

माईनिंग प्लान नागपुर द्वारा अनुमोदित

एसईसीएल कोरबा क्षेत्र के बगदेवा भूमिगत परियोजना(कोयला उत्पादन क्षमता 0.75 मिलियन टन(नोर्मेटिव) एवं 0.76 मिलियन टन(पीक) प्रति वर्ष) का माईनिंग प्लान की प्रति पृष्ठ. क्र. 52...में संलग्न है। जो कि सेंट्रल माईन प्लानिंग एंड डिजाइन इन्स्टीच्यूट लिमिटेड(सीएमपीडीआईएल- भारत सरकार का एक उद्यम) द्वारा प्रस्तुत किया गया है एवं कोल ईंडिया लिमिटेड बोर्ड ऑफ़ डायरेक्टर द्वारा अनुमोदित है।

Chakoria
30/8/23
खान प्रबंधक
बगदेवा भूमिगत खदान

1-8
10.8.23
सर्वेक्षण अधिकारी
बगदेवा भूमिगत खदान

30/8/23
उपक्षेत्रीय प्रबंधक
ढेलवाडीह-सिंघाली-बगदेवा उपक्षेत्र

30/8/23
वनमण्डलाधिकारी
कटघोरा वनमण्डल, कटघोरा

30/8/23
क्षेत्रीय महाप्रबंधक
एसईसीएल कोरबा क्षेत्र



The information given in this report is not to be communicated to the press or to any person not holding an official position in the CIL / Government

REVISED PROJECT REPORT

FOR

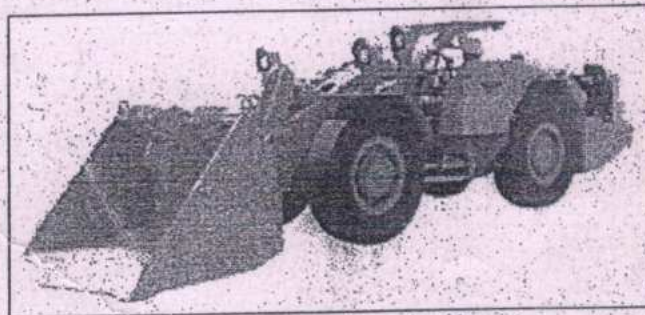
BAGDEWA UG MINE

(Capacity-0.75 Mty)

(Job No.-501085)

KORBA AREA

SOUTH EASTERN COALFIELDS LIMITED



MARCH-2011

REGIONAL INSTITUTE-V

CENTRAL MINE PLANNING & DESIGN INSTITUTE

SECL COMPLEX, SEEPAT ROAD, BILASPUR

CHHATTISGARH, PIN – 495 006

SOUTH EASTERN COAL FIELDS LIMITED,
SEEPAT ROAD, BILASPUR (CG)

REF. NO. SECL/BSP/196BME XT/11/ 426

DT 5/4/11

EXTRACT OF THE MINUTES OF THE 196th MEETING OF THE BOARD OF DIRECTOR
OF SOUTH EASTERN COALFIELDS LIMITED HELD ON FRIDAY THE 25th MARCH, 2011
AT 11.30 A.M AT THE REGISTERED OFFICE OF THE COMPANY AT SEEPAT ROAD
BILASPUR (CG)

ITEM NO. 196-4:15

Sub Revised Project Report for Bagdeva UG Mine (0.75 MTY)

The Board approved the Revised Project Report (0.405 Mty to 0.75 Mty) for Bagdeva UG Mine of Korba Area, at an additional capital of ₹ 87.12 Crores, as recommended by the Technical Sub Committee of SECL at its 30th Meeting held on 10.03.2011 at Bilaspur.

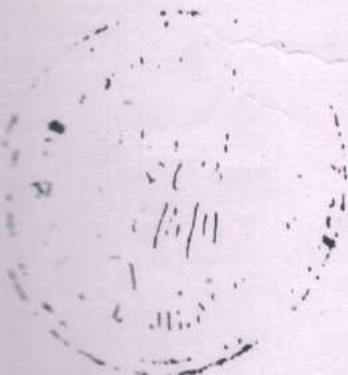
S. J. Joshi
COMPANY SECRETARY

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REVISED PROJECT REPORT FOR BAGDEWA UG

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REVISED PROJECT REPORT FOR BAGDEWA UG

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REVISED PROJECT REPORT FOR BAGDEWA UG

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RPR OF BAGDEWA UG (0.75Mty)SUMMARISED DATA

Sl. No.	Particulars	Unit	Value
A.	GENERAL		
1	Name of the Report		RPR of Bagdewa UG
2	Mining Area		5.02 sq. km
3	Nearest Railway Station from project	Name km	Gevra Road Railway Station at a distance of 20 Km from Katghora
4	Nearest National / State Highway / Approach road	Name km	Bilaspur Katghora State Highway.
B.	GEOLOGICAL		
1	Name of geological blocks considered	Name	Bagdewa block
2	Area of the geological blocks	sq. km	10.54 Sq. Km.
3	Borehole Density within blocks	BHs / sq. km	10
4	Description of all coal seams within block		
	Name of seam	Thickness-range (m)	No. of borehole intersections
	Seam		
	G-V	0.10-2.29 (<1.5m)	36
	Parting	12.27-26.9m	
	G-IV	1.4-2.65	51
	Parting	33.65-50.60	
	G-III (Top)	0.25-3.05(<1.8)	64
	Parting	0.60-15.07	
	G-III (Bottom)	0.45-7.0	82
	G-III (Comb)	4.74-7.0	
	Parting	1.27-28.0	
	G-II A	0.1-2.64	63
	Parting	17.25-41.00	
	G-II	0.07-0.77	
	Parting	16.74-30.26	
	G-I	0.12-1.35	

C.	TECHNICAL					
1	Area of the proposed mine					5.026 sq. km
2	Borehole density within mine area					10 BHs/sq. km
3	Mine parameters (seam-wise) Extent along strike (min. – max.) Extent along dip (min.-max.)					1.48-2.18Km 3.4-1.71 km
4	Description of coal seams proposed to be worked					
Name of seam	Mining Area (sq. km)	Thickness range considered (m)	Av. Thickness (m)	Av. Grade (UHV/ GCV)	Av. gradient (1 in ...)	Extractable Reserves (Mt) as on 1.4.10
G-III T	1.35	1.5-3.5	2.0	B	1in16	1.29
G-IIIB	5.026	1.5-3.5	2.5	B	1in16	5.923
G-IIA	2.50	1.5-3.5	2.4	B	1in16	2.266
Entries Name / No.		Size	Gradient/ vertical		Purpose	
Existing Mine Entries						
Incline No. 1		4.2x 2.5x164	1 in 4		Main Intake Belt/coal transport	
Incline No. 2		4.2x 2.5x164	1 in 4		Main intake Traveling/ Haulage roadway	
Air Shaft		5.0 m Dia x 45m	Vertical		Main Return airways	
Existing underground drivage						
Drift No.1		40m	1 in 4		GIIA to GIIIB Intake & Travelling	
Drift No.2		40m	1 in 4		GIIA to GIIIB Intake & Haulage	
Staple Pit (16L/2D)		5.0m Dia.X11m	Vertical		Return	
Staple Pit (26L/2D)		5.0m Dia.X11m	Vertical		UG Bunker	
Staple Pit (43L/2D)		5.0m Dia.X11m	Vertical		UG Bunker	
Proposed Underground Drivage		To cross	Two		Faults	
Drift 1 & 1A		4.2x 2.5X25	1 in 5		Haulage / Material transport /Intake	
Drift 2 & 2A		4.2x 2.5X25	1 in 5		Intake airway/Travelling Roadway	
Drift 3 & 3A		4.2x 2.5X25	1 in 5		In seam Return	
Air Shaft		5.0 m Dia x 45m	Vertical		Main Intake airways	

RPR Bagdewa UG(0.75 Mty)

Strata Bunker (100t)		10mx2	Vertical	Coal Bunkering	
6	Method of Mining				
7	Panel Parameters No. of headings in each panel Size of galleries / roadways Pillar sizes			6 Nos. 4.2 m 26m x 26m	
8	Production Parameters No. of panels to be worked Production from each panels			4 Nos. 2460 TPD	
9	Target Output Normative production capacity (at 100%) Peak production capacity. Production capacity (at 85%)			0.75Mty 0.75Mty 0.76 Mty 0.64Mty	
10	Year of achieving Target Production (from zero date)			II Year(i.e.-year of LHD/UDMs Introduction)	
11	Production Phasing (from zero date up to target year)			Mt	
Year / Coal Seam		Year 1	Year 2 (Target Year)	Year 3	
G-III (TOP/ BOT.), II A		0.62	0.75	0.75	
12	Total Mine Life (at Normative production capacity) Construction period & Production build-up period Production period Tapering / mine closure period			13Years 1Year 11 Years 1Year	
13	Degree of Gassiness (I / II / III)			I	
14	Major Equipment Deployed in panels LHD UDM			Nos. 7+3 4+4	
15	Average Specific Energy Consumption			15.83 kWh/t	
16	Total Manpower Existing Additional			1121 Nos. 1027 Nos. 94 Nos.	

SD-3/6

Job No.501085

	(FIRR)% At 100% production level At 85% production level	692.30 528.85
12	Desired average Selling Price to yield 12% FIRR At 100% production level At 85% production level	Rs1357.63 / tonne Rs1550.99 /tonne
13	Break-even point Production Production level	0.23 Mty 31.42 %
14	Mine Closure Cost (for corpus fund)	683.99 Lakhs
15	Expected Completion Capital	Rs.122.01 Crores

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TEXT

CHAPTER-I

INTRODUCTION

1.1 BACKGROUND OF THE PROJECT REPORT

The Original Project Report for Bagdewa Underground Mine (0.24 Mty) was prepared in February, 1995 and subsequently approved by SECL Board. The Project Report envisaged exploitation of the G-III top, G-III Bottom & G-II A seam in an area of about 3.03 Sq. Km (These seams were earlier nomenclature as G-IV, G-III top & G-III bottom). Later on a scheme was formulated by area for incremental production of 0.242 Mty over RPR (0.405Mty), March, 1999., in July, 2007 covering an area of 4.69 sq. k.m. This RPR is being prepared for incremental production of 0.345 Mty over previous RPR (0.405Mty), March, 1999.

Summary of the earlier approved Project Reports and RPR, Dec 2010, of the mine is as shown in the table below:-

Sl. No.	Particulars	OPR (Feb 1995)	RPR (March 1999)	RPR (Dec 2010)
A.	Mining Parameters			
1.	Seams to be worked	G-III T G-III B G-II A	G-III T G-III B G-II A	G-III T G-III B G-II A
3.	Extractable Reserves (Mt)	9.58	12.375	9.475 (as on 01.04.10)
4.	Method of work	B&P with manual loading	B&P with SDL, Pony, conveyor	B&P with LHD, UDM and belt conveyor
5.	Mine Entries	2 inclines and an air shaft	2 intakes and 1 return incline	2 inclines and one air shaft as intake and a return air shaft
6.	Targeted Production (Mt)	0.24	0.405	0.75
7.	Mine life (years)	44	35	13

B.	Financial Parameters			
1.	Total Capital (Rs. Lakhs)	1858.89	3845.92	11760.28
2.	Specific Investment (Rs/t)	774.52	949.61	1568.03
3.	P&M Capital (Rs. Lakhs)	765.46	2116.17	4294.27
4.	P&M Capital (Rs/t)	318.94	522.51	572.57
5.	Cost of Production (Rs/t)			
a)	At 100%	472.95	677.12	1301.59
b)	At 85%	544.14	777.05	1483.38
6.	Selling Price (Rs/t)	563.54	808.20	3658.03
7.	Profit (Rs/t)			
a)	At 100%	90.59	131.08	2356.44
b)	At 85%	19.40	31.15	2174.65
8.	IRR			
a)	At 100%	21.79	45.06	692.30
b)	At 85%	-	21.03	528.85

This RPR has been prepared with a view to enhance the production and further increase profitability of the mine by introducing high capacity LHD and UDM and provision for acquisition of land with all rights as statutorily required for depillaring for abiding by DGMS compliance.

1.2 EXPLORATION STATUS

1.2.1 HISTORY OF MINING IN THE BLOCK :-

Bagdewa Geological block (part of Dilwadih Block, GR prepared in 1985) covers an area of about 10.54 Sq. Km. The original underground PR (0.24 Mty) was prepared on the basis of geological note prepared in August, 1994. Later on, a small OC patch (23 Ha) in the north-western part of OPR has also been planned for 0.20 Mty Production which will be liquidated after closure of UG working.. The Revised Project Report for Bagdewa Underground mine was approved on 21.07.1999 for a production capacity of 0.405 Mty. Bagdewa RPR is a completed project. The date of completion is 31.03.2006.

