12.676" N	45	84° 38' 31.389" E	23° 45' 34.868" N
11	84° 40' 6.156" E	23° 46' 2.046" N	46	84° 38' 29.084" E	23° 45' 35.254" N
12	84° 40' 3.664" E	23° 45' 53.138" N	47	84° 38' 28.596" E	23° 45' 35.373" N
13	84° 40' 1.356" E	23° 45' 48.009" N	48	84° 38' 27.424" E	23° 45' 34.364" N
14	84° 39' 58.655" E	23° 45' 45.279" N	49	84° 38' 26.150" E	23° 45' 33.372" N
15	84° 40' 2.733" E	23° 45' 34.903" N	50	84° 38' 25.205" E	23° 45' 32.397" N
16	84° 39' 49.760" E	23° 45' 29.021" N	51	84° 38' 24.302" E	23° 45' 31.464" N
17	84° 39' 45.984" E	23° 45' 27.491" N	52	84° 38' 23.683" E	23° 45' 31.065" N
18	84° 39' 38.986" E	23° 45' 27.703" N	53	84° 38' 22.248" E	23° 45' 30.139" N
19	84° 39' 31.339" E	23° 45' 27.867" N	54	84° 38' 20.931" E	23° 45' 29.129" N
20	84° 39' 29.549" E	23° 45' 28.559" N	55	84° 38' 20.051" E	23° 45' 28.418" N
21	84° 39' 28.584" E	23° 45' 28.945" N	56	84° 38' 19.163" E	23° 45' 27.701" N
22	84° 39' 25.887" E	23° 45' 29.532" N	57	84° 38' 19.333" E	23° 45' 28.803" N
23	84° 39' 23.076" E	23° 45' 29.418" N	58	84° 38' 19.722" E	23° 45' 30.094" N
24	84° 39' 21.503" E	23° 45' 29.355" N	59	84° 38' 20.178" E	23° 45' 36.246" N
25	84° 39' 14.890" E	23° 45' 28.686" N	60	84° 38' 17.587" E	23° 45' 41.362" N
26	84° 39' 14.621" E	23° 45' 28.659" N	61	84° 38' 13.091" E	23° 45' 54.363" N
27	84° 39' 11.419" E	23° 45' 28.817" N	62	84° 38' 6.290" E	23° 46' 7.358" N
28	84° 39' 1.448" E	23° 45' 29.920" N	63	84° 37' 51.537" E	23° 46' 28.773" N
29	84° 38' 57.351" E	23° 45' 29.599" N	64	84° 37' 48.401" E	23° 46' 33.355" N
30	84° 38' 53.253" E	23° 45' 28.939" N	65	84° 37' 39.282" E	23° 46' 41.818" N
31	84° 38' 49.678" E	23° 45' 27.939" N	66	84° 37' 38.780" E	23° 46' 47.485" N
32	84° 38' 47.526" E	23° 45' 28.093" N	67	84° 37' 41.898" E	23° 46' 59.352" N
33	84° 38' 43.371" E	23° 45' 29.441" N	68	84° 37' 42.583" E	23° 47' 11.977" N
34	84° 38' 42.985" E	23° 45' 30.409" N	69	84° 37' 48.113" E	23° 47' 25.425" N
35	84° 38' 42.561" E	23° 45' 31.276" N	70	84° 37' 53.216" E	23° 47' 50.907" N
The line between Points 1 and 71 represents Sukri river			71	84° 37' 55.962" E	23° 48' 2.680" N

Rajeev Ranjan
ESE (P & S)
TVNL Niwoo, Ranchi-834002
21 DEC 2021

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

ANNEX. - II A

सेन्ट्रल माइन प्लानिंग एण्ड डिजाइन इन्स्टीच्यूट लिमिटेड
(कोल इण्डिया लिमिटेड की सहायक कम्पनी/ भारत सरकार का एक लोक उपक्रम)
गोण्डवाना प्लेस, कांके रोड, राँची - 834 031, झारखंड (भारत)
Central Mine Planning & Design Institute Limited
(A Subsidiary of Coal India Limited/ Govt. of India Public Sector Undertaking)
Gondwana Place, Kanke Road, Ranchi - 834 031, Jharkhand (INDIA)
Corporate Identity Number - U14292JH1975GOI001223

फैक्स / स्पीड डाक द्वारा

पत्रांक : सीएमपीडीआई/बी.डी./ C(886-A)/E-220387/ I-4734 दिनांक : 26.10.2018

सेवा में,
Shri Rajesh Ranjan,
ESE (P&S)
Tenughat Vidyut Nigam Ltd.,
Hinoo, Doranda,
Ranchi – 834 002 (Jharkhand)

विषय : **Certification of Geological Coordinates used in preparation of Mining Plan of Rajbar E & D Coal Block in accordance with the vesting order – Reg. Submission of Revised Certificate (Job no. 511015170)**

संदर्भ : i) CMPDI's offer letter no. सीएमपीडीआई/बी.डी./ए (003)ऑफर नं –XXI/349
दिनांक : 27.11.2015
ii) Your Work Order no. 069/15-16 dtd. 3.12.2015
iii) CMPDI's letter no. CMPDI/D/C(886-A)/11 dtd. 06.01.2016
iv) TVNL's letter no. 440/17-18 dtd. 28.06.2017
v) CMPDI's letter no. CMPDI/BD/C(886-A)I-1572 dtd. 11.07.2017
vi) TVNL's letter no. 842/18-19 dtd. 28.09.2018

महोदय,

This has reference to the above referred letters pertaining to the subject assignment.

Plan showing the geographical co-ordinates (Latitude, Longitude) used in the preparation of Mining Plan for **Rajbar E & D**, which was submitted by you, was examined by the committee constituted for the same. Accordingly, the two copies of ***revised plans*** having CMPDI's certification is enclosed herewith superseding the earlier certification issued by CMPDI vide letter no. CMPDI/BD/C(886-A)I-1572 dtd. 11.07.2017.

धन्यवाद एवं सदैव अपनी सर्वोत्तम सेवाओं के आश्वासन सहित ।

भवदीय,

Encl : As above

26/10/18

महाप्रबंधक
(व्यवसाय विकास)

Vijay Kumar Singh
(Recognised Qualified Person)
(Recognition No. 24012/(03)/2014-CPAM
Dated- 29.05.2015)

II A - 1/2

फोन/ Ph : +91 651 2230116 फैक्स/ Fax: +91 651 2232249, 2231447
ईमेल/ email: gmbd.cmpdi@coalindia.in वेबसाइट/ Website :http://www.cmpdi.co.in

Rajesh Ranjan
ESE (P&S)
27 DEC 2018

It is certified that.

The geological block boundary of Rajbar E 2-D is within the bounding coordinates (Latitude and Longitude) as given in corrigendum No. 1 to the Allotment order No 103/19/2015/NA of the vesting order.

The Mine Plan boundary is also within the geological block boundary of Rajbar E 2 D coal block, except the 31 Ha. area proposed by the party for infrastructural use in the southern part, lies outside the geological block boundary as well as geographical coordinates provided in the corrigendum No. 1 to the allotment order No. 103/19/2015/NA dt. 21-12-2016. However, as per the available information, the aforementioned area lies on non-coal bearing and it does not encroach into any other coal block

Further, it may be mentioned that, with this certification, the earlier certificate issued by CMPDI vide letter no. CMPDI/BPJ C(ESG-A)/1-1752 dt 11.07.2017 stands cancelled.