1.2.2 RECENT STUDIES:-

The detailed exploration has been carried out by CMPDI and DGM (MP) in different phases. In total 105 bore holes have been drilled in an area of 10.54 sq. km. The borehole density works out to 10 per Sq. km.

In view of large geological block area it is proposed to exploit the block in two units. In this RPR, i.e. Unit-I, the original mining boundary has been retained and area lying south of the Kholar nala and fault F7F7 would be annexed. The total mining area in Bagdewa UG will be about 476.88 sq. km.

1.3 MINING ACTIVITIES

The nearby mines in the block are Dhilwadhi U/G and Singhali U/G. These are semi mechanized mines working with LHDs/ SDLs and belt conveyors.

1.4 JUSTIFICATION OF PRESENT REPORT

Bagdewa U/G mine is an existing mine and a completed project. This mine has potential to increase production. Earlier there was a prevailing practice to pay crop commensuration to the land owners these days; DGMS has been insisting, acquiring of land before allowing permission for depillaring. Therefore looking to the prevailing practice for procurement of land has also been provisioned. Total mining area, geological reserve and mine plan has not been changed against RPR,99 only addition of one district for increased production has been envisaged alongwith needed infrastructure and capital provision .

1.5 SALIENT FEATURES OF PREVIOUS AND PRESENT REPORT

In the original Project Report and RPR (1999), G-III (Top), G-III (Bottom) & G-II A seams have been considered for exploitation. The Revised Project Report also envisages exploiting the same seams covering the same mining area. The lower limit of thickness will be 1.5m for deploying low height LHD. The reserves lying between 1.2 m to 1.5 m thickness will be exploited later if some suitable loading machine is proved successful under this thickness range. Bagdewa underground mine is a completed project .Mine is earning net profit since last 5 years.

The OPR had envisaged extraction of reserves by Bord and Pillar System with manual shoveling on face chain conveyors.

As per the latest guidelines issued by Ministry of coal, Finance Division, all the ongoing projects of SECL should have a minimum internal rate of return of 17% at 85% of capacity utilization. In view of this, the Original Project Report had been updated at base price of August 1997 and found it unfavourable due to low IRR. Subsequently, it had been decided to suspend

all the project activities till its financial viability is established by enhancing the project capacity or improving the project economics by improved technology.

The production capacity of Bagdewa Underground Mine was, therefore, revised with an objective to enhance the production capacity up to 0.405 Mty and introduce SDL / low height SDLs to have better productivity and economics. This leads to better return on investment and improved IRR. (RPR-1999)

The reserve statement of proposed mine as per RPR,99 in Phase-I operation is given below:-

Seam	RESERVES IN MT.		
	Geological (1.2-3.5)	Mineable (1.5-3.5)	Extractable (1.5-3.5)
G-III T	4.93	2.20	1.29
G-III-B	13.01	12.39	8.196
G-II A	6.60	4.044	2.9
	24.54	18.634	12.38

The thickness-wise percentage reserves in Bagdewa Underground Mine area is given as follows:-

Thickness Range	% Reserve
1.2m-1.5m	12.13
1.5m-1.8m	19.44
1.8m-2.0m	13.84
2.0m-2.5m	34.39
2.5m-3.0m	19.05
>3.0m	1.15

About 3.3 Mte of geological reserves would be available in thickness range of 1.2-1.5m.

1.5.1

The present and current Revised Project Report envisages to deploy extra low height LHD, standard height LHDs and high capacity LHDs (capacity ~3cum.) as loading machine, UDMs for face and roof drilling for coal preparation and roof support respectively, gate and trunk belts to improve the transport system, productivity and over all economics of the mine.

From above table, it is inferred presently that major area of the project (about 80% of reserves) offers deployment of low height LHDs and standard height LHDs.

In view of above, the production target of Bagdewa is revised at 0.75 Mty. The revised extractable reserves work out to 9.475 Mt. The mine life with a target production of 0.75 Mty works out to 13 years including development and tapering period.

The estimated capital requirement in the present Revised Project Report is Rs.117.60crore. Additional capital requirement will be Rs.87.12 crore. The Project will have an Internal Rate of Return of 528.85 at 85% production level.

The project is techno-economically viable and recommended for approval by the Competent Authority.

1.5.2 SALIENT POINTS OF REVISED PROJECT REPORT:-

Salient parameters of the Project are as follows:

Particulars	Values
Target Production / Nominal Production Capacity (Mty)	0.75
Peak Production Capacity (Mty)	0.76
Manpower Requirement (Nos.)	1121
Output Per Man shift - OMS (t)	2.56
Earning Per Man shift - EMS (Rs.)	1631.32
Total Capital Investment (Rs. Lakhs)	11760.27
Additional capital investment (Rs. Lakhs)	8711.95
Specific Investment (Rs./t)	1568.03
Capital Investment on P&M (Rs. Lakhs)	4294.27
Specific Investment on P&M (Rs./t)	572.57
Cost of Production (Rs./t) (at 100%)	1301.59
Cost of Production (Rs./t) (at 85%)	1483.88
Av. Selling Price (Rs./t)	3658.03
Profit (Rs./t) (at 100%)	2356.44
Profit (Rs./t) (at 85%)	2174.65
Break-even point (%)	31.42
Break-even production (Mty)	0.23
Financial IRR (at 100%)	692.309
Financial IRR (at 85%)	528.847
Desired Selling Price to yield 12% FIRR (at 100%)	1357.63
Desired Selling Price to yield 12% FIRR (at 85%)	1550.99

1.6 RISK / DIFFICULTIES & CONSTRAINTS IN MINING

The difficulties / constraints and risk associated are:

- Presence of village on the surface which has to be shifted and necessary provisions for Rehabilitation & Resettlement have to be made for acquiring the tenancy land before the start of depillaring operations in the mine.
- The parting in the overlapping portion of the G-III T seam and G-III B seam varies from 9.75m to 13.20m and near the boundary it is around up to 3.0m. The panel projections and the layout has been proposed keeping in the mind

superimposition of workings in the seams so that the cracks of lower seam do not propagate to the upper seam.

- Large highly cultivated land on surface, which may pose difficulty in acquisition as in the present scenario the land owners are generally reluctant for giving up their rights just by payment of crop compensation.

1.7 PROJECT OBJECTIVES & TARGET BENEFICIARIES

The purpose / objective of the present report is to assess feasibility of increasing underground coal production with a view to further improve the profitability of the mine to contribute to the total coal production from SECL keeping in view overall demand of better quality coal. The coal produced from the Bagdeva UG project would be included in the basket linkages.

(a) Introduction of appropriate man-riding system

It has been envisaged to install man-riding system and the supplier of the system shall also maintain the system. A separate scheme for installation of man riding system has all ready been approved and the capital required has been included in this RPR.

(b) Increased Working Hours

With a view to reduce the arduous traveling distance, to increase working efficiency and working time, installation of man riding system will be highly beneficial during the working of mine.

(c) Equipment / Machinery

Details of requirement of equipment, as per technology suggested have been provided.

(d) Infrastructure Requirement

Modifications needed in the existing infrastructure like, transport, electrical layout, workshop, stores, coal handling etc has been provided.

(d) Manpower

Requirement of manpower in the district and for the mine has been detailed in appendix-B with their job description.

CHAPTER-II

MARKETABILITY & JUSTIFICATION

2.1 DEMAND, AVAILABILITY & DEFICIT IN SECL

The sector-wise coal demand for SECL is summarised in Table - 2.1. It may be seen from the table that against the present production level of 108.01 Mty. (2009-10) the total demand as projected for the year 2011-12 is 218.88 Mt. The projected production in the year 2011-12 is 128.85 Mt. resulting in to shortfall of 90.03 Mt.

Table 2.1

<u>SOUTH EASTERN COALFIELDS LTD.</u>		
<u>TOTAL COAL DEMAND & AVAILABILITY (SECL)</u>		
		(Figures in Mt)
Sl. No.	Sector	XI Plan 2011-12
A.	COKING	
	Steel (Indigenous)	0.14
B.	NON-COKING	
1	Power (Utilities)	162.17
2	Power (Captive)	21.69
3	Sponge Iron / CDI	7.77
4	BRK & Others / LTC/SSF	3.00
5	Soft Coke	
6	Cement	10.36
7	Fertilizer	0.85
8	Colliery Consumption	0.02
9	E-auction	12.88
	Total Demand (SECL)	218.88
	Availability	128.85
	Balance	-90.03

2.2 PRODUCTION SCHEDULE

The production schedule of Bagdewa UG is as follows:

Table-2.1: Production Schedule (Mty)

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
0.62	0.75	0.75	0.75	0.75	0.75	0.75

2.3 JUSTIFICATION OF OPENING THE PROJECT (ENHANCING PRODUCTION CAPACITY)

The Revised Project Report for Bagdewa U/G Mine has been planned for a target production of 0.75Mty. The overall grade of ROM Coal from the Project is average grade B. From the above table it can be seen that the gap between demand and availability is -90.03 Mt deficits. As such, there will not be any problem in the off-take of coal from this project. In this project report production capacity has been enhanced keeping all the mining and geological parameters same.

2.4 LINKAGE

Coal from this project is not linked to any specific consumer. It will be included among basket linkages for miscellaneous consumers.

2.5 DESPATCH

It is proposed to sell the coal to miscellaneous consumers from the existing mine CHP. The coal is being presently transported from the CHP to Surakachhar railway siding (located 22.6 km from Bagdewa Mine) with use of tippers. The transportation charges for surface coal transportation from Bagdewa Mine to CHP has been considered as Rs. 61.61/t. respectively. Coal will be loaded into wagons at the railway siding. The cost of loading is included in the report.

Chapter – III

PROJECT SITE INFORMATION

3.1 LOCATION

Bagdewa U/G mine is situated in the Bagdewa block. This Block is situated in the Northwestern part of the Korba coalfield. Administratively, it is located in Korba District of Chattisgarh State. It falls in Survey of India Topo-sheet no.-64J/11(R.F. 1: 50,000). Bagdeva geological block is measuring 10.54 sq. km. The limiting geographic co-ordinates of the block are as under:

Co-ordinates:

Latitudes: 22° 22' 34" N to 22° 23' 47" (N)

Longitudes: 82° 30' 37" E to 82° 33' 35" (E)

3.2 ACCESS

The block is located at an approximate distance of 1.5 Km East of Bilaspur-Katghora Road. The approach road to mine already exists. The mine is also approachable from Sutarra by Sutarra-Bagdewa Village road.

The nearest railway station is Gevra Road of SE Railway, at a distance of about 20 Km. Katghora is about 12 Km from Bagdewa Block.

3.3 CLIMATE

The area is characterised by tropical climate, seasons being well defined, summer from mid March to mid June, rainy season from mid June to September and winter season from October to mid March. May is the hottest month during which the temperature raises upto 48°C. In December (during the winter season) mercury falls to as low as 5°C.

3.3.1 RAINFALL

The average rain fall is about 1500mm. The maximum recorded rainfall within a period of 20 hrs, is 252 mm in September, 1973 in last 30 years.

3.3.2 The Relative humidity during monsoon ranges from 75-80% and in summer from 18 to 60%.

3.3.3 The wind direction is generally westerly to north- westerly, during monsoon, winter & summer, and varies from 5.4 to 8.3 Km/Hr, 3.6-4.9 Km/hr and 5.7 to 8.1 Km / hr respectively.

3.4 MINE BOUNDARIES

- North - Fault F9-F9 & 15m hard cover line of workable seams.
- South - Kholar nalla later on Fault F7-F7 and its extension up to Fault F10 (3 m parting with Seam III top and bottom will follow the extension line).
- West - 15m HCL of G-II A seam, working thickness (1.5m lying) and 40m against road to Amarpur village.
- East - Fault F8, F10 & workable thickness line (1.5m) of seam.

3.5 TOPOGRAPHY & DRAINAGE

The block is largely characterised by almost plane country, except on both sides of Kholar nala where undulations are there. The altitude varies from 327.38m to 300.18m above MSL.

North & North East is high ground whereas; south-west is low area along which the Nala flows. The water from the entire catchments area of the block flows into Kholar nala.

3.6 LAND USE PATTERN

Land for surface facilities / pit facilities have been acquired and an amount of Rs.45.27 lakhs has been incurred.

The EMP of original Project Report is approved by MOEF for 502.60 Ha. Within 1-2 years, an Action Plan may be drawn to process the acquisition of Land covering total mining area upto fault F7-F7. Total land is to be acquired for depillaring of coal and statutory compliance.