The certificate issued today is based on the inputs and duly certified copies of plans submitted by the party CMPDI neither vouches for accuracy and authenticity of the information provided by the party nor responsible for it.

Kumar Singh
(In Person)
Registration No. - 7014-GP/M
Dated- 29.

Rajesh Ranjan
ESE (P&S)
CMPDI, Ranchi-834002
27 DEC 2017

महा प्रबन्धक (पर्यवेक्षण) 26.12.17
General Manager (Expl.)

II A - 2/2

TENUGHAT VIDYUT NIGAM LIMITED

Hinoo, Ranchi-834002 **ANNEX. - III**

MINUTES OF THE 54th MEETING OF BOARD OF DIRECTORS HELD ON THURSDAY, THE 16TH DAY OF AUGUST, 2018 AT 10.30 AM AT OFFICE OF THE DEVELOPMENT COMMISSIONER, GOJ, NEPAL HOUSE, RANCHI.

PRESENT

1.	Shri. D.K Tiwari, IAS Development Commissioner, GoJ	Chairman
2.	Shri. Sukhdéo Singh, IAS Add. Chief Secretary, Planning- cum-Finance, GoJ	Director
3.	Dr. Nitin Madan Kulkarni, IAS Secretary, Energy, GoJ	Director
4.	Shri. Kuldeep Chaudhary, IAS Managing Director, TVNL	Managing Director

PRESENT IN PERSON

Shri. Dipak Kumar Singh — Company Secretary

The 54th meeting of the Board of Directors started under the Chairmanship of Shri. D.K. Tiwari, Development Commiasioner, GoJ and Chairman, TVNL.

The Chairman declared the presence of quorum at the meeting to transact the business as per the agenda circulated. Discussions were held and following decisions were made:-

Item No.54/01

Sub: Compliance report on the decisions taken in the 53rd meeting of Board of Directors.

The actions taken by the Management for compliance of decisions taken in the 53rd Board of Directors Meeting were noted.

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
ESE (P&S)
TVNL, Hinoo, Ranchi-834002
27 DEC 2018

It was further informed that Rs 144.47 crores has been proposed as capital expenditure for current Financial Year.

The Board discussed the matter at length and passed the following resolutions:

"RESOLVED THAT that financial budget estimate for the FY 2018-19 be and hereby approved as placed before the Board".

"RESOLVED FURTHER THAT that financial revised budget estimate for the FY 2017-18 be and hereby approved as placed before the Board".

Item No.54/08.
Sub: Approval of Investment Policy for Fixed Deposits of TVNL.

The managing Director informed that Committee on Public Undertakings (COPU), Jharkhand meeting had been held in the month of October 2017, in which it was directed to submit an Investment Policy of Nigam with proper procedure and guidelines for Investment of Short Term Deposits/Fixed deposits. In compliance of above direction an investment policy has been framed and placed before the Board for getting best rate of return on Investment of Short Term Deposits/Fixed deposits.

The Board discussed the investment policy and decided that eligibility criteria of net worth of Rs 15,000 crores and 10% of capital adequacy ratio shall be applicable to nationalized as well as scheduled banks. It was unanimously decided to remove restriction of 70:30 ratio for investment of surplus fund in nationalized and scheduled banks.

Subject to above direction the Board passed the following resolutions:

"RESOLVED THAT Investment Policy as placed before the Board for making Fixed Deposits against available surplus funds in Nationalized and Scheduled banks, Ranchi be and hereby approved."

Item No.54/09.
Sub: Approval for submission of modified Mining Plan (Including Mine Closure Plan) and financial assurance for progressive and final mine closure activities of Rajbar E & D coal mine.

The Managing Director informed that the Ministry of Coal, GoI vide its letter dtd 07.03.2018, in its Observation at S.No.14 pointed out that as per Guidelines for Mine Closure Plan dated 07.01.2013, it is required that the financial assurance for Mine Closure shall come from Mining Company, i.e. TVNL.

It was informed by the Managing Director that vide Board resolution no 53/4 dtd 07.09.2017, MD, TVNL is authorized to do all needful action including provision required by MoC, GoI for completing the mine closure activities.

Rajesh Ranjan
ESE (P&S)
TVNL Hindi, Ranchi
27 DEC 2017

Vijay Kumar Singh
(Recognised Qualified Person)
(Recognition No. [illegible])
Dated- 29.05.2015]

It was also informed that in consultation with RQP, Certificate regarding Mine Closure Cost of Rajbar E & D Coal Mine duly signed by MD, TVNL vide no.121/18-19, dt.26.04.18 was incorporated along with the submissions by TVNL on the 24 point observations of the Standing Committee in the Mining Plan (Including Mine Closure Plan) and submitted to MoC, GoI vide letter no.196/18-19, dt.14.05.18, for perusal and approval. MoC, GoI after perusal of Mining Plan (Including Mine Closure Plan) informed that Starting date of the mine in proposed Plan is not in line with Efficiency Parameter of Allotment Agreement and Life of mine should be considered from the date on which any activity is taken up in the proposed area, vide letter no.34011/18/2017-CPAM, dt.21.06.18.

In compliance of further observation of the Ministry, RQP modified the Mining Plan (Including Mine Closure Plan) and considering the firmed up WPI Base Date as March, 2018, the expenditure under the head of mine closure plan is estimated to be at Rs.475.52 crores. The calculation of the amount was done on the basis of revised estimated life of the coal mine, which is envisaged to be 50 Years (2 years of construction period & 48 years of production period).

The Board discussed the matter and passed the following resolutions:

"**RESOLVED THAT** approval be and hereby accorded for submission of Mining Plan (Including Mine Closure Plan) of Rajbar E & D coal mine, as per the Observations and Guidelines of MoC, GoI and making presentation of the same for its approval from the Ministry of Coal, Govt. of India".

"**RESOLVED FURTHER THAT** Sri Vijay Kumar Singh (associated with M/s Gondwana Geotech Services Pvt. Ltd.), the Recognized Qualified Person (RQP) be and hereby authorized alongwith officers of Nigam for making presentation required for the purpose of approval of this Mining Plan (Including Mine Closure Plan) of the Coal Mine".

"**RESOLVED FURTHER THAT** approval be and hereby accorded for assured support to TVNL for financial provisions estimated at Rs.475.52 crores for progressive & final mine closure activities of Rajbar E & D coal mine, which is spelt out in the referred Mining Plan (Including Mine Closure Plan) for Rajbar E & D coal mine".

"**RESOLVED FURTHER THAT** MD, TVNL be and hereby authorized to do all needful actions in this regard including other provision required by MOC, GOI for completing the mine closure activities".

Vijay Kumar Singh
(Recognised Qualified Person)
(Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015)

Rajesh Ranjan

III 3/4

21 DEC 2018

There was no other business to transact, the meeting ended with thanks to the Chair.

21/08/18
(Kuldeep Chaudhary)

(Nitin Madan Kulkarni)

21/08
(Sukhdeo Singh)

21/08/18
(D.K Tiwari)

Vijay Kumar Singh
(Recognised Qualified Person)
(Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015)

Rajesh Ranjan
ESE (P&S)
TVNL, Hinoo, Ranchi-834002
27 DEC 2024

III - 4/4

तेनुघाट विद्युत निगम लिमिटेड
(झारखण्ड सरकार का उपक्रम)
TENUGHAT VIDYUT NIGAM LTD.
(A Govt. of Jharkhand Undertaking)

हीनू, डोरण्डा, रांची-834002 (झारखण्ड)
फैक्स 2251205 / 865

Hinoo, Doranda, Ranchi - 834002 (Jharkhand)
Ph.: 0651-2252160/62/63
Website : www.tvnlonline.com

CIN U40101JH1987SGC013153

पत्रांक / Ref. 686/18-19

दिनांक / Date 30/08/18

ANNEX. – IV

Earlier Approved Mining Plan

This is to certify that for Rajbar E & D Coal Mine, no approval of Mining Plan has been granted till date. Therefore, presently, there is no earlier approved Mining Plan for the block.

30/8/18

Managing Director
TVNL

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
EGC (P&S)
TVNL, Hinoo, Ranchi-834002
27 DEC 2018

ANNEX. – V

BY SPEED POST

No. 34012/03)/2014-CPAM
Government of India
Ministry of Coal

New Delhi, the 29th May, 2015

TO **Shri Vijay Kumar Singh** (Renewal)
Hill Top, Kahalla-Chandwe,
Kanke Road,
Ranchi-834008 (Jharkhand)
(Mobile No.08226865342/07782928577)

Subject Grant of recognition as competent person to prepare Mining Plan for Coal/Lignite block.

Sir,

I am directed to refer to your letter No. RQP.VKS:2014:06 dated 26.12.2014 on the above cited subject and to convey approval of the Central Government to the grant of recognition under Rule 22 (c) of Mineral Concession Rule, 1960 in your favour as competent person to prepare Mining Plan/Mine Closure Plan for Coal/Lignite block(s) up to 10 years from the date of issue of this letter.

2. RQP is required to comply with the provisions of all the concerned statutes and guidelines / circulars of the Govt. issued from time to time in regard to preparation of Mining Plans.

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

Yours faithfully

(I.P. Nagpal)
Under Secretary to the Govt. of India

Copy to : TD, NIC, Ministry of Coal for including in the list of RQP in Ministry of Coal's Web Site.

Rajesh Ranjan
ESE (P & S)
TVNL Hindo Ranchi
21 DEC 2015

तेनुघाट विद्युत निगम लिमिटेड

(झारखण्ड सरकार की उपक्रम)

TENUGHAT VIDYUT NIGAM LTD.

(A Govt. of Jharkhand Undertaking)

हिनू, दोरण्डा, रांची - 834002 (झारखण्ड)
फैक्स : 2251205 / 865

Hinoo, Doranda, Ranchi - 834002 (Jharkhand)
Fax : 0651 - 2251205/865
CIN-U40101JH1987SGC013153
Website : www.tvnlonline.com

ANNEX. - VI

पत्रांक / Ref. 2242/17-18

दिनांक / Date 15-03-2018

Mr. Vijay Kumar Singh
Hill Top Mohalla- Chandwe
Kanke Road
Ranchi-834008
Jharkhand

Sub: Authorization for preparation of Mining Plan (Including Mine Closure Plan) for Rajbar E & D Coal Mine.

Sir,

You are hereby authorized for preparation of the Mining Plan (Including Mine Closure Plan) of Rajbar E & D Coal Mine allotted to Tenughat Vidyut Nigam Limited (TVNL) by MoC, GoI vide their order No.103/19/2015/NA dtd.-30.06.2015 and amended vide Corrigendum No. 1 dated 21/12/2016.

We note that you are a RQP recognized by Ministry of Coal, Govt. of India and are associated with M/s Gondwana Geotech Services Pvt. Ltd., Ranchi.

Thanking You.

Yours faithfully

15/3/18
(S. Singh)
Managing Director

Vijay Kumar Singh
(Recognised Qualified Person)
(Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015)

Rajesh Ranjan
EE(E) 'A'
Hinoo, Ranchi-834002
17 DEC 2024

VI - 1/1

ANNEX. – VII

Certificate of Acceptance to prepare Mining Plan (Including Mine Closure Plan)

This is to certify that M/s TVNL vide their Managing Director's letter no. 2242/17–18 dated 15/03/2018, have authorized the undersigned for preparation of Mining Plan (Including Mine Closure Plan) of Rajbar E & D Coal Mine. The undersigned, being a RQP for Coal/ Lignite mines, has accepted to formulate the Mining Plan (Including Mine Closure Plan), for Rajbar E & D Coal Mine and has prepared the same as requested by M/s TVNL. This Mining Plan (Including Mine Closure Plan), for Rajbar E & D Coal Mine, has been prepared by me and is being submitted, covering the letters from MoC and observations of the expert committee of MOC, GOI, made during presentation of previously submitted Mining Plan (Including Mine Closure Plan) for this block. The coverage of the observations and submission thereof, is detailed at Annex. – XVIII (A) & XVIII (B).

ESE (P & S)
TVNL, Hinoo, Ranchi-834002
21 DEC 2024

(Vijay Kumar Singh)
RQP No. 34012/(03)/2014 – CPAM
dt. 29/05/2015
Valid upto 28/05/2025.

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

ANNEX. – VIII

Certificate by RQP Regarding Mining Plan Preparation

I, Vijay Kumar Singh, hereby certify that I have a valid recognition from MOC, GOI under MCR, 1960 to prepare mining plan for Coal & lignite deposits. The recognition no is 34012/(03)/2014 – CPAM dated 29/05/2015 Valid upto 28/05/2025. It is further to Certify that I have been duly authorized by the proponent M/s Tenughat Vidyut Nigam Ltd. vide their letter no. 2242/17–18 dated 15/03/2018, to prepare the Mining Plan (Including Mine Closure Plan) for Rajbar E & D Coal Mine. This Mining Plan (Including Mine Closure Plan) is being submitted covering observations of expert committee of MOC, GOI and guidelines for preparation of Mining Plan for Coal & Lignite block/ mines, issued by MoC, GoI.

Provisions of relevant rules & regulations made there under have been observed in the formulation of this Mining Plan (Including Mine Closure Plan) for Rajbar E & D Coal Mine.

(Vijay Kumar Singh)
RQP No. 34012/(03)/2014 – CPAM
dt. 29/05/2015
Valid upto 28/05/2025.

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
ESE (P & S)
TeNL, HO, Ranchi-834002
27 DEC 2024

तेनुघाट विद्युत निगम लिमिटेड
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हीनू, डोरण्डा, राँची 834002 (झारखण्ड)
फोन : 2251205 / 865

Hinoo, Doranda, Ranchi - 834002 (Jharkhand)
Ph.: 0651-2252160/62/63
Website : www.tvnlonline.com

CIN U40101JH1987SGC013153

पत्रांक / Ref. 688/18-19

दिनांक / Date 30/08/18

ANNEX – IX

Preparation of Mining Plan (Including Mine Closure Plan)

This is to state that the Mining Plan (Including Mine Closure Plan) for Rajbar E & D Coal Mine has been prepared, considering the guidelines pertaining to Mining Plan/ Mine Closure Plan issued by MoC, GoI. Wherever specific permissions will be required, for operating this mine, the same will be sought from concerned Authority.

28/8/18

Managing Director
TVNL

Vijay Kumar Singh
(Recognised Qualified Person)
(Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015)

Rajesh Ranjan
DGM (P & S)
TVNL, Hinoo, Ranchi-834002
21 DEC 2018

IX - 1/1

ANNEX. – X

Confirmation Regarding Block Boundary

This is to state that the block boundary of Rajbar E & D Coal Mine has been firmed up, based on the block area plan provided by CMPDI. The area covered by the mining plan does not encroach on any other coal block. This non encroachment has been confirmed by CMPDI, as can be seen in the enclosed Annex. – II A of this Mining Plan.

(Vijay Kumar Singh)
RQP No. 34012/(03)/2014 – CPAM
dt. 29/05/2015
Valid upto 28/05/2025.