The existing capital (Gross block) as on 31.3.2010 is Rs.3048.26 lakhs. The head wise details are given in Appendix-A.

TYPE OF LAND	AREA (Ha)
Tenancy Land	143.51
Government Land	76.81
Forest Land	282.28
Total Land	502.60

CHAPTER - IV

GEOLOGY AND DEPOSIT APPRAISAL

4.1 BACKGROUND / INTRODUCTION

Geological exploration in Dilwadih geological block covering an area of about 26 Sq. Km has been done during 1979 to 1984 and a geological report on Dilwadih block, Korba coal field has been prepared in March, 1985. Based on this geological report, two underground mines viz., Dilwadih and Singhali have been prepared in Sector-E and Sector-A, G respectively. Later on, detailed exploration in Sectors H I J K L M N have been explored in details by CMPDI covering an area of about 10.54 sq. km and a final G.R. on Bagdewa block, Korba coal field have been made in February, 1998.

4.2 EXPLORATION STATUS

A total of 105 Nos. of boreholes has so far been drilled by various agencies within Bagdewa block area. The details of which is given below:

Year	Agency	Number of Boreholes	Meterage
1979-1995	CMPDIL	93	10447.15
1996-1998	DGM(MP)	12	1017.42
TOTAL		105	11464.58

During 1979 to 1995 CMPDI (Code-CMKD) has drilled 93 boreholes involving 10447.15 m in Dilwadih Block.

DGM (MP) carried out exploration by drilling 12 boreholes during 1996 to 1998 involving 1017.42 m in covering an area of 10.54 sq. km. with density of 10 boreholes per sq. km.

In 1977 GSI also drilled 9 boreholes of KL series in the eastern part of the block.

4.3 GEOLOGY AND STRUCTURE OF BLOCK AREA

4.3.1 Structural setting within the block area

Korba coalfield has a well defined east-west trending southern boundary fault. The northern margin is a normal sedimentary contact. Thus the Korba basin corresponds to a half graben configuration. The boundary fault defines a

prominent lineament. Beside the boundary fault, the coalfield is affected by several intra-basinal faults of varying magnitude and direction. Most of the intra-basinal faults are strike faults, aligned in east-west or NW-SE directions. The faults usually dip towards north resulting in repetition of coal seams. A major southerly throwing fault having more than 300 m throw has preserved thick coal seams of middle and upper Barkars in the southern part of the coalfield.

4.3.2. STRUCTURE OF THE BLOCK

4.3.3. Structural setting within the block area

Bagdewa block is covered by thick soil cover in major part and rock exposures are only along the Kholar Nala section. Hence the structural interpretation presented in this report is based on subsurface data obtained by drilling.

The Bagdewa block structurally represents the western limb of a doubly plunging synclinal sub-basin with the axis running NW-SE. The part of the southern limb of this sub-basin is faulted.

Due to rolling nature of strata the amount of dip varies in different part of the block. In the northern part, dip is very gentle about 3° . In the central part of block, the dip of strata is 4° . In the area just south of Kholar nala the dip is steeper and become 7° . Again in the south-eastern part of the block the dip is 4° .

4.3.4 FAULTS

A total of 12 Nos. of faults named F1 to F12 have been interpreted in the block on the basis of available subsurface data. However, taking into considerations the frequent swing in strike direction, rolling nature of dip and sudden variation in parting of seam, the presence of some minor faults cannot be ruled out.

4.4 DESCRIPTION OF COAL SEAMS

The sequence of coal seam in the block is as given below:-

Seam	Depth (m)	Thickness	Grade	GCV	No. of BH	Geological Reserves (Mte)
G-V	15.17-64.70	0.10-2.29 (<1.5m)	F-B (D)	4095-568	36	5.86
Parting		12.27-26.9m			51	
G-IV	14.2-85.0	1.4-2.65	G-C (C)	4005-5256		6.62
Parting		33.65-50.60				
G-III (Top)	10.60-132.50	0.25-3.05 (<1.8)	F-A (B)	4720-6.346	64	13.93
Parting		0.60-15.07				
G-III (Bottom)	13.2-136.49	0.45-7.0	E-A(B)	4607-6540	82	29.44
G-III (Comb)		4.74-7.0				
Parting		1.27-28.0				
G-II A	13.2-158.6	0.1-2.64	F-A(B)	5643-6195	63	8.097
Parting		17.25-41.00				
G-II		0.07-0.77				
Parting		16.74-30.26				Not estimated
G-I		0.12-1.35				Not estimated
TOTAL						67.9

Description of individual coal seams

4.4.1 Seam -GV

Seam GV is the youngest coal seam encountered and it has been intersected in 36 boreholes. The seam is intersected at the minimum and maximum depths of 15.17ms (CMKD-122) and 64.70ms (CMKD-57) respectively.

In crop

The seam GV does not crop out at any place in the block.

Thickness

The including band thickness of the seam varies from 0.10m to 2.29m. However, the normal range of thickness falls between 0.9m to 1.5m.

Roof & Floor

The roof of Seam-GV is predominantly coarse grained sandstone. In small patches, it is Carb. shale or gray shale. Floor of the seam is predominantly coarse grained sandstone. Occasionally, fine grained sandstone, Grey shale & Carbonaceous Shale form the floor.

Dirt Bands

Out of 36 boreholes in which Seam-GV has been encountered, the seam is banded only in 3 boreholes; their cumulative thickness varies from 0.20 to 0.37m.

Quality Parameter

The number of band-by-band analysis, Proximate Overall analysis and special test obtained are given in the following table.

Details of band by band analysis of seam are given in Annexure-III and have been graphically presented as the structure of seam in Plate-IV.

Proximate overall analysis at 60% RH & 40° C has been determined for 10 bore holes and calculated for 11 boreholes out of 21 boreholes where it has developed workable thickness of 0.90m and above. The ranges of different quality parameters are tabulated below:-

Parameter	M%	Ash %	VM%	FC	GCV K. Cal/Kg	UHV K. Cal/Kg	Grade
E/Bcs Sample							
No. of Sample	21	21	11	11	10	21	21
Minimum	4.5	13.4	19.2	36.4	4075	2773	F
Maximum	9.4	39.6	31.6	52.0	5680	6112	B

Workability:-

On perusal of isochors of G-V Seam indicates that it has attained a thickness of more than 1.2m in very small patch, having no definite pattern of development. The grade in this workable thickness range is D to E and a total geological reserve in free area is 2.24 Mte which do not offer economic potentiality.

4.4.2 Seam- G-IV

Seam GIV underlies seam GV with a parting of 12.27m to 26.90m.

The depth of occurrence of Seam G-IV varies from 14.20 to 85.00m.

Thickness

The stratigraphic thickness of the combined seam varies from 1.4m to 3.50m. But from the nature of bands developed in the middle of the seam, for all practical purposes the seam is considered into 2 sections, i.e. Seam GIV Top and G IV Bottom.

Seam G IV is split up into top and bottom section in 42 bore holes and combined thickness is observed in 9 boreholes.

The thickness of GIV Top varies from 0.07m to 1.30m and unworkable in entire area.

The thickness of GIV bottom varies from 0.13 to 1.65m and major area does not offer any workable patch.

Roof & Floor:-

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Roof of Seam GIV is predominantly coarse grained sandstone.

Floor of the seam is also coarse grained sandstone in major part; however, in the northern part it is argillaceous.

As the seam was considered composite earlier, therefore, proximate analysis on 60% RH & 40°C is available for the entire composite seam for 20 boreholes, for GIV Bottom Seam – the quality data is available for 13 boreholes, and for GIV Top seam for 5 boreholes only. The different parameters of quality are presented in Table below:-

PROXIMATE ANALYSIS (on 60% RH 40°C) of Seam GV, Bagdewa Block

Parameter	M%	Ash%	VM%	FC%	GCV K.c al/Kg	UHV K. Cal/Kg.	Grade
GIV Composite							
I Sample							
Minimum	4.0	40.9	16.5	30.3	3375	1517	G
Maximum	5.3	48.8	18.4	33.5	3927	2514	F
G IV Top							
I ₃₀ Sample							
Minimum	5.3	22.0	-	-	4207	2514	F
Maximum	7.1	38.5	-	-	5251	4981	C
G IV Bottom							
E/Bcs Sample							
Minimum	4.2	17.4	20.0	35.1	4242	2290	G
Maximum	7.4	43.5	27.4	47.2	5478	5560	C

The overall grade of Seam IV Composite seam varied between G-F on I sample, that of GIV Top is F to C and GIV Bottom Seam G-C.

Workability :-

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A perusal of Isochors line indicates that Seam G-IV is split-up in two sections in the entire block except in four small isolated patches.

Due to inconsistent nature of Seam G IV Top and GIV Bottom, both the seam does not attract attention from the workability point of view.

4.4.3 Seam G III

Seam G III is the most potential seam of the block from the view point of quality and thickness. It underlies seam G IV at a parting varying from 33.65 to 50.60m. The seam generally occurs in two splits except for a small patch around bore hole CMKD-115, 124, MPDJ- 1,2,3,9 in the southern part of block where it occurs as combined seam varying in thickness for 4.74 to 7.00m.

4.4.4 Seam G III Top

Seam G III Top underlies Seam GIV after a parting of 33.65m to 50.60m.

The minimum depth of occurrence of Seam G-III Top is 10.60m and the maximum depth of Seam is 132.50m.

Thickness

The range of seam thickness is between 0.9 and 2.5m. In south-eastern part of the block, seam thickness is less than 0.9m and unworkable.

Roof & Floor

The roof of Seam G-III Top is predominantly coarse grained sandstone. In the northern and southern part it is alternate shale and sandstone to carb.shale.

Floor of the seam varies in lithology. In the northern most part floor is Fine grained sandstone. It is comprised of Shaley sandstone, alternate shale and sandstone and Grey sandy shale in the central part. Therefore, the floor of seam in major part of the block is argillaceous.

Dirt band

Out of 64 bore holes in which seam G III Top has been encountered, the seam is banded only in 5 boreholes.

Quality

The number of band by band analysis, proximate overall analysis and special tests obtained given below:-

Proximate analysis (on 60% RH & 40°C) of Seam G III Top

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Parameter	M%	Ash%	VM%	FC%	GCV K. Cal/Kg	UHV K. Cal/Kg.	Grade
E / Bcs Sample							
No. of Sample	42	42	19	19	13	42	42
Minimum	3.1	12.0	21.0	34.3	4720	2989	F
Maximum	9.8	39.4	31.0	54.0	6346	6224	A

The overall grade of Seam G-III Top varies between A and F.

Ultimate Analysis, Ash Fusion range ash analysis and HGI of the seam is given in table below:-

Ultimate Analysis of Seam G III Top

Borehole No.	Sample Type	Constituents (on Unit Coal basis)				
		C%	H%	N%	S%	O%
CMKD-146	Bcs	81.5	4.6	1.7	0.8	11.4
	I ₃₀	81.6	4.5	1.7	0.9	11.3
CMKD-150	Bcs	80.2	5.0	1.6	0.6	12.6
CMKD-168	I ₃₀	70.2	3.3	1.2	0.5	23.6
CMKD-180	Bcs	80.8	5.0	1.9	0.6	11.7

Ash Fusion Range of Seam G III Top

Ash Analysis of Seam G III Top

Content	Borehole No.			
	CMKD-146 Bcs	CMKD-146 I ₃₀	CMKD-167	CMKD-180
SiO ₂	58.46	58.48	59.62	60.14
Al ₂ O ₃	31.26	30.86	26.76	28.26
Fe ₂ O ₃	5.34	5.65	4.06	3.98
TiO ₂	1.58	1.56	2.20	2.06
P ₂ O ₅	0.05	0.06	Traces	0.01

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Content	Borehole No.			
	CMKD-146	CMKD-146	CMKD-167	CMKD-180
	Bcs	I ₃₀		
MnO	0.45	0.48	0.92	0.9
CaO	0.96	0.95	2.96	2.16
MgO	1.00	0.94	2.24	1.28
SO ₃	0.12	0.10	-	-
Alkalis	0.78	0.92	1.24	1.21

Hard Grove Index of Seam GIII Top

Borehole Number	H.G.I
CMKD-168	51
CMKD-180	53

On perusal of ultimate analysis, it may be seen that the Sulphur content (in GIII Top Seam is higher (0.5 to 0.9%) in comparison with the other seams).

Workability

Seam G III Top is an important seam of the block after G III Bottom seam. The Seam G III Top can be mined in the northern and southern part of the mining block, where it attains workable thickness and grade.