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
Chief (P&C)
RRSL, Hindo, Ranchi
27 DEC 2024

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फैक्स : 2251205 / 865

Hinoo, Doranda, Ranchi - 834002 (Jharkhand)
Ph.: 0651-2252160/62/63
Website : www.tenughin.com

CIN U40101JH1987SGC013153

पत्रांक / Ref. 689/18-19 दिनांक / Date 30/08/18

ANNEX. – XI

Approval of Mining Activities from Competent Authority

This is to certify that mine will be worked as per the Mining Plan approved by the Ministry of Coal, Govt. of India and other approval/ permission would be obtained from relevant Authorities, whenever and wherever required.

29/8/18
Managing Director
TVNL

Vijay Kumar Singh
(Recognised Qualified Person)
(Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015)

Rajesh Ranjan
ESE (P & S)
TVNL, Hinoo, Ranchi-834002
27 DEC 2018

तेनुघाट विद्युत निगम लिमिटेड
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हीनू, डोरण्डा, रांची-834002 (झारखण्ड)
फैक्स : 2251205 / 865

Hinoo, Doranda, Ranchi - 834002 (Jharkhand)
Ph.: 0651-2252160/62/63
Website : www.tvulondin.com

CIN U40101JH1987SGC013153

पत्रांक / Ref. 690/18-19 दिनांक / Date 30/08/18

ANNEX. – XII

Geological Exploration

This is to certify that all Geological Exploration and reporting has been conducted by Department of Geology & Mines, Government of Jharkhand for working in this mine.

30/8/18
Managing Director
TVNL

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
ESE (P & S)
TVNL, Hinoo, Ranchi-834002
27 DEC 2024

ANNEX. – XIII

Certificate of Project Boundary

This is to certify that the mine boundary of proposed Rajbar E & D Coal Mine is within the allotted block. Only 31 ha of area for other uses for the project, lies outside and is adjacent to the block on non coal bearing area. As per guideline of MoC, GoI vide their no. 34011/48/2009–CPAM dated 8th May 2018, a letter of request has been made by M/s TVNL to the State Govt. of Jharkhand. The request is for issuance of a Letter of Intent (LoI) by State Govt. for processing of Mining Plan approval. Covering this 31 ha area outside the mine block but forming part of project area. Total project boundary covers 1351 ha area.

(Vijay Kumar Singh)
RQP No. 34012/(03)/2014 – CPAM
dt. 29/05/2015
Valid upto 28/05/2025.

Rajesh Ranjan
TVNL, Hinoo, Ranchi-834002
27 DEC 2024

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

तेनुघाट विद्युत निगम लिमिटेड
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हीनू, डोरण्डा, राँची–834002 (झारखण्ड)
फैक्स : 2251205 / 865

Hinoo, Doranda, Ranchi - 834002 (Jharkhand)
Ph.: 0651-2252160/62/63
Website : www.tvnlonline.com

CIN U40101JH1987SGC013153

पत्रांक / Ref. 691/18-19 दिनांक / Date 30/08/18

ANNEX. – XIV

Certificate Regarding Mining Plan & Mine Closure Plan

This is to certify that there is no approved Mining Plan & Mine Closure Plan for Rajbar E & D Coal Mine.

This Mining Plan (Including Mine Closure Plan) for Rajbar E & D Coal Mine has been prepared as per guidelines issued from time to time by MoC, GoI for preparation of the Mining Plan (Including Mine Closure Plan). A certificate to this effect has been given by RQP as Annex. – VIII.

Vijay Kumar Singh
(Recognised Qualified Person)
(Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015)

30/8/18
Managing Director
TVNL

Rajesh Ranjan
DEC 2021

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हीनू, डोरण्डा, राँची-834002 (झारखण्ड)
फैक्स : 2251205 / 865

Hinoo, Doranda, Ranchi - 834002 (Jharkhand)
Ph.: 0651-2252160/62/63
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CIN U40101JH1987SGC013153

पत्रांक / Ref. 692/18-19

दिनांक / Date 30/08/18

ANNEX. – XV

Reclamation and Rehabilitation

This is to certify that the reclamation and rehabilitation work shall be carried out in accordance with the approved Mine Closure Plan and in line with any modification/ amendments which may be made in the Mine Closure Plan by Ministry of Coal from time to time.

Managing Director
TVNL

Rajesh Ranjan
ESE (P & S)
TVNL, Hinoo, Ranchi-834002
27 DEC 2018

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

तेनुघाट विद्युत निगम लिमिटेड
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CIN U40101JH1987SGC013153

पत्रांक / Ref. 693/18-19

दिनांक / Date 30/08/18

ANNEX. – XVI

Mining Lease Area

This is to certify that no lease area has been granted to Rajbar E & D proposed coal mine till date. The needed action for getting lease is being undertaken by M/s TVNL.

25/8/18
Managing Director
TVNL

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
ESE (P&S)
TVNL Hinoo, Ranchi-834002

XVI - 1/1

तेनुघाट विद्युत निगम लिमिटेड
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हीनू, डोरण्डा, राँची-834002 (झारखण्ड)
फैक्स : 2251205 / 865

Hinoo, Doranda, Ranchi - 834002 (Jharkhand)
Ph.: 0651-2252160/62/63
Website : www.tvnlonline.com

CIN U40101JH1987SGC013153

पत्रांक / Ref. 694/18-19

दिनांक / Date 30/08/18

ANNEX. – XVII

Regarding Hydrological Studies

This is to state that at time of the EIA/EMP formulation, required Hydrological Studies shall be carried out for the Rajbar E & D proposed coal mine.

29/8/18

Managing Director

TVNL

Rajesh Ranjan
ESE (P & S)
TVNL, Hinoo, Ranchi-834002
27 DEC 2018

Vijay Kumar Singh
(Recognised Qualified Person)
(Recognition No. 34012/(92)/2014-CPAM
Dated- 2

Annex. – XVIII (A)

MoC Observation vide letter no. 34011/12/2016–CPAM dated 20-06-2016 & 34011/18/2017–CPAM dated 07-03-2018 and Our Submission

Sl. No.	Ref. Para	MOC's Committee's Observation	Our Submission
1.	Cover Page	Name of the mining plan should be Mining Plan (including mine closure plan) instead of Revised Mining Plan only.	Cover Page in Mining Plan submitted in December 2017 (considered by MoC, GoI) had the title as "MINING PLAN INCLUDING MINE CLOSURE PLAN". However, correction to cover page has now been made, as directed; in this Mining Plan - October 2018.
2.	CL 8 (i), Sum 5 (c) & Para 5.11	As indicated at para CL 8 (e) the mine is likely to commence from Oct'17, while at para 8 (i) provision of 2 years has been envisaged for construction of the mine, this needs to be reconciled. Further, it is indicated that UG operation is likely to be completed before 48 years with overall life of 48 year. It needs to be clarified how the UG and OC operation in the mine could be co-terminus.	Now the production is anticipated to commence in the year 2019. It meets the year mentioned in allotment agreement. The proposed U/G mine will progress keeping a safe distance and a time lag of 7–8 years from O.C. mine blasting faces. It is estimated that during the last decade of mine life, opencast mining would be carried out over North-Western region, where Seam I & II are not workable because of thinning & inconsistent deposit. The underground mining would be carried out in North area, where OC mining would have been completed before 41st year of mine life. Thus exhaustion of underground mine reserve in North area would take place as a coterminous operation of the OC mining in North-West. This is explained in para no. 5.4.6.
3.	Plate 11	Embankment/Safety barrier from Sukri Nadi on North-East part of the quarry may be examined.	Embankment base is 30 m wide. Most of the Southern embankment is rocky except near West end of river bed. Strengthening the South bank of river would be ensured and the embankment top would be built 1.5 m above HFL. Plate no. – 11 being conceptual plan has been improved to show

Vijay Kumar Singh
(Recognised Qualified Person)
(Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015)

Rajesh Ranjan

Sl. No.	Ref. Para	MOC's Committee's Observation	Our Submission
			embankment and HFL clearly.
4.	CL 12.4	Feasibility of accommodating the overburden completely inside the quarry having working stripping ratio of 5.04 has not been addressed properly.	A paragraph no. 5.16.4 A has been added in Chapter V, to explain accommodation of overburden and interburden into decoaled area. Bank Volume of Coal = 255 Mm^3. Bank Volume of Waste = 2119 Mm^3. Total volume of excavation = 2374 Mm^3. Expanded volume of waste = 2394 Mm^3. If the mine is filled up completely at ground level, there is spill over of 20 Mm^3 of waste. However, there is a final void volume of 220 Mm^3 to be left at the close of the mine for water lagoon. Hence spill over quantity of waste totals to 240 Mm^3. A second layer of agl waste dump, 90 m high above ground level, covering about 502 ha area, has been planned to accommodate these 240 Mm^3. Thus entire bank volume of 2119 Mm^3 is accommodated as internal dump.
5.	CL 8 (n)	As the mine is likely to be operated through MDO, it is envisage population of HEMM for range of equipment instead for a particular size of HEMM.	Para no. 5.13.6 and table no. 5.25 has worked out the system capacity of equipment for every stage and compared it with target capacity to ensure that the population of equipment fully matches with the target capacity required. For the annual task of 10 Mt coal production and of 50 – 55 Mm^3 waste removal; size of envisaged equipment are matching. The mine life being 48 years, any equipment would serve for its full life & MDO would not face financial strain. Such equipment are in use in other countries and are available from major manufacturers. Therefore, MDO will be able to handle the matter.

Rajeev Ranjan
ESE (P & S)
TVNL, Hirodi, Ranchi-834002
27 DEC 2024

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. [illegible]-CPAM
Dated- [illegible]]

Sl. No.	Ref. Para	MOC's Committee's Observation	Our Submission
6.	CL 8 (j)	7.85 Mt of coal at a stripping ratio of 8.04 M3/t has been envisaged to be left unmined in 150 ha of the block area. Whether any technical study in support of the same has been done by independent agency, if so the same should be attached.	In depth study was carried out, in house, based on geological report. Available coal and associated waste, over 150 ha, was worked out based on borehole data. Net geological reserve over 150 ha was estimated at 7.85 Mt. Extractable coal is estimated at 7.30 Mt. The waste to be removed to extract this coal is estimated at 58.7 Mm^3. Resulting stripping ratio comes to 58.7 ÷ 7.30 = 8.04. This stripping ratio was considered uneconomical for coal quality averaging at G-11. Against this, in the area – 1320 ha (under consideration for mining) there is 697 Mt of reserves (upto Seam I). It gives a density of 52.8 Mt/ Km^2. Against this high reserve density of 52.8 Mt/ Km^2, 150 ha patch is having merely 5.2 Mt/ sq. km. The economy was one of the considerations for excluding this area from mining. Another very important consideration for excluding this area is rehabilitation and resettlement of about 800 persons residing in this part of the area, for such low quantity of coal deposit. In house expertise with experienced geologists and mining engineers was considered sufficient for this exercise. This issue has been deliberated in detail in the text at para no. 5.4.3.
7.	CL 11 (a)	Pre-mining land use, proposed land use, land use at the end of mining and post closure should be indicated. The land use table furnished at table should be re-checked and reconciled with the table.	Pre mining land use, proposed land use and land use at the end of mining and post closure has been rechecked and reconciled and is given hereafter. This has been included in text table no. 13.3. The table shown on next page (Page – XVIII (A)-6/13) is concised version of table no. 13.3.

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. ... 2014-CPAM
Dated- ... 2018]

Rajesh Ranjan
ESE (P.S.)
TVNL, Hinoo, Ranchi-834002

Sl. No.	Ref. Para	MOC's Committee's Observation	Our Submission

Area in ha

Present Land Uses		Proposed Land Uses		Land Uses	
Type of Land	Area	Type of Use	Land Area	End of Mine Life	Post Closure after Reclamation
Tenancy	581.18	Excavation Area	1262.00		
Govt. NF	272.54	Backfilled Area		982.00	
Forest		Excavated Void		280.00	
Reserve		Top Soil Dump			
Protected	495.20	External Dump			
C-J-B-J	2.08	Infrastructure	33.90	33.90	
		Agricultural			506.48
		Plantation Area	28.90	28.90	537.12
		Water Body			269.00
		Public/ Com Use	11.00	11.00	37.40
		Other Use	14.20	14.20	
		Undisturbed/ MR for UG	1.00	1.00	1.00
Total	**1351.00**	**Total**	**1351.00**	**1351.00**	**1351.00**

8.	**CL 12.4 & Para 5.16.8, Para 15.3.1.8**	Land likely to be degraded and technically and biologically reclaimed should be indicated.	Land likely to be degraded and technically and biologically reclaimed is included in the text in para no. 14.5.1.1.5 & 15.3.1.1.3 and table nos. 14.14, 15.6 and 14.15, 15.7 besides appearing in the checklist at para no. CL 12.4. Para no. 15.3.1.8 is now renumbered as 15.3.1.1.3. The para no. 5.16.8 and table no. 5.30 in Chapter-V detailing mining has been modified to cover details of reclaimed backfilled area into agriculture, plantation and water lagoon. The tables are given hereafter, for ease of comprehension.

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 3[illegible]-2014-CPAM
Dated- 29.05.2015]

Sl. No.	Ref. Para	MOC's Committee's Observation	Our Submission

Area in ha

Production Stage Years		Land Degraded				Technically Reclaimed Area				
		Excav	Dump (Extn + Top Soil)	Infra/ others	Total	Back-filled	Dump (Extn + Top Soil)	Infra & Others	Green Belting	Total
1	2	3	4	5	6	7	8	9	10	11
Y-1	2018-19	20	No external dumping of Waste Rock or Top soil is proposed.	88	108		Not required as explained in Column 3.	59.1		59.1
Y-3	2020-21	96		88	184			59.1		59.1
Y-5	2022-23	153		88	241	48		59.1	28.9 ha	136.0
Y-10	2027-28	439		88	527	117		59.1	28.9 ha	205.0
Y-15	2032-33	535		88	623	174		59.1	28.9 ha	262.0
Y-20	2037-38	617		88	705	222		59.1	28.9 ha	310.0
Y-25	2042-43	772		88	860	318		59.1	28.9 ha	406.0
Y-30	2047-48	916		88	1004	406		59.1	28.9 ha	494.0
Y-35	2052-53	1034		88	1122	525		59.1	28.9 ha	613.0
Y-40	2057-58	1138		88	1226	639		59.1	28.9 ha	727.0
Y-45	2062-63	1195		88	1283	795		59.1	28.9 ha	883.0
Y-48	2065-66	1262.		88	1350	982		59.1	28.9 ha	1070.0
Post Closure Y-51	2068-69					982		59.1 + 280 = 339.1 ha	28.9 ha	1350.0 *
Undisturbed					1					1
					1351					1351