The seam G III Top has a parting with the underlying GIII Bottom seam less than 3m in the east-southern part of block. This portion will be exploited in Unit-2.

4.4.5 Seam G III Bottom

Seam G III Bottom is the most important seam in the block. The seam has been intersected in 82 boreholes. It is developed in the entire block Seam GIII Bottom underlies the GIII Top seam at parting varying in thickness from 0.60m (MPDJ-4) to 15.07m (CMKD-145). Most of the area considered for working lies within 10m parting with G-III top.

The seam is intersected at the minimum and maximum depth of 13.20m (CMKD-184) to 136.49m (CMKD-26).

Thickness

The thickness of seam varies between 0.45m and 7.00m. The normal range of seam thickness varies between 2.00m and 3.00m (in Phase-I).

Roof & Floor

The roof of Seam G III Bottom is predominantly argillaceous, consists of Grey Shale, Grey Sandy Shale, Shaly Sandstone and Alternate Shale & Sandstone.

The floor of the seam is predominantly arenaceous comprised of Fine to Coarse grained sandstones.

Dirt Bands:-

Out of 82 borehole intersections, the seam is banded in 9 boreholes. Details of dirt bands observed in the seam in 9 bore holes are given in the following table.

Borehole wise details of dirt band in G III Bottom / Combined

B.H. No.	Combustible			Non-Combustible		
	No. of bands	Total Thickness	% of band	No. of bands	Total Thickness	% of band
CMKD-43	1	0.13	2.6	2	0.86	17.2
CMKD-107	1	0.60	13.0	-	-	-
CMKD-115	1	0.11	1.6	2	0.44	6.3
CMKD-127	1	0.16	6.1	-	-	-
CMKD-132	-	-	-	1	0.30	12.5
CMKD-180	-	-	-	1	0.30	13.8
MPDJ-3	1	0.22	4.6	-	-	-
MPDJ-4	-	-	-	1	0.08	1.5
MPDJ-9	-	-	-	1	0.30	3.6
MPDJ-12	-	-	-	1	0.22	7.5

Proximate Overall analysis as stated above has been determined for 50 boreholes and calculated for 17 boreholes. The ranges of various parameters of Proximate Analysis are given below:-

PROXIMATE ANALYSIS (On 60%RH 40°C) of GIII Bottom / Combined

Job No: 501085

IV-10/19

Parameter	M%	Ash%	VM%	FC%	GCV K. Cal/Kg	UHV K. Cal/Kg.	Grade
E / Bcs Sample							
No. of Sample	68	68	45	45	7	68	
Minimum	3.6	10.0	22.0	44.9	4607	3523	E
Maximum	8.0	33.5	29.9	57.4	6540	6733	A
I ₃₀ Sample	(Including E/Bcs Samples where C, Sh band is not developed)						
No. of Sample	72	72	45	45	1	4	
Minimum	3.6	10.0	22.0	44.9	4607	3523	E
Maximum	8.0	33.5	29.9	57.4	6540	6733	A

Ultimate Analysis of Seam G III Top

Borehole No.	Sample Type	Constituents (on Unit Coal basis)				
		C%	H%	N%	S%	O%
CMKD-168	E	80.8	4.8	1.8	0.3	12.3
CMKD-180	E	80.2	4.9	1.8	0.5	12.6
CMKD-188	E	81	5.1	1.9	0.4	11.6
MPDJ-1	BCs	84.6	4.3	1.4	0.6	9.1
MPDJ-2	BCs	85.2	4.4	1.4	0.3	8.7
MPDJ-3	I ₃₀	85.7	4.4	1.6	0.2	8.1
MPDJ-4	I ₃₀	81.7	4.3	2.1	0.4	11.5
MPDJ-9	I ₃₀	83.2	4.3	1.4	0.4	10.7

Ash Fusion Range of Seam G III Top

Job No: 501085

IV-11/19

B.H. No.	Ash fusion range °C			
	Sample Type	IDT	HT	FT
MPDJ-1	E	1340	>1400	>1400
MPDJ-2	E	1390	>1400	>1400
MPDJ-3	I ₃₀	>1400	>1400	>1400
MPDJ-4	I ₃₀	>1400	>1400	>1400
MPDJ-5	I ₃₀	>1400	>1400	>1400

Ash Analysis of GIII Bottom/ Combined

Content	Borehole No.							
	CMKD-168	CMKD-180	CMKD-188	MPDJ-1	MPDJ-2	MPDJ-3	MPDJ-4	MPDJ-9
SiO ₂	59.46	57.34	56.72	55.86	57.84	57.44	58.46	58.23
Al ₂ O ₃	26.23	28.92	27.68	30.50	28.90	28.60	29.00	29.50
Fe ₂ O ₃	4.18	4.40	5.06	6.92	5.80	6.40	5.46	5.00
TiO ₂	2.08	1.98	2.16	1.6	1.60	1.70	1.6	1.70
P ₂ O ₅	0.01	Traces	0.01	0.2	0.22	0.16	0.22	0.20
MnO	-	-	-	0.3	0.30	0.12	0.30	0.26
CaO	3.24	3.02	2.94	2.10	2.00	2.20	1.90	1.90
MgO	2.56	2.26	3.13	1.7	1.7	1.40	1.40	1.60
SO ₃	0.94	0.96	0.88	0.16	0.22	0.11	0.20	0.18
Alkalies	1.30	1.12	1.42	0.66	1.42	1.87	1.46	1.43

Workability

Seam G III is combined in a small patch in the south-western part of the block where the thickness of seam (Ex-band) varies from 4.74m to 6.56m with grade C-D. The seam splits towards the in crop zone. In the northern most part of the block, the parting between the G III Bottom and the underlying G II A seam reduces, below 3m.

4.4.6 Seam-G II A

Job No: 501085

IV-12/19

Seam G IIA underlies seam G III Bottom with a parting of 1.27 to 28.00m. In most of the area parting is 10m. In the western most part of Bagdewa block, workable thickness of seam with good quality was observed, which is correlated as Seam G IIA. This seam has been encountered in 63 boreholes. Out of which 3 boreholes fall in the in crop zone.

Seam G II A shows splitting tendency throughout the block.

The minimum and maximum depth of occurrence from surface is 16.71m and 158.60m respectively.

Thickness

The thickness of the seam varies from 0.10m (CMKD-114) to 2.64m (CMKD-147). Out of the three splits of Seam G-II A, the middle section is consistent in thickness and is considered for drawing of Isochors. However, in the northern part of the block, the Top & Middle sections are well developed.

From the perusal of isochors plan of G IIA seam it is observed that the seam thickness reduces abruptly along a north south alignment which corresponds very much with the abrupt increase in parting between Seam G II A and G III Bottom.

In the south of Fault F7-F7, the seam again abruptly deteriorates in thickness and become less than 0.9m in thickness.

Roof & Floor

The roof of Seam G II A is predominantly coarse grained sandstone except in the northern part where roof is argillaceous.

Floor of the Seam is predominantly argillaceous comprised of grey shale, grey sandy shale and intercalation of shale and sandstone.

Dirt band

Out of 63 borehole intersection of Seam G IIA, in 15 bore holes seam has developed band. Details of dirt bands observed in 15 bore hole is given in the following table.

Details of dirt band in Seam G II A Bagdewa Block

B.H. No.	Combustible			Non-Combustible		
	No. of bands	Total thickness	% of band	No. of bands	Total thickness	% of band
CMKD-147	-	-	-	1	0.15	5.60
CMKD-150	-	-	-	1	0.17	8.90
CMKD-152	-	-	-	1	0.12	11.20
CMKD-153	-	-	-	1	0.20	7.70
CMKD-161	-	-	-	1	0.03	1.80
CMKD-174	-	-	-	1	0.20	14.80
CMKD-176	-	-	-	1	0.11	8.90
CMKD-179	-	-	-	1	0.10	7.10
CMKD-180	1	0.18	7.00	1	0.20	13.2
CMKD-184	-	-	-	1	0.16	8.60
CMKD-190	1	0.14	17.70	-	-	-
CMKD-193	-	-	-	1	0.20	12.50
CMKD-202	1	0.22	8.80	-	-	-
CMKD-203	1	0.11	4.90	-	-	-
CMKD-205	-	-	-	1	0.15	6.70

Proximate overall analysis has been determined for 26 bore holes and calculated for 10 boreholes. The ranges of different parameters of proximate analysis are given below:-

PROXIMATE ANALYSIS (On 60%RH 40°C) of Seam G II A

Parameter	M%	Ash%	VM%	FC%	GCV K.Cal/Kg	UHV K. Cal/Kg.	Grade
E Sample							
No. of Sample	38	38	30	30	4	38	38
Minimum	5.1	10.1	20.9	42.7	5643	2994	F
Maximum	7.6	37.4	31.7	53.7	6195	6678	A
I ₃₀ Sample	(Including E/Bcs Samples where C, Sh band is not developed)						

Job No: 501085

IV-14/19

Parameter	M%	Ash%	VM%	FC%	GCV K.Cal/Kg	UHV K. Cal/Kg.	Grade
No. of Sample	42	42	32	32	4	-	
Minimum	4.7	10.1	20.9	37.5	5643	2994	F
Maximum	7.6	37.4	31.7	53.7	6195	6678	A
I Sample							
No. of Sample	3	3	3	3	-	-	
Minimum	6.2	28.1	22.4	39.3	-	3739	E
Maximum	6.5	31.2	25.1	41.6	-	4125	E

Ultimate Analysis, ash fusion range as well ash analysis of Seam G II A is given in the following table :-

Ultimate Analysis of Seam G II A

Borehole No.	Sample Type	Constituents (on Unit-Coal basis)				
		C%	H%	N%	S%	O%
CMKD-150	E	80.4	4.6	1.1	0.4	12.9
CMKD-168	BCs	81.1	4.9	1.8	0.4	11.8
CMKD-180	I ₃₀	82.1	4.7	1.8	0.4	11.0
CMKD-188 (Top)	E	80.0	4.9	1.7	0.3	13.1
CMKD-188 (Bottom)	E	80.5	5.0	1.8	0.4	12.3

Ash Fusion Range of Seam G II A

B.H. No.	Ash fusion range °C			
	Sample Type	IDT	HT	FT
CMKD-150	E	1100	1390	>1400

Ash Analysis of Seam G II A

Job No: 501085

IV-15/19

	Borehole No.			
	CMKD-168	CMKD-180	CMKD-188 (Top split)	CMKD-188 (Bottom split)
SiO ₂	57.2	56.92	59.01	60.18
Al ₂ O ₃	27.35	27.74	26.58	25.72
Fe ₂ O ₃	4.68	4.52	4.84	5.12
TiO ₂	1.98	2.09	2.11	1.86
P ₂ O ₅	Traces	Traces	Traces	Traces
CaO	3.63	3.68	2.86	2.70
MgO	2.92	2.86	2.31	2.02
SO ₃	0.86	0.88	0.93	0.95
Alkalies	1.38	1.31	1.36	1.45

HARD GROVE INDEX OF SEAM G II A

Borehole Number	H.G.I
CMKD-168	50
CMKD-180	51
CMKD-188 (Top)	51
CMKD-188(Bottom)	54

Workability

A perusal of the isochors of Seam II A indicates that the seam attains workable thickness only in Sector A and part of Sector D. In other sectors the seam has deteriorated in thickness below workable limit. However, in Sector A the seam G II A and overlying GIII Bottom has a parting thickness less than 3m in the northern most part in a small reserve.

4.5 HYDROGEOLOGICAL DETAILS

4.5.1 SURFACE WATERS

The block is largely characterised by almost plane country, except on both sides of Kholar nala where undulations are there. The altitude varies from 327.38m to 300.18m above MSL.

North & North East is high ground whereas; south west is low area along which the Nala flows. The water from the entire catchments area of the block flows into Kholar nala.

4.5.2 PROBABLE IMPACT OF MINING ON GROUNDWATER SYSTEM

(a) **Impact on Topography & Drainage:** Subsidence due to total extraction of coal causes changes in topography and drainage by developing micro basins, subsidence fractures, ridges, pot holes etc. This alters the drainage of the area in micro level. Care is taken during mining activity to leave enough pillars in underground as barriers below main drainage/water body to avoid any damage to surface water bodies. In deeper underground mines, the subsidence is barely noticeable on the surface.