- Infrastructure to be retained – 37.4 ha
- Infra Others to be dismantled – 21.7 ha

} 59.1 ha + Green Belt – 28.9 ha = 59.1 + 28.9 = 88 ha

- Backfilled – 982 ha
- Void – 280 ha
  - ❖ Water Body – 269 ha
  - ❖ Slant Plantation – 11 ha
- Infra & Others – 88 ha
  - ❖ Infra & Others – 59.1 ha
  - ❖ Green Belting – 28.9 ha

Total – 1350 ha

Undisturbed – 01 ha

Total Project Area – 1351 ha

Area in ha

Production Stage Years		Biologically Reclaimed Area					Forest Land (Returned)	Un Disturbed	Total
		Agricul-ture	Planta-tion	Water Body	Public/ Company (Infra Retained)	Total			
Y-1	2018-19								
Y-3	2020-21								
Y-5	2022-23								
Y-10	2027-28	3	43			46			
Y-15	2032-33	16	81			97		1	
Y-20	2037-38	30	114			144		1	
Y-25	2042-43	85	152			237		1	
Y-30	2047-48	141	190			331		1	
Y-35	2052-53	177	245			422		1	
Y-40	2057-58	213	300			513		1	
Y-45	2062-63	330	311			641		1	
Y-48	2065-66	447 #	322 #			769		1	
Post Closure									
Y-51	2068-69	506.48	537.12	269	37.4	1350	497.28	1.0	
Undisturbed					1	1351			

- After the end of 48th year, 59.48 ha of agricultural land and 215.12 ha of plantation to be done during post mining reclamation.

Vijay Kumar Singh
(Recognised Competent Person)

Ranjan
Exp (P&S)
TML, Kiriburu

XVIII (A)-5/11

<table>
<tr><th>Sl. No.</th><th>Ref. Para</th><th>MOC's Committee's Observation</th><th>Our Submission</th></tr>
<tr><td>9.</td><td>CL 12.8</td><td>Infrastructure to be dismantled and retained should be provided in a tabular form.</td><td>Infrastructure/ others in tabular form are given hereafter. This has been included in para 14.5.1, 15.3.2.1 and CL 12.8.</td></tr>
<tr><td></td><td colspan="3">A. Infrastructure to be dismantled and retained is shown below in tabular form.
<table>
<tr><th colspan="2">Infrastructure to be Dismantled</th><th>Non Forest</th><th>Forest</th><th colspan="2">Infrastructure to be retained</th><th>Non Forest</th><th>Forest</th></tr>
<tr><td colspan="2">Workshop</td><td>2.9</td><td>2.9</td><td>0</td><td>Garland Drain</td><td>4.3</td><td>2.26</td><td>2.04</td></tr>
<tr><td colspan="2">Store</td><td>1.9</td><td>1.9</td><td>0</td><td>Embankment with Road at its top</td><td>9.5</td><td>5.75</td><td>3.75</td></tr>
<tr><td colspan="2">Electrical Sub Station</td><td>2.0</td><td>2</td><td>0</td><td rowspan="2">Sedimentation Tank</td><td rowspan="2">0.6</td><td rowspan="2">0.6</td><td rowspan="2">0</td></tr>
<tr><td colspan="2">CHP & Coal Storage</td><td>12.7</td><td>0</td><td>12.7</td></tr>
<tr><td colspan="2">Total</td><td>19.5 ha</td><td>6.8 ha</td><td>12.7 ha</td><td>Total</td><td>14.4 ha</td><td>8.61 ha</td><td>5.79 ha</td></tr>
</table>
B. Others
<table>
<tr><th colspan="2">Infrastructure to be Dismantled</th><th>Non Forest</th><th>Forest</th><th colspan="2">Infrastructure to be retained</th><th>Non Forest</th><th>Forest</th></tr>
<tr><td colspan="2">ETP</td><td>1.2</td><td>0.6</td><td>0.6</td><td>Road</td><td>11</td><td>5.12</td><td>5.88</td></tr>
<tr><td rowspan="2">Magazine</td><td rowspan="2">1.0</td><td rowspan="2">0.5</td><td rowspan="2">0.5</td><td>Township (Colony)</td><td>10.1</td><td>10.1</td><td>0</td></tr>
<tr><td>Office Building</td><td>1.9</td><td>1.9</td><td>0</td></tr>
<tr><td colspan="2">Total</td><td>2.2 ha</td><td>1.1 ha</td><td>1.1 ha</td><td>Total</td><td>23.0 ha</td><td>17.12 ha</td><td>5.88 ha</td></tr>
</table></td></tr>
<tr><td>10.</td><td>CL 12.13 & Para 15.5.2</td><td>Rs. 98.77 Crore have been envisaged for taking up mine closure activities. The amount provisioned for mine closure activities should be at par with the amount to be deposited in Escrow account.</td><td>This direction has been complied with. The amount provided for mine closure activities now comes to Rs. 458.65 crores which equals the amount to be deposited in Escrow Account. Para 15.5.2 now reappears in the text as para no. – 15.5. The cost details may be seen in text in table nos. – 15.15 & 15.16. This has been included in CL 12.13.</td></tr>
<tr><td>11.</td><td>CL 12.14 & Para 15.6.1</td><td>Amount to be deposited in the escrow account needs to be checked. Reference WPI appears to be incorrect. This needs to be verified and furnished in the table.</td><td>In this mining plan being submitted, the firm figure of WPI for July 2018 is available and stands at 119.9. It has been used for assessing the total closure cost for the project area of 1351 ha. It has comes to ₹ 117.087 crores as base amount. With life of 48 years and annual escalation rate of 5%, Total Amount to be Deposited in the Escrow</td></tr>
</table>

Rajeev Ranjan
ESE (P & S)
TVNL Hindo, Ranchi-834002
27 DEC 2018

Vijay Kumar Singh
(Recognised Qualified Person)
(Recognition No. 3[illegible]014-CPAM
Dated- 2[illegible]15]

Sl. No.	Ref. Para	MOC's Committee's Observation	Our Submission
			A/c comes to ₹ 458.65 crores. It is well within the sanctioned amount of ₹ 475.52 crores, approved by the TVNL Board of Directors in their meeting on 16-08-2018. This has now been considered for the Escrow A/c calculations, with 48 years of mine life. Calculation table is given hereafter. The text in para 15.6.1 reappearing now as para no. 15.8.1 along with table no. 15.17 has been changed accordingly. Para no. CL12.14 in the checklist has also been updated.

WPI			Aug-09	⟶	129.60 WPI
WPI in new Base Year	Base Year 11-12	Old WPI – 156.13 From year 11-12 – 100	July-18	119.90	187.200 WPI (On Old Base)
Escalation rate of Closure Cost from August–09 to July–18					1.44
				UG	OC
Base rate of Closure Cost "Rs. Crs./Ha"				0.01	0.06
Closure Cost "Rs.Crs/Ha"					0.06 x 1.44 = 0.087
Proposed Project Area "in ha"					1351.00
Base Amount for Escrow Account (Rs. in Crs)					1351 x 0.087 = 117.087
Rate of compounding of Annual Closure Cost					5.00%
Balance Life of the Project "in Yrs"					48
Annual Closure Cost					**2.4393**
Amount to be deposited into Escrow Account after compounding @ of 5% "Rs. in Crs"					**458.65**
Amount already deposited into Escrow Account "Rs. in Crs."					
Net Amount to be deposited into Escrow Account "Rs. in Crs."					**458.65**

12.	Sum 4 (o)	At para under reference instead of gross geological reserve of 784.48 Mt net geological reserve of 706.03 Mt has been indicated. This should be corrected.	Correction has been made as directed i.e. the gross geological reserve is 784.48 Mt and net geological reserve is 706.03 Mt at para no.– 4.7.4 and table no.– 4.14 of text, CL – Para no. 7 (n) & 7 (r) and SD – Para no. 4 (o).