(b) **Impact on Aquifer System:** Various methods of U/G mining activities may cause changes in aquifer geometry, water level in the vicinity of the mine and disturb ground water flow direction. This can also create secondary fractures and higher permeability zones within the aquifer system. Thereby, the aquifer units maintain continuity. After the mining activity, the aquifer restores its original water level and mined out area acts as a good reservoir. In the present case, as the Bagdeva U/G project is a shallow U/G mine, the impact of mining activity on unconfined aquifer, will be observed only near to the mine mouth and shallow workings. However, the impact will be marginal to negligible towards north-east, i.e. in the deep dip direction.

(c) **Impact of Water Levels:** During mining, the formation near to the mine mouth only get disturbed and marginally dewatered. With the presence of low permeable beds such as clay (shale) and younger coal seams (Ghurdeva) in the formations lying above the top working seam, the water level in the phreatic aquifer is not affected during the Bord and Pillar mining activity. In case of total extraction of coal (depillaring) and resultant subsidence cracks, the water may drain into the mine causing lowering of water table at the vicinity of the mine. Draw down thus created may be limited to lesser area since the mine pumped out water is re-circulated into the phreatic aquifer by natural recharge. It was also observed that after mining activity is over the water level restores to its original level after one or two monsoons.

The radius of probable impact on groundwater level under caving conditions was predicted to vary from 255m to 462m. With variation in aquifer/ mine geometry, return flow for mine discharge, abundant recharge potential and

improved subsidence management, the zone of disturbance will be reduced further.

Due to this impact, the groundwater levels in the nearby villages close to the mine workings are marginally affected. The water levels in other areas maintain the natural fluctuations and even the tube wells are operating in villages without any problem. This clearly indicates that the impact is limited close to the mine operating area only.

(d) Impact on Ground Water Quality: The groundwater chemistry indicates that the groundwater in the area is potable and does not contain any toxic elements. The underground mining activity does not induce any unwanted chemical or elements into the groundwater affecting the water chemistry except for Total Suspended Solids (TSS), no serious pollutant has been observed in the mine water discharge. The discharge water conforms to the MOEF standards. After necessary treatment, mine water from adjacent Singhali UG and Dhelwadih tgoan UG has been gainfully utilised for drinking purposes.

4.5.3 CONSERVATION MEASURES

- The effected habitation has been provided with suitable drinking water supply by sinking hand pumps/deep tube wells.
- The entire mine industrial water demand, would be met from the treated mine discharge. The wastage of water will be minimized.
- The surplus treated mine water will be discharged into the local ponds or agricultural fields. Thereby, the mine water will behave as constant source of recharge and improves the water levels in the mine area. This will also become a resource for irrigation and increase agriculture output in the area.
- To assess the impact on local water levels, in time and space coordinates, a monitoring net work of dug wells in the zone of influence base established and the water levels are monitored quarterly (February, May, August and November).

4.6 GEOLOGICAL RESERVES

4.6.1 The geological reserve statement in the block is given in the following pages:-

Seam	Under free Area	Blocked Nala Village	15 M HCL	Total	Remarks
G-V	2.978	0.846	2.036	5.86	Not considered in RPR Patchy Deposit
G-IV:-					
IV Top	1.157	0.118		1.275	Not considered
IV Bott.	2.656	1.07		3.726	Poor Grade
IV C	0.852	0.772		1.624	
G-III					
III Top	10.119	1.657	2.115	13.891	4.934 Mt considered
III Bott.	22.05	3.445	3.947	29.442	13.01 Mt considered
III C	3.966			3.966	Available in Phase-II Block
G-II A	6.47	1.625	-	8.095	6.6 Mt considered
Total	50.248	9.533	8.098	67.879	24.54 Mt considered in RPR

About 24 Mte of coal would be available in Unit-2 of mine operation lying south of the fault F7-F7.

4.6.2 GEOLOGICAL LOSSES / SURFACE CONSTRAINTS

The reserve estimation has been done on the basis of the plans of the seams provided and reserve calculated in previous RPR of the Bagdewa Block. Geological losses has been calculated which is blocked in 15M HCL, Nalla, and villages.

STATEMENT OF GEOLOGICAL RESERVES IN UNIT-I PROPERTY

Particulars	Thickness Range	A Reserves	B Reserves	C Reserves	D Reserves	E Reserves	F Reserves	Area	Total Reserves
1. Seam III T Sector-A									
(a) Free Area	1.2-1.5		0.3321	0.2801	0.2124	0.3269	0.1071	0.6874	1.2586
	1.5-1.8		0.3022	0.2434	0.0955	0.2318	0.1309	0.4487	1.0038
	1.8-2.0		0.2496	0.139	0.1404	0.0035		0.2134	0.5325
	2.0-2.5		0.0684	0.2346	0.0302			0.1124	0.3332
	2.5-3.0			0.0138				0.0038	0.0138
Sub Total(a)			0.9523	0.9109	0.4785	0.5622	0.238	1.4657	3.1419
(b) Within 60m Barrier Area									
	1.2-1.5		0.0017	0.0693	0.0185			0.0498	0.0895
	1.5-1.8		0.1371	0.0869	0.0977			0.1481	0.3217
	1.8-2.0		0.0274	0.0271	0.0026			0.0231	0.0571
	2.0-2.5		0.1274	0.0753				0.0696	0.2027
Sub Total(b)			0.2936	0.2586	0.1188	0	0	0.2906	0.671
(c) Within Village Area									
	1.2-1.5		0.0224					0.013	0.0224
	1.5-1.8		0.0221	0.0236				0.0213	0.0457
Sub Total(c)			0.0445	0.0236	0	0	0	0.0343	0.0681
TOTAL SECTOR-A			1.2904	1.1931	0.5973	0.5622	0.238	1.7906	3.881
II. SECTOR-B									
(a) FREE AREA								0.033	0.0633
	1.2-1.5		0.0633					0.192	0.45
	1.5-1.8		0.45					0.044	0.1187
	1.8-2.0		0.1187					0.01075	0.032
	2.0-2.5		0.032					0.27975	0.664
Sub Total(a)			0.664	0	0	0	0		
(b) Within 60m Barrier Area									
	1.5-1.8		0.0555					0.0263	0.0555
	1.8-2.0		0.0425					0.0175	0.0425
	2.0-2.5		0.0066					0.0023	0.0066
Sub Total(b)			0.1046	0	0	0	0	0.0461	0.1046
(c) Within Village Area									
	1.2-1.5		0.148646	0.0277				0.0921	0.176346
	1.5-1.8		0.074608	0.0251				0.0464	0.099708
	1.8-2.0			0.008412				0.0013	0.008412
Sub Total(c)			0.223254	0.061212	0	0	0	0.1398	0.284466
TOTAL SECTOR-B			0.991854	0.061212	0	0	0	0.46565	1.053066
III. SECTOR-C									
(a) Free Area	1.2-1.5		0.1817	0.0893				0.1563	0.271
	1.5-1.8		0.253	0.0203				0.1293	0.2733
	1.8-2.0	0.0031	0.1153					0.0488	0.1184
	2.0-2.5		0.1078					0.0375	0.1078
Sub Total(a)		0.0031	0.6578	0.1096	0	0	0	0.3709	0.7705
(b) Within 60m Barrier Area									
	1.2-1.5		0.0155	0.0479				0.0358	0.0634
	1.5-1.8		0.0154	0.0338				0.0228	0.0492
Sub Total(b)			0.0309	0.0817	0	0	0	0.0586	0.1126
TOTAL SECTOR-C			1.130554	0.142912	0	0	0	0.56175	1.273466
TOTAL SECTOR-III T									
3. SE								0.1121	0.1932
(a) Area	1.2-1.5	0.0167	0.1765					0.3098	0.6524
	1.5-1.8	0.0651	0.5873					0.3248	0.7853
	1.8-2.0	0.2382	0.5471					1.1848	3.4204
	2.0-2.5	1.5876	1.6155	0.2173				0.7391	2.6122
	2.5-3.0	0.272	1.7934	0.5468				0.0335	0.1418
	3.0-3.5		0.0623	0.0795					
Sub Total(a)		2.1796	4.7821	0.8436	0	0	0	2.7141	7.8053
(b) Within 60m Barrier Area									

Particulars	Thickness Range	A Reserves	B Reserves	C Reserves	D Reserves	E Reserves	F Reserves	Area	Total Reserves
	1.5-1.8		0.097					0.046	0.097
	1.8-2.0	0.033	0.0728					0.0438	0.1058
	2.0-2.5	0.0349	0.0684					0.0361	0.1033
	2.5-3.0		0.3156	0.3129	0	0	0	0.1758	0.6285
Sub Total(b)		0.0679	0.5538	0.3129	0	0	0	0.2557	0.9346
© Within Village Area									
	1.5-1.8	0.0177	0.008					0.0123	0.0257
	1.8-2.0	0.0371	0.0141					0.0213	0.0512
	2.0-2.5	0.0666	0.2223	0.1399				0.1478	0.4288
Sub Total(c)		0.1214	0.2444	0.1399	0	0	0	0.1814	0.5057
TOTAL SECTOR-A		2.3689	5.5803	1.2964	0	0	0	3.1972	9.2456
II. SECTOR-B									
(a) Free Area	1.2-1.5								
	1.5-1.8								
	1.8-2.0								
	2.0-2.5		1.258					0.4039	1.258
	2.5-3.0		0.5816					0.1645	0.5816
	3.0-3.5								
	4.0-4.5								
	4.5-5.0								
Sub Total(a)		0	1.8396	0	0	0	0	0.5684	1.8396
(b) Within 60m Barrier Area									
	1.2-1.5				0.0079			0.0043	0.0122
	1.5-1.8				0.0214			0.0095	0.0214
	1.8-2.0				0.039			0.015	0.039
	2.0-2.5				0.1108			0.036	0.1108
	2.5-3.0		0.0063	0.1182				0.0343	0.1245
	3.0-3.5		0.0054	0.0408				0.0108	0.0462
Sub Total(b)			0.0117	0.159	0.1791	0	0	0.1099	0.3541
© Within Village Area									
	1.2-1.5		0.0302					0.0175	0.0302
	1.5-1.8		0.0886					0.042	0.0886
	1.8-2.0		0.0554					0.0228	0.0554
	2.0-2.5		0.0267					0.0093	0.0267
Sub Total(c)			0.2009	0		0	0	0.0916	0.2009
TOTAL SECTOR-B		0	2.0522	0.159	0.1791	0	0	0.7699	2.3903
III. SECTOR-C									
(a) Free Area	1.2-1.5								
	1.5-1.8		0.038					0.0196	0.038
	1.8-2.0		0.115	0.0908				0.0705	0.2058
	2.0-2.5		0.0063	0.27				0.0778	0.2763
	2.5-3.0		0.031	0.64				0.1698	0.671
	3.0-3.5								
	3.5-4.0								
Sub Total(a)			0.1903	1.0008	0	0	0	0.3377	1.1911
(b) Within 60m Barrier Area									
	1.2-1.5				0.0107			0.0058	0.0107
	1.5-1.8				0.026			0.0115	0.026
	1.8-2.0		0.0073		0.0047			0.0048	0.012
	2.0-2.5		0.0181	0.0039				0.0076	0.022
	2.5-3.0			0.0218				0.006	0.0218
	3.0-3.5			0.0937				0.0218	0.0937
Sub Total(b)			0.0254	0.1194	0.0414	0	0	0.0575	0.1862
TOTAL SECTOR-C			0.2157	1.1202	0.0414	0	0	0.3952	1.3773
TOTAL SEAM-III B		589	7.847773	2.5756	0.2205	0	0	4.3623	13.01277
SEAM-II A									
1. Sector A									
a) Free Area	1.2-1.5	0.362	0.2878	0.1675	0.1034	0.0182		0.5389	0.9389
	1.5-1.8	0.2356	0.7338	0.1786	0.2117	0.2311	0.0198	0.7434	1.6106
	1.8-2.0	0.0575	0.584	0.4223	0.1235	0.0305		0.4913	1.2178
	2.0-2.5	0.0043	0.7672	1.1246	0.201			0.7114	2.0971
Sub Total(a)		0.6594	2.3728	1.893	0.6396	0.2798	0.0198	2.485	5.8644

Particulars	Thickness Range	A Reserves	B Reserves	C Reserves	D Reserves	E Reserves	F Reserves	Area	Total Reserves
(b) Within 60m Barrier Area									
	1.2-1.5			0.0393	0.0582			0.0198	0.0284
	1.5-1.8		0.0027	0.0629	0.0677			0.0535	0.0975
	1.8-2.0			0.0817				0.0601	0.1333
	2.0-2.5		0.0684	0.056				0.0325	0.0817
								0.0426	0.1244
Sub Total(b)			0.0711	0.2399	0.1259	0	0	0.2085	0.4653
(c) Within Village Area									
	1.2-1.5	0.0345	0.0592	0.05				0.0826	0.1437
	1.5-1.8	0.027	0.0822	0.0044				0.054	0.1136
	1.8-2.0	0.0079	0.008					0.0066	0.0159
		0.0694	0.1494	0.0544	0	0	0	0.1432	0.2732
Sub Total(c)		0.7288	2.5222	1.9474	0.6396	0.2798	0.0198	2.6282	6.1376
TOTAL SEAM-II A		3.0977	12.7283	6.0172	1.5833	0.842	0.2578	9.45525	24.54974
GRAND TOTAL									
(Seam III T, IIIB & IIA)									

CHAPTER-V

MINE BOUNDARY, RESERVES & MINE LIFE

5.1 SELECTION OF MINING AREA

A. Blocks considered for finalizing mining area:

The following geological blocks have been considered while evaluating and finalising the proposed mine boundaries of Bagdewa UG project and indicated future extension of project boundaries:

- (a) Bagdewa Block (GR on Bagdewa Block, Korba Coalfield, February, 1998)
- (b) Additional 93 no. Boreholes of CMKD Series drilled by CMPDI have been considered. Based on the data of the boreholes, isochores and iso-grades of the property have been drawn for the calculation of reserves and for lying of panel projections in the area to be developed in the mine.