Vijay Kumar Singh
(Recognised Qualified Person)
(Recognition No. 3[illegible]/2014-CPAM
Dated- 2[illegible]2015)

Rajesh Ranjan
GM (P&S)
TVNL, Hinoo, Ranchi-83402
27 DEC 2024

Sl. No.	Ref. Para	MOC's Committee's Observation	Our Submission
13.	Sum 4 (o)	Instead of 574.86 Mt of net geological reserve considered for mining in this mining plan, 567 Mt of net geological reserve considered for mining has been provided. This should be corrected.	Correction has been made as directed i.e. net geological reserve upto Seam III is 574.86 Mt at para no. – 5.7.6 and para no. – 5.7.7 & table no – 5.18 of text, SD – Para no. 4 (r) & (t).
14.	Annexure III	The board approval attached at Annexure III, envisages as an assurance from the mining company that Rs. 431 crores would be made as a part of Tender document while floating the tender for selection of MDO. The guideline requires this financial assurance should come from the mining company.	TVNL Board during its meeting on 16-08-2018 passed the following resolutions under agenda item 54/09 as follows: "**RESOLVED THAT** approval be and hereby accorded for submission of Mining Plan (Including Mine Closure Plan) of Rajbar E & D coal mine, as per the Observations and Guidelines of MoC, GoI and making presentation of the same for its approval from the Ministry of Coal, Govt. of India". "**RESOLVED FURTHER THAT** approval be and hereby accorded for assured support to TVNL for financial provisions at Rs. 475.52 crores for progressive & final mine closure activities of Rajbar E & D coal mine, which is spelt out in the referred Mining Plan (Including Mine Closure Plan) for Rajbar E & D coal mine". **"RESOLVED FURTHER THAT** MD, TVNL be and hereby authorized to do all needful actions in this regard including other provision required by MoC, GoI for completing the mine closure activities". The above mentioned approved amount of Rs. 475.52 crores covers the proposed closure cost of Rs. 458.65

Rajesh Ranjan
ESE (P & S)
TVNL, Hinoo, Ranchi-834002
27 DEC 2024

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34[illegible]03-2014-CPAM
Dated- 29 [illegible] 2015]

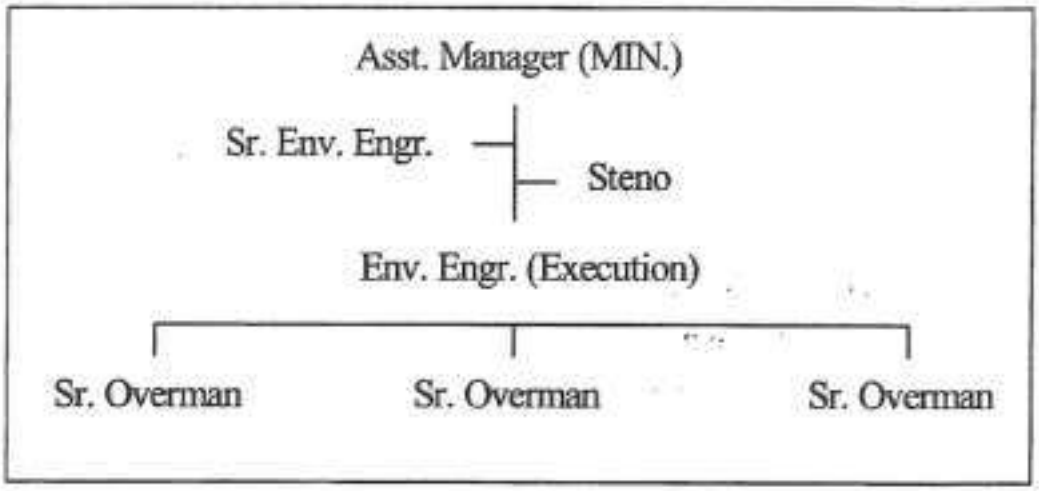
Sl. No.	Ref. Para	MOC's Committee's Observation	Our Submission
			crores. The above resolution does not mention any role of MDO.
15.	Annexure III	The board authorizes MD, TVNL as authorized signatory for the issues relating to Mining plan and mine closure plan, while all the certificates on behalf of M/s TVNL has been signed by ESE (P&S). This needs to be corrected.	All certificates on behalf of TVNL are now signed by MD, TVNL.
16.	Plate 03	Mine Boundary, Mining Lease boundary and Geological block boundary should be shown in distinct colour.	Plate No. – 03 has been modified to show three boundaries in distinct colours.
17.	Plate 06	Tenancy, Govt. NF and Forest land should be shown in distinct colour. Further, coal bearing area planned for mining, project area as per mining plan and surface edge of the quarry indicated in the legend is not distinctly marked on the plan.	Plate No. - 06 has been modified to show the various edges in distinct colours.
18.	Para 15.1.6	Statutory Clearance vis-s-vis compliance status should be indicated in tabular form.	This has been given at para no. 15.1.2 and table no. – 15.3 in text.
19.		Mine Closure plan is not in line with the guideline for formulation of mine closure plan circulated vide letter dated 7th January 2013. It needs to be redrafted in line with the guideline.	Chapter on Mine closure plan is in line with guidelines circulated vide MoC letter dated 7th January 2013.
20.	Para 15.3.2.4.6	Manpower requirement in the form of Organizational chart may be furnished.	Para 15.3.2.4.6 of text reappears as para no. 15.3.1.11. Manpower requirement for Environment Mitigative Measures including land reclamation and CSR have been included in the text on Manpower at para no. 10.2 and table no. 10.1 at the bottom of page X-4. It is

Vijay Kumar Singh (Recognised Competent Person) (Recognition No. Retd. 14-CPAM 2015)

Rajesh Ranjan

27 DEC 2024

Sl. No.	Ref. Para	MOC's Committee's Observation	Our Submission
			reproduced in the form of Organization Chart hereafter.
	Supervisory Manpower Chart		



21.	Plates	KML file of the proposed mining lease area to be attached.	KML file of proposed mining lease area may be seen at Plate No. – 02 B.
22.		Evacuation route from the pit to railway siding is yet to be decided, this should be attached.	Evacuation route from Mine to Railway Siding has been shown on a separate Plate No. – 11 B on the base of Toposheet enlarged to 1:25,000. Plate No. – 11 B may be seen along the text at para 9.7. Tube Conveyor route has been kept close to an existing road. Conveyor transport on trestles is proposed for coal movement to Chetar Railway siding. Tube conveyor is proposed to be enclosed to minimize coal dust emission. Land required would be only for trestles & maintenance access. Thus land required would be down to minimum.
23.		Implementation of road transport is likely to environmental issue, this needs to be looked into.	Road transportation of coal from CHP to Railway Siding has not been envisaged. Coal transport is proposed through conveyors.

Rajesh Ranjan
ESE (P&S)
TVNL, Hinoo, Ranchi-834002
27 DEC 2024

(Recognition No. [illegible]/2014-CPAM
Dated- 29.05.2015]

Sl. No.	Ref. Para	MOC's Committee's Observation	Our Submission
24.		Ambient air fugitive emission study to be enclosed.	The ambient air quality in the buffer area is shown at table no. 14.5 in Chapter – XIV dealing with Environment Management. This air quality shows a typical rural background. There appears to be ample assimilative capacity for generated dust. However presently for this block, no air quality data has been generated, as the process of EIA/EMP is still waiting for approval of Mining Plan and thereafter forest application & TOR application to be submitted to MoEF&CC.

Vijay Kumar Singh
(Recognised Qualified Person)
(Recognition No. 340...03)/2014-CPAM
Dated- 29.05.2015

Rajesh Ranjan
21 DEC 2016

Annex. – XVIII (B)

MoC Observation vide letter no. 34011/18/2017–CPAM dated 21-06-2018 and Our Submission

MOC's Observation	Our Submission
I am further directed to inform you that while examining the proposal it is found that the starting date of the mine considered in the proposed mining plan submitted for approval of the Standing Committee (after incorporating the observations of the Technical members of the Standing Committee) is not in-line with the efficiency parameter listed in Schedule E of the allotment agreement for the project. Further the life of the mine should be considered from the date on which any activity is taken up in the proposed project area.	In view of this observation of MoC, starting date has now been brought in line with the efficiency parameter listed in Schedule E of the allotment agreement for the project. Life of the mine has been considered as 48 years. This has been clearly brought out at para 5.11 in Chapter – V.

Vijay Kumar Singh
(Recognised ... Person)
[Recognition No. 34... ...)/2014-CPAM
Dated- 29...5.2015]

Rajesh Ranjan
ESE (P & S)
TVNL, Hinoo, Ranchi-834002
27 DEC 2018

तेनुघाट विद्युत निगम लिमिटेड
(झारखण्ड सरकार का उपक्रम)
TENUGHAT VIDYUT NIGAM LTD.
(A Govt. of Jharkhand Undertaking)

हीनू, डोरण्डा, राँची–834002 (झारखण्ड)
फोन्स : 2251205 / 865

Hinoo, Doranda, Ranchi - 834002 (Jharkhand)
Ph.: 0651-2252160/62/63
Website : www.tvnlonline.com

CIN U40101JH1987SGC013153

पत्रांक / Ref. 555/18-19

दिनांक / Date 02/08/2018

ANNEX. - XVIII (C)

To
Deputy Commissioner
Latehar.

Sub: Application for issuance of Letter of Intent (LoI) from State Government of Jharkhand for 31 Ha of land included in the proposed Project Area of Rajbar E & D Coal Mine but outside the allocated Block Area in District Latehar, allotted to Tenughat Vidyut Nigam Limited.

Sir,

This is in pursuance of the Guidelines issued by MoC, GoI vide letter no. 34011/48/2009–CPAM dated 8th May 2018, for preparation of Mining Plan for coal blocks.

1. For the proposed Rajbar E & D Coal Mine, the allocation of the block was done by MoC, GoI vide the allotment order no. 103/19/2015/NA dated 30-06-2015 and covered by Corrigendum No. 1 dated 21-12-2016. Based on the 71 Coordinate points of the allocation area, given by CMPDI, the block area has been firmed up at 1487 ha (Coal Bearing).

2. During planning a coal mine over this 1487 ha area of the block: 17 ha of land under meanders of Sukri River and 150 ha of area in the metamorphic high zone was excluded from mining area. Thus 1320 ha of mine area was firmed up for coal winning.

3. Beyond the 1320 ha of proposed coal winning area; area required to sustain mining operations as infra areas and associated needs; was firmed up as 31 ha. This 31 ha of needed area was planned over non coal bearing area in South of the allotted block. The selected area is rocky, undulating and mostly non forest area.

4. The associated needed area for infra and other needs cannot be setup in the North side metamorphic high (150 ha) area, as the North side area is reverine area, thickly populated area (more than 800 persons) and good agricultural area. This aspect has been covered in the Mining Plan.

Vijay Kumar Singh
Recognised Qualified Person)
[3012/(03)/2014-CPAM
2015]

Rajesh Ranjan
ESE (Civil)
TVNL, Ranchi-834002
DEC 2018

It is therefore requested that a letter of intent be issued by State Government, for this 31 ha of area, outside allotted block, as required by MoC, GoI vide their guideline issued referred at 1st Para above; in May 2018, for processing of mining plan approval. Thus the 1320 ha will remain for mining lease approval. In addition to that, 31 ha of associated needed area to support mining of coal from this block, is allowed to form part of the proposed project area. The state intends to allow use of 31 ha + 1320 ha i.e. total of 1351 ha area for carrying out the mining operations in Rajbar E & D Coal Mine. A letter of this intent may kindly be issued, addressed to M/s Tenughat Vidyut Nigam Limited, for processing of the Mining Plan by Ministry of Coal, Govt. of India.

Thanking you.

31/7/18

Managing Director
TVNL

Encl: (1) Ministry of Coal, Govt. of India letter no.34011/48/2009-CPAM, dt.08.05.18.
(2) Map of Project Area of 1351 Ha with demarcation of 31 Ha in 3 (three) sets.
(3) Land Schedule of 31 Ha in 3 (three) sets.

Vijay Kumar Singh
(Recognised Qualified Person)
(Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015)

Rajesh Ranjan
ESE (P & S)
TVNL, Hindoc, Ranchi-834002
21 DEC 2018

तेनुघाट विद्युत निगम लिमिटेड
(झारखण्ड सरकार का उपक्रम)
TENUGHAT VIDYUT NIGAM LTD.
(A Govt. of Jharkhand Undertaking)

हीनू, डोरण्डा, राँची-834002 (झारखण्ड)
फैक्स : 2251205 / 865

Hinoo, Doranda, Ranchi - 834002 (Jharkhand)
Ph.: 0651-2252160/62/63
Website : www.tvnlonline.com

CIN U40101JH1987SGC013153

पत्रांक / Ref. 695/18-19

दिनांक / Date 30/08/18

ANNEX. – XIX

Environmental Clearance Transfer

This is to certify that no Environmental Clearance (E.C.) has been received for proposed Rajbar E & D Coal Mine. As such this transfer of Environmental Clearance (E.C.) clause does not apply for this proposed mine.

30/8/18
Managing Director
TVNL

Vijay Kumar Singh
(Recognised Qualified Person)
[Recognition No. 34012/(03)/2014-CPAM
Dated- 29.05.2015]

Rajesh Ranjan
ESE (P & S)
TVNL, Hinoo, Ranchi-834002
27 DEC 2018

तेनुघाट विद्युत निगम लिमिटेड
(झारखण्ड सरकार का उपक्रम)
TENUGHAT VIDYUT NIGAM LTD.
(A Govt. of Jharkhand Undertaking)

हीनू, डोरण्डा, राँची-834002 (झारखण्ड)
फैक्स : 2251205/865

Hinoo, Doranda, Ranchi - 834002 (Jharkhand)
Ph.: 0651-2252160/62/63
Website : www.tvnlonline.com

CIN U40101JH1987SGC013153

पत्रांक / Ref. 687/18-19

दिनांक / Date 30/08/18

ANNEX. – XX

Forest Clearance – Stage I

This is to certify that Forest Land is involved in proposed Rajbar E & D Coal Mine. Necessary clearances shall be undertaken from concerned authorities for the forest land involved in the project area.

28/8/18

Managing Director
TVNL

Vijay Kumar Singh
(Recognised Qualified Person)
(Recognition No. 3401/2/(03)/2014-CPAM
Dated- 29.05.2015)

Rajesh Ranjan
ESE (P&S)
TVNL Hinoo, Ranchi-834002
27 DEC 2018