B. Criteria for selection of mining area & seams :

The following criteria have been used for selection of mining area:-

- a. Proved coal reserves
- b. Large workable area or patches
- c. Hard cover thickness of more than 15m
- d. Workable seam thickness of 1.2m & above

5.2 MINE BOUNDARIES

The Bagdewa geological block is located in the West of Dilwadih underground mines. The area proposed to be exploited in Unit-I by underground mining will be about 4.69 sq. km. The additional area lying up to fault F7-F7 has been annexed and environment clearance from MOEF has been obtained. The underground extraction will be limited up to 4.69 sq. km (the rest of area Unit -II will be exploited only after (later on stage) clearance from the competent authority). The ultimate mine boundary has been demarcated same as mining area proposed in previous RPR (1999), which is given below:-

- North - Fault F9-F9 & 15m hard cover line of workable seams.
- South - Kholar nalla later on Fault F7-F7 and its extension up to Fault F10 (3 m parting with Seam III top and bottom will follow the extension line).
- West - 15m HCL of G-II A seam, working thickness (1.5m lying) and 40m against road to Amarpur village.
- East - Fault F8, F10 & workable thickness line (1.5m) of seam.

JUSTIFICATION OF BLOCKING :

As mentioned earlier the geological block covers an area of about 10.54 sq. km, if the entire block is considered for exploitation in one unit, the length of strike panel will be more than 3 Km each side of main dip. This may lead to poor ventilation and transport system. Moreover, the geological structures also favours in exploitation of block in two units as fault F7-F7 divides the block in almost two parts and the extent of G-II A Seam has been limited up to Fault F7.

Extractable reserves:

Table 5.1: Summary of Geological and Extractable Reserve

Seam	Geological Reserves (Mt)			Mineable Reserves (Mt)
	FREE AREA	BLOCKED	TOTAL	
G-III TOP	10.119	3.772	13.891	4.934 considered
G-III BOTTAM	22.05	7.392	29.442	13.01 considered
G-III C	3.966	-	3.966	Available in Phase-II
II-A	6.47	1.625	8.095	6.6 MT considered
TOTAL	36.18	11.164	51.428	24.54 MT considered

Grade of coal: Grade of coal is A-C .average saleable grade of coal is B.

Mineable reserves: Comprises of reserves in seam thickness >1.5m and hard cover more than 15m.

Table 5.2: Summary of Geological and Mineable Reserve

Seam	Area considered (Ha)	Thickness range (m)	Geological Reserve (Mt)	Mining Losses Barr.(Mt)	Blocked coal losses, if any	Mineable Reserve (Mt)
1	2	3	4	6	7	8
G-III TOP	135	1.5-3.5	13.891	0.314	3.772	2.20
G-III BOTTAM	469.08	1.5-3.5	29.442	1.767	7.392	12.39
II-A	2.5	1.5-3.5	8.095	0.583	1.625	4.044
TOTAL			51.428	2.664	11.164	18.634

5.3

PRODUCTION TARGET & LIFE OF THE MINE

In this RPR it is proposed to deploy additional four LHDs and four UDMs in the second year for an incremental production of 0.345Mty. The existing LHDs will be replaced in accordance with their balance life. The mine has a flat gradient, and favorable roof conditions. The productivity of total machineries deployed has been assessed to be 2460 tpd.

TOTAL - 0.75 Mty

Considering the extractable reserves and the production schedule, the life of the mine is expected to be about 13 years (including production built-up & tapering periods).

MINE LIFE

The balance extractable reserves considered in RPR of Bagdewa UG mine is 9.475 Mte (in the 4.69 sq. km area) inclusive of all three workable seams. With a targeted output of 0.75 mty the life of the mine works out to 13 years including development and depillaring.

CHAPTER-VI

MINE ENTRIES

6.1 SELECTION OF MINE ENTRIES

It was proposed to approach and work the seams IIA and III T, III B by the Existing two inclines and one air shaft in addition; two drifts and staple pits required for ventilation at dip most part. One additional air shaft 5.0m diameter as intake is being proposed up to G-II A seam.

The details of the existing mine entries along with proposed underground mine drivages is shown in Table 6.1.

6.2 JUSTIFICATION FOR LOCATION OF PROPOSED DRIFTS

The location of the proposed drifts has been fixed considering the following factors:

The existing inclines have been driven up to seam II A. Trunk belts are installed in main incline. Coal from top seams is loaded through bunker in trunk belts in II A seam. Therefore two drifts were driven to make approach from IIA seam to III Bottom seam. Staple pits were required for better ventilation location as shown in Table 6.1. Six additional drifts are being proposed to cross two faults F2-F2 and F3-F3 of 5m throw each. Two strata bunkers are being proposed between II A seam and III seam on both sides of trunk belts i.e. northern and southern side. Two drifts and one staple pit is being proposed to inter in G-III T seam from G-IIIB seam from rise side of overlapping G-III T & G-III B seam.

6.3 DIMENSION & PURPOSE OF MINE ENTRIES

The detail of the existing & proposed entries is shown in Table 6.1 along other underground drivage.

6.4 DETAILS OF DRIFTS & STRATA BUNKERS

The brief description of mine entries, underground drivages and other drivages / strata bunkers is given in Table 6.1.

Table - 6.1: Brief Description of Mine Entries & Drivage

Entries Name / No.	Size (X-section /length) (m x m /m)	Length/Depth (m)	Gradient (1 in ... / vertical)	Purpose
Existing Mine Entries				
Incline No. 1	4.2x 2.5	164 m	1 in 4	Main Intake Belt/coal transport
Incline No. 2	4.2x 2.5	164m	1 in 4	Main intake Traveling/ Haulage roadway
Air Shaft	5.0 m Dia	45m	Vertical	Main Return airways
Existing underground drivage				
Drift No.1	40m	40m	1 in 4	GIIA to GIIIB ,Intake & Travelling
Drift No.2	40m	40m	1 in 4	GIIA to GIIIB ,Intake & Haulage
Staple Pit (16L/2D)	5.0m Dia.	11m	Vertical	Return
Staple Pit (16L/2D)	5.0m Dia.	11m	Vertical	UG Bunker
Staple Pit (16L/2D)	5.0m Dia.	11m	Vertical	UG Bunker
Proposed Underground Drivage	To cross		Two	Faults F2-F2 & F3-F3
Air shaft	5 m dia.	45m	vertical	Intake airways
Drift 1 & 1A	4.2x 2.5	25m	1 in 5	Haulage / Material transport /Intake
Drift 2 & 2A	4.2x 2.5	25m	1 in 5	Intake airway/Travelling Roadway
Drift 3 & 3A	4.2x 2.5	25m	1 in 5	In seam Return
Drift G-III B TO G-IIIT	4.2x 2.5	50x2m	1 in 5	Intake and transport
Staple pits for ventilation	4.8 m dia. 2 no	20 mx2	Vertical	In seam
Strata Bunker (100t), 2 no.	4.8 m dia	10	Vertical	Coal Bunkering

CHAPTER-VII

MINING STRATEGY

7.1 SURFACE CONSTRAINTS DURING DEVELOPMENT

The EMP report has been prepared and approved for development and depillaring for a mining area of 5.02 sq. km. The surface of the proposed mine take is occupied by forest, agricultural land, village and basties. Few village roads and forest roads also exist within the proposed mining area.

7.2 MINE BLOCKING

As mentioned earlier the total Block area is 10.54 sq. km. Out of which, about 9 sq. km area is considered to be workable. The average length of dip is about 2 Km where as total strike is about 7 Km. For such an extensive property, it is not advisable to work through single unit keeping in view of length of strike panel more than 3 km. It is proposed to work this property in two units which will ease the mine transport and ventilation system. At the same time, traveling of men will be about 6 Km to and fro as envisaged in RPR-99.

In the Unit-I of mine operation (presently considered for) the boundaries are:-

North	-	Fault F9-F9 & 15m HCL of seam.
South	-	Fault F7-F7 and its extension up to Fault F10 and 3m parting with III top & III bottom.
West	-	15m HCL of G-IIA seam, Road to mine.
East	-	Fault F8, F10.
Mining area.	-	4.69 sq. km.

Unit-2

North	-	Fault F7-F7 and its extension up to fault F10.
South	-	Fault F12, F4 & F11
East	-	Fault F10 & F11.
West	-	15M HCL of G-III Seam
Area	-	4.25 sq. km (approx.) geological

This unit may be exploited through separate mode of entry or from the same unit, to be decided in later stage.

7.2 GEO-MINING CHARACTERISTICS:-

Seam G-III Bottom has attained its workable thickness in the entire area whereas workability in G-II A is limited up to Unit-I (2.5 sq. km). G-III top is workable in small patch of 0.35 Sq. km area in north side and 1 Sq. Km in the southern side of main dip. The seams are

dipping towards east. Seams are occurring at a depth of minimum 35m to maximum 120 m from the surface. Seam G-II A and G-III bottom and G-III top are contiguous in some portion of mining area and they are proposed to be worked as per statutory provisions of Coal Mines Regulations.

7.3 MODE OF ENTRY,

The original PR has envisaged driving two inclines (4.2x2.5 sq. m 1 in 4) and one return air shaft (5m dia, 45 m depth). Due to non-availability of land, the sets of inclines had been re-located near B.H.No.179. These two inclines have been driven at 1 in 4 having a cross section area of 4.2x2.5 sq. m. After driving 200m along main dip in G-II A seam a pair of rising incline have been driven at suitable gradient 1 in 4 having cross section of 4.2 x 2.5 sq. m. up to G-III bottom seam.

An airshaft has been sunk to serve as main return.

The details of existing entries are given below:-

Sl. No.	Shaft / Incline	Purpose	Dimension (width, height & length)
1	Incline No.1	Coal transport & traveling, Main Intake airway.	4.2 x 2.5 Gradients 1 in 4, 164m.
2.	Incline No.2	Material transport, main Intake airway to G-III B & G-II A.	4.2 x 2.5 Gradients 1 in 4, 164m.
3.	Air shaft	Main return airway up to G-IIA	5m dia, 45m depth.
4	Air shaft (PROPOSED)	Main Intake airway up to G-II A	5m dia, 45m depth.

The location of the entries was considered by the following considerations:-

- Coal seam should touch as early as possible to reduce the gestation period.
- Entries should be away from Geological disturbances and adequate hard cover is available.
- The area should be free from surface constraints like village, nalla etc.
- Entries should not touch the seam at a point where the seam is thin, otherwise heightening of roof in stone would be required.

The length of main dip heading would be around 2.3 km in G-III Bottom.

The Unit-2 area can be worked through a separate pair of inclines, preferably in an area where land can be acquired easily and the topography suits for pit infrastructure development.

7.4. MINING & MINE DEVELOPMENT STRATEGY

After touching of coal seam G III Bottom & G-II A, main dip drive of five headings in each seam have been continued up to the eastern boundary. The total length of main dip in Seam G II (A) is about 1.4 Km and that of G-III Bottom is 2.3 Km.

Bottom Approach to G-III & G-III top seams:-

The original PR envisaged driving a pair of drifts from G-II A seam to G-III bottom seam. At present, the site of inclines is lying in the 15m Hard cover line of G-II A seam & G-III B Seam. The existing inclines had been driven at 1 in 4 and touched seam G-III B at about 30m and G-II A seam at 40m depth from surface. The Hard cover available at G-III Bottom seam is about 14.75m composed of coarse grained sandstone and shale. From these point entries to Seam G-III Bottom is not possible due to unconsolidated strata. The drift driven to G-II A seam and main dip have been driven for 200m, further rising drift at 1 in 4 was driven to touch G-III B Seam.

Five headings main dip panel in G-III Bottom is driven which is super imposed with the workings of main dip of G-II A Seam.

The overlying seam of Seam-III bottom is G-III top which occurs in two workable patches. The northern most patches are about 0.35 sq. km of poor grade (D, E & F) and southern patch is about 1 sq. km. The parting between workable southern patch of G-III top seam and G-III Bottom seam varies from 9m to 3m (limiting the boundary of mine). It is proposed to enter the G-III top seam, from the level galleries of G-III bottom seam through drifts and staple pits from rise side of the overlying portion. A pair of rising drift for intake and transport and one staple pit for return will be driven. One more workable patch in III top seam exists above the main trunk headings of the mine. To connect both workable patches for transport and ventilation network, thin seam drive is involved for which capital provision has been made in A-8.1

Beneath the ponds, nalla, development will be the final operation. As a safety measures, about 60m barrier pillar will be left against nallas. The HFL of Kholar nala shall be determined and marked and monitored for precautionary observations.

7.5 PANEL WISE RESERVES STATEMENT

The panels have been projected in all workable seams. The reserves statement for Seam III T, III B and Seam II A are enclosed in the following pages as given below in Table.

PANEL-WISE RESERVE OF BAGDEWA UNDERGROUND MINE

(In Tonne)

SEAM-III TOP :

Panel No.	Length	Width(m)	Thickness (m)	Sp.Gravity	Reserve	DEV	DEP	Barrier
MD	400	200						
T7	550	132	1.9	1.52	231040	74348.67	23925.4	
	175	132	2.0	1.52	220704	71022.55	121077.3	41933.76
T8	200	132	1.8	1.52	63201.6	20338.27		12008.3
T9	250	450	1.6	1.42	59980.8	19301.82	32905.23	11396.35
T1	500	132	2.4	1.47	396900	127722.4		75411
T2	500	132	1.7	1.47	164934	53075.76	90482.13	31337.46
T3	250	132	1.8	1.42	168696	54286.37	92545.95	32052.24
T4	250	132	1.9	1.42	89034	28651.14	48843.69	16916.46
MD T	500	76.5	1.7	1.42	79662	25635.23	43702.25	15135.78
	250	76.5	1.7	1.42	92335.5	29713.56	50654.88	17543.75
T5	550	102	1.9	1.40	46167.75	14856.78	25327.44	8771.873
T6	450	102	1.9	1.42	149226	48020.93	81864.78	28352.94
					123838.2	39851.13	67937.14	23529.26
					1885719.9	606824.6	679266.2	314389.2
TOTAL EXTRACTABLE (MT)					1.2861			

SEAM-III BOTTOM :

Panel No.	Length	Width(m)	Thickness (m)	Sp.Gravity	Reserve	DEV	DEP	Barrier
MD-III A	1650	102	2.2	1.42	525769.2	169192.5	54446.16	
MD-III B	1500	76.5	2.25	1.42	366626.25	117980.3	37966.07	
MD-III C	1050	102	2.76	1.47	432951.75	139323.9	44834.42	
III-1	950	132	1.8	1.42	320522.4	103144.1	175837.3	60899.26
III-2	925	132	2.4	1.42	416116.8	133906.4	228280	79062.19
III-3	975	132	2.4	1.42	438609.6	141144.6	240619.5	83335.82
III-4	250	132	2	1.4	92400	29734.32	50690.27	17556
III-5	600	132	2.3	1.42	258667.2	83239.1	141903.8	49146.77
III-6	950	132	2	1.42	356136	114604.6	195374.8	67665.84
III-7	550	132	2.1	1.47	224116.2	72120.59	122949.2	42582.08
	150	132	2	1.42	56232	18095.46		10684.08
	550	132	2.2	1.4	223608	71957.05	122670.4	42485.52
III-8	950	132	1.9	1.42	338329.2	108874.3	185608	64282.56
III-9	550	132	2	1.42	206184	66350.01	113111.7	39174.96
	150	132	2	1.42	56232	18095.46	118767.3	10684.08
	550	132	2.1	1.42	216493.2	69667.51	218982	41133.71
III-10	900	132	2.4	1.4	399168	128452.3	131731.3	75841.92
III-11	550	132	2.25	1.47	240124.5	77272.06		45623.66
	175	132	2.3	1.47	78101.1	25032.93	103788.3	14839.21
	325	132	3	1.47	189189	60881.02	164012	35945.91
III-12	725	132	2.2	1.42	298966.8	96207.52		50803.69
	290	132	2	1.42	76976	24127.28	29273.63	14245.44
	125	132	2.2	1.47	53361	17171.57	180978.7	10138.59
III-13	800	132	2.2	1.42	329894.4	106160		62679.94
	250	132	2.75	1.47	133402.5	42928.92	431620.9	25346.48
III-13A	800	132	1.6	1.42	239923.2	77207.29	138818.9	45585.41
III-14	675	132	2	1.42	253044	81429.56		48078.36
	175	132	2.1	1.47	71309.7	22947.46	172752.4	13548.84
III-15	700	132	2.4	1.42	314899.2	101334.6	128537.8	59830.85
III-16	525	132	2.3	1.47	234303.3	75398.8		44517.63
	150	132	2.4	1.47	69854.4	22479.15	92803.02	13272.34
III-17	475	132	1.9	1.42	169164.6	54437.17	374811.4	32141.27
III-18	1350	132	2.7	1.42	683218.8	219859.8		129811.6
	200	132	2.7	1.42	101217.6	32571.82	156480.9	19231.34
III-19	525	132	2.8	1.47	285288.6	91789.85	98972.75	54195.37
III-20	350	132	2.75	1.42	180411	58056.26	49357.84	34278.09
III-21	200	132	2.4	1.42	89971.2	28952.73	296918.2	17094.53
III-22	1050	132	2.75	1.42	541233	174168.8		102834.3
	175	132	3	1.42	38400	81007.05	239511.5	18807.11
III-23	750	132	3	1.47	436590	140494.7		82952.1
	175	132	3	1.47	101871	32782.09	143068.2	19355.49
III-24	420	132	3.2	1.47	260789.76	83922.14	92020.12	49550.05
III-25	350	125	2.7	1.42	167737.5	53977.93		31870.13
					10567354	3419241	4777496	1767002

TOTAL MINEABLE (MT)
TOTAL EXTRACTABLE (MT)

12.39236
8.19649

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RESERVE OF BAGDEWA UNDERGROUND MINE

Panel No.	Length	Width(m)	Thickness (m)	Sp.Gravity	Reserve	DEV	DEP	Barrier
Drift	600	90						
Main Dip	1350	102	2.0	1.41	388314	124959.4	213027.5	
II-1	125	132	1.6	1.4	36960	11893.73	20276.11	7022.4
II-2	215	132	2.2	1.147	71614.092	23045.41	39287.2	13606.68
II-3	310	132	2.4	1.42	139455.36	44876.73	76504.65	26496.52
II-4	225	132	2.4	1.42	101217.6	32571.82	55527.57	19231.34
II-5	950	132	2.0	1.47	368676	118639.9	202254.2	70048.44
II-6	600	132	2.0	1.45	229680	73911.02	126001.5	43639.2
II-7	600	132	1.6	1.52	192614.4	61983.31	105667.5	36596.74
II-8	175	132	2.0	1.47	67914	21854.73	37257.35	12903.66
	325	132	2.0	1.47	126126	40587.35	69192.22	23963.94
	150	132	2.0	1.47	58212	18732.62		11060.28
II-9	600	132	1.9	1.42	213681.6	68762.74	117224.9	40599.5
II-10	600	132	1.9	1.42	213681.6	68762.74	117224.9	40599.5
II-10A	150	132	2.4	1.45	68904	22173.31	37800.46	13091.76
	150	132	2.4	1.45	68904	22173.31		13091.76
	650	132	2.4	1.45	298584	96084.33	163802	56730.96
II-11	550	132	1.7	1.4	172788	55603.18	94790.8	32829.72
	175	132	2	1.42	65604	21111.37		12464.76
	575	132	2.5	1.47	278932.5	89760.48	153021.2	52997.18
II-12	800	132	2	1.42	299904	96509.11	164526.1	56981.76
					3461767.2	1113997	1793386	583956.1

MINEABLE (MT) 4.044
EXTRACTABLE 2.9094

SEAM	RESERVES (MT)	
	MINEABLE	EXTRACTABLE
SEAM-III T	2.2	1.286
SEAM-III B	12.39	8.19
SEAM- IIA	4.044	2.9

18.63 12.37

CHAPTER-VIII

METHOD OF MINING

8.1 PROPOSED MINE DEVELOPMENT

A. Approach to Seams

The existing approach to the G-III B and G-II A Seam is through two inclines and one return air shaft. Two rising drift has been made from G-III B to G-III T from main incline. One additional air shaft has been provided in this RPR for fulfilling the ventilation requirement of the mine.

B. Trunk Roadways Development

It is proposed to form main trunk roadway in the all the three seams through the center of the property. The central main dip would rationalize the transportation of coal & materials. This would rationalize the ventilation system of the mine with reasonably long panels. The galleries in the seams have been developed superimposed. Staple pits have been provided for better ventilation.

C. Panel Development:

In all the three seams, it is proposed to form panels on either side of the main trunk roadways, wherever possible. The panels have been kept self draining as far as possible taking into consideration the superimposition.

D. Sequence of Development :

Immediately after the development in the main dip has reached the dip most point, development is proposed in the G-III T seam. After development and depillaring of panels in seam G-III T the depillaring in panels of G-III B Seam would commence in the overlying superimposed area and area free of overlying G-III T seam will be depillared simultaneously. The final extraction of the trunk-roadways would be taken up from the dip most side only after final extraction of working panels, on either side of the trunk roadways. After exhaustion of reserves in panels, the standing pillars in these trunk roadways would be depillared. The extraction sequence would be from dip to rise.

E. EXISTING PANELS:

Bagdewa is an operating mine. Presently three districts namely N-8, N-9 and S-9 are being worked in G-III B seam producing 0.62Mty.

N-8-	130mX680m
N-9-	130mX560m
S-9-	130mX1400m

8.1.1 BOARD AND PILLAR:

Mining parameters (B&P)

The various mining parameters envisaged in a panel are:

No. of headings	-	6
Gallery width	-	4.2 m
		(Subject to permission from DGMS)
Development height	-	Full seam thickness up to 3.0 m
Extraction Height	-	Full seam thickness
Depth of proposed workings	-	30-120m (mining area)
	-	
Pillar size	-	26mx26m (centre to centre)
Panel width	-	134.2m
Panel length	-	Ranging 400 to1500m

The geo-mining parameters of mining area have great influence on the choice of mining method. Following are some of the parameters that have been taken in account while making selection of mining methods:-

(a) Workable Seams :-

As mentioned earlier, the Bagdewa mine envisages to exploit three seams viz., G-III top, G-III bottom. & G - II A.

(b) - Surface features :-

The following surface features are present in the proposed mining area:-

- Villages Amarpur (part), Bagdewa, Vijaypur & some basti.
- Kholar nala
- Roads

Due precautions and all relevant statute should be taken in to consideration during exploitation of seams to protect these surface features.

(c) Dip & Strike :-

The seams and the associated coal measures strata exhibit gentle dip of 3° to 4° towards East to SE in North & NE to NNE in South portion.

(d) Dirt Bands :-

Though all the seams considered for exploitation are generally free of bands at places it has bands of less than 30 cm mostly composed of shaly to carb shale.

(e) Roof & Floor:-

The seam wise roof and floor are given in the following table :-

Seam	Roof	Floor
G-III Top	Coarse grained SST to shale and SST at intervals	Fine grained SST, shaly SST argillaceous.
G-III Bottom	Argillaceous	Fine to medium coarse grained SST.
G-IIA	Coarse grained sandstone in North argillaceous	Predominantly argillaceous, shale / sandy shale.

(f) Cavability of immediate roof:-

The immediate roof is generally coarse to medium coarse grained sandstone and the floor consists of sandy shale / carb. shale to sandstone, argillaceous nature. In considerable area, the seams are occurring as contiguous seam which has to be extracted simultaneously.

(g) Depth of coal seam:-

Seam-wise depth range is given as below:-

Seam	Workable Depth range (m)
G-III Top	30-120
G-III Bottom	30-120
G-IIA	35-110

(h) Thickness & grade of coal seam :-

The seam wise thickness & grade are as under:-

	Workable Thickness range (m)	Grade
G-III Top	1.2-2.4	C-A
G-III Bottom	1.2-3.5	A-B
G-IIA	1.2-2.64	C-A

(i) Faults :

Five number of faults have been deciphered in the proposed mine area. Rest of seven faults will be falling outside the present considered area.

(j) Incubation Period :

The incubation period is yet to be determined. However, based on the experience of this coalfield it is considered to be six to nine months.

(k) Gassiness of the Seam :-

The gassiness of all the workable seams have been determined and seams have been classified as Degree-I.

8.2 PROPOSED METHOD OF MINING

Opencast Mining:-

A small quarriable patch North West of approved Bagdewa UG had been planned in a area of 23 Ha. Earlier a scheme was prepared to exploit G-III Bottom & G-II A seam lying in lower cover zone having 1.17 Mt of reserve with stripping ratio of 6 cum/te. The target capacity of OC patch was kept as 0.20 Mty. On detailed exploration one more patch in the southern most geological boundary (falling in Phase-II) was also identified which may be amenable for opencast. This reserve will be exploited in the later stage after completion of underground working.

8.3.1 UNDERGROUND MINING :-

Long wall Mining:-

Considering the various geo-mining characteristics of the deposit, Seam G-III bottom is not amenable for long wall mining because of presence of stone band in coal seam G-III B. Thickness and reserve does not suggest for deployment of capital intensive long wall system.

8.3.2 Bord & Pillar Mining :-

Continuous Miners:-

This system of mining is well established in other countries. SECL is in the process of introducing this technology in many mines. On detailed study of nature of the floors of workable seams at Bagdewa it is found that the nature of floor is argillaceous to arenaceous comprising gray shale, sandy shale and alternate shale and coarse grained sandstone to fine grained sandstone. These strata are generally considered to be inadequate in strength to bear the kinetic thrust / pressure of heavy machines like C.M and plying of shuttle car. The shale normally contains clay which absorbs water and will make the floor unfit for application of such machines. Also a stone band of thickness 30 cm exists in major seam i.e. G-III. This is one of the reasons which do not provide adequate confidence level in selecting continuous miner machines and thereby, Continuous Miner technology is not being envisaged at Bagdewa mine.

LHD:-

Keeping in view the above, this mine is proposed to exploit by Bord & Pillar system of mining deploying LHD as loading machine.

At places where the thickness of seam is less than 2m, extra low height SDL/LHD will be deployed.

8.3.3 Panel Formation / Development**Panel Layout & System of Panel Development:**

It is proposed to develop each panel by driving six headings galleries from main dip trunk roadways, in a similar manner as currently practised in Indian underground coal mines. In a strike panel, the pillar size will be 26m (centre to centre) with gallery width of 4.2m. Uniform pillar size & gallery width have been envisaged in the panels for smooth operation, during development of a panel, height of extraction would be the seam height up to a maximum of 3.0m. The panel layouts would be made as favourable for self draining.

System of Mining:-**Main dip development:-**

Five headings dip panel is proposed with 25.5m x 25.5m pillar and 4.2 m gallery. Full thickness of coal will be extracted. Blasting of solids will be adopted for winning coal. LHD will be used as a loading machine to discharge coal onto gathering/gate belt. Which will discharge coal in G-II A seam whereas trunk belts will be used in G-III bottom seam. The main dip will have full thickness of seam or roof will be heightened up to 2.5m where seam thickness is less than 2.5m.

Production Parameters:-**Panel in G-III Bott. Seam:-**

Height	=	2.5m (average)
Sp. Gravity	=	1.45
Gallery width	=	4.2m
Pull	=	1.0m (av.)
No. of faces	=	13 (maximum)
No. of panels	=	4
No. of blast/shift/panel	=	13
Coal/Blast	=	4.2x2.5x1.0x1.45
	=	15.225 t
No of blast/shift	=	13.5
Coal/panel/shift	=	15.225 x 13.5
	=	205te
Coal / day	=	205x3x4
Say	=	2460 t.

G-III / G-II A Seam:-

No. of face	=	13 (maximum)
Gallery width	=	4.5m
Pull	=	1 m
Sp. gr.	=	1.45
		Full thickness
Height	=	2.0m (av. thickness)
Coal / blast	=	2.0x4.5x1.45x1
	=	13.05 t
No. of blast /shift/panel	=	15-16
Coal per day	=	15.7x 3 x 13.05x4
	=	2460 t
Say	=	2460 t/day.

8.3.4 Proposed System of Depillaring

After development of rise side panels, it shall be effectively sectionalised. The depillaring of these panels would be carried at a later date. The dip most panel will be developed and depillaring will be carried out simultaneously.

The inter-partings between G-III top, G-III bottom and G-II A varies from few meters to 15m. The area lying in contiguity will be developed and depillared simultaneously.

During depillaring operation, each pillar would be divided into two equal rectangular halves by driving a level split gallery having width of 4.5m. The half pillar on dip side is to be sliced first from this split gallery whereas the remaining half pillar on rise side would be extracted from original gallery.

In each half of spitted pillar, number of slices would be three, having width 4.6m, by leaving a rib thickness of 1.8m against Goaf sides. While retreating, rib would be judiciously robbed.

8.3.5. Production from depillaring panel :-

From Split galleries:-

Average seam thickness	-	2.5m
Width of split gallery	-	4.5m
Specific gravity	-	1.45
No. of splits	-	3 (average)
Coal produced per blast (pull per blast – 1m)	-	4.5x2.5x1x1.45
Considering 1 blast shift/split	-	16.31 te
No. of blast/split(3)/panel	=	8
No. of panels	=	4
Coal/panel/shift-split	=	16.31 x 8
Coal per day	-	16.31 x 3 x 8x4
	-	1565.76 te.

Production from slice:-

1.	No. of slices available	-	4 (average)
2.	Width of slice	-	4.6m
3.	Specific gravity	-	1.45
4.	Pull per blast	-	1.0m
	No. of panels	=	4
5.	Coal produced per blast per slice	-	$4.6 \times 2.5 \times 1.0 \times 1.45$
		-	16.675 te
6.	No. of shifts per day	-	3
7.	No. of blast / shift/panel-slice	-	5 (average)
8.	Coal produced per day	-	$16.675 \times 5 \times 3 \times 4$
9.	Coal from Slice	-	1000.5 Te.

Total coals available from each depillaring panel:-

Split production	-	1565.76 Te
Slice production	-	1000.5 Te
Coal produce per day	-	2566.26 te

Considering 96 % recovery,

Coal production from Four depillaring districts = 2460 tpd

In G-II A & G-III Top Seam :-Coal from Split :-

No. of splits	-	3
Av. thickness	-	2m
Sp. gravity	-	1.45
Width of split	-	4.5m
Coal/blast	-	$2 \times 1.45 \times 4.5 \times 1$ (panel)
No. of panels	=	4
Taking 8 blast / shift/panel		
Coal per day	=	$13.05 \times 3 \times 4 \times 8$
		=1252.8 te

Coal from Slices:-

Width of slice	-	4.6m
Thickness	-	2.0m
	-	1.0m
Sp. grade	-	1.45
No. of panels	=	4

No. of slices available-	4 (average)
No. of blast / shift/panel	- 8
Coal / blast	- $4.6 \times 2 \times 1.0 \times 1.45$
	- 13.34 t
Coal / day	- $4 \times 3 \times 13.34 \times 8$
	- 240 t.

The bolting density in junctions would be enhanced by 25%. Timbers will be placed over steel cogs members to adjust the height and use as indicator of roof movement. Anchorage testing for 10% of roof bolt should be carried out at regular intervals to monitor the efficiency of bolting operation. Strata movement monitoring should also be carried out by using convergence recorder at vulnerable places.

8.6 SUPPORT SYSTEM AT SPLIT GALLERY & SLICE:-

In the split gallery, two pillars ahead of pillar under extraction would be supported by using quick setting resin bolts or cement grouted bolts and steel channels as mentioned earlier to facilitate the movements of SDLs.

In slice, support system should be predominantly being of roof bolting. Occasional timber props may be used as indicator prop and by the side of ribs, steel cogs will be used. Goaf edges will be supported by skin to skin cogs. Goaf edges may be supported with two rows of pit props (mild steel) closely spaced at interval of 0.6m.

It is proposed that once the coal in all seams is touched, RMR study is to be carried out for formulating the systematic support rule and it will be continued after certain period of intervals for preparing fresh support plan when the mine workings gradually progress.

SAFETY ASPECTS

Major safety considerations involved in the mining operations are:

A. Spontaneous Heating & Fire

After depillaring, there is a risk of spontaneous heating in the Goaf area. To prevent such risk, it is necessary to avoid any stray air current in the Goaf by sealing off properly all abandoned accesses to a panel, steadily check the atmosphere in the vicinity of the caving zone (carbon monoxide, carbon dioxide, oxygen, methane) by daily samplings and measurements and avoid high levels of head losses in the ventilation circuit. In case of spontaneous heating, a quick sealing procedure (from surface and underground) must be implemented and the required equipment and materials should be ready for use.

Considering that about 20-30% coal will be left in the Goaf, chances of spontaneous heating especially in the depillaring panels is not ruled out. It is desirable that studies may be carried out for spontaneous heating characteristics of the seams. As a precautionary measure, solid barrier between panels has been suggested. Each panel will be connected to the minimum number of airways so that in case of heating, quick sealing off is possible.

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B. Caving and Strata Control

The seams in the mine are at generally low to moderate depth of cover with a maximum depth of around 120 m. Moreover, parting between the seams is also low. The characteristic of roof rock indicates moderate nature and is not likely to pose difficulty in caving.

It is proposed to undertake scientific studies to determine the cavability characteristics & determination of rock & coal strength properties before commencement of depillaring. Even while depillaring operation, it is proposed for suitable studies to ascertain the parting stability. Appropriate method of strata control should be adopted and practiced in the panels. It would be necessary to experiment and adopt a wider and more effective & efficient strata management. It should form the integral part of the method of mining.

C. Scientific Studies

Considering the above, it is proposed for undertaking scientific studies before commencement of panel extraction and for monitoring during and after the panel extraction. The following studies may be undertaken before commencement of the operations.

- Study of parting stability between the seams for minimum safe parting necessary in case of final pillar/panel extraction.
- Investigation /study for incubation period for seams
- Study of cavability characteristics and establishment of optimum panel size.
- Studies to be undertaken for establishment of method of strata management and control during panel extraction.
- Any other studies as found necessary.

It is desirable to have in-house organization & set up as well as engage scientific bodies for monitoring the following:

- Monitoring & study of roof behavior & the strata movement
- Environmental monitoring within and outside the panel under extraction.

CHAPTER-IX

MINING SCHEDULE

9.1 PRODUCTION SCHEDULE

A. Extractable Reserves

Following considerations have been taken into account for estimation of extractable coal reserves in working panels and trunk roadways:

i) Panel layout:

In trunk roadways, 5-headings and 6 headings in the working district have been envisaged. However, some panels have been formed with varying headings owing to disposition of faults and / or block boundary. Presently three no of panels namely N-8, N-9 and S-9 with 7 LHDs and 4 UDMs are operating in the mine.

ii) Working height during development & depillaring :

The B&P panels have been proposed to be developed with full seam thickness (max. thickness 3.0 m). It is proposed that while extraction full seam thickness would be extracted. The gallery width of 4.2m has been considered for reserve estimation in the B&P panel with LHDs & UDMs combination.

iii) Sectionalisation & panel / sub-panel formation :

The formation of sub-panels and sectionalisation of the panels would be done based on the incubation period or other technical requirement. To account for reserves lost in these barriers, average percentage of final extraction has been considered.

iv) Extraction percentage :

The target production from Bagdewa UG mine is proposed to be 2460 TPD and this production can be achieved working four numbers of Strike Panels or three strike panels and two main dip panels. During initial periods of the mine, workings will be concentrated in G III top & bottom seam. G-IIA seam will be depillared where it occurs in contiguity of overlying seam as a simultaneous operation. The production from the development depillaring panel has been considered as 615 tpd deploying 3/2 LHD in G-III bottom seam in each panel. The production from G-II A and G-III T will be considered by deploying low/ extra low height/standard height LHD as per requirement and actual condition encountered during operation. The existing productivity in area has been given due consideration.

It is proposed to depillar the developed panel preferably from the bottom / dip most point of the property. DGMS also insists to follow this sequence of operation. This ensures safety as well as smooth operation of the panel extraction. It is also recommended that as soon as panels are developed it should be extracted to avoid repetition of many operational