सीएमपीडीआई
cmpdi
A Mini Ratna Company

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
CIN: U40100GJ1993SGC019988

MINING PLAN & MINE CLOSURE PLAN
FOR
GARE PALMA SECTOR-I COAL BLOCK

(Block Area – 57.39 Sq. Km)

MAND RAIGARH COALFIELD

DIST: RAIGARH
STATE: CHHATTISGARH

GUJRAT STATE ELECTRICITY CORPORATION LTD.

Office of the Chief Engineer (Fuel)
Vidyut Bhavan, Race Course, Vadodara,
Gujrat-390007

(Mining Plan is being prepared for the 1st time)

Opencast Mine, target capacity – 15 Mty
Underground Mine, target capacity - 6Mty

Date of preparation
21.12.2016

Mining Plan prepared by
Arun Kumar Bal
RQP No. 34011/(22)/2005-CPAM
CMPDI, HQ, Ranchi-834008

21/12/16
ARUN KUMAR BAL
RQP u/s 22 (C), MCR, 1961
Vide No. 34011/(22)/2005-CPAM
Dated 21.02.17

VOLUME-I
(Text and Plates in A3)

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LIST OF ABBREVIATION

Abbrn.	Expanded form	Abbrn.	Expanded form
ACGIH	American Conference of Governmental Industrial Hygienists	Mcum	Million Cubic Metre
BHs/bhs	Boreholes		
BOD	Bio-Chemical Oxygen Demand	MDO	Mine Developer and Operator
CGPCL	Chhattigarh Power Corporation Limited	MECL	Mineral Exploration Limited
CHP	Coal Handling Plant	MGD	Million Gallon per Day
CMDCL	Chhattisgarh Mineral Development Corporation Limited	MoC	Ministry of Coal
CMPDI	Central Mine Planning and Design Institute	MoEF	Ministry of Environment and Forest
CMR	Coal Mine Regulation	MSL	Mean Sea Level
CPCB	Central Pollution Control Board	Mt	Million Tonne
CT	Current Transformer	Mtpa/MTPA	Million Tonnes per Annum
dB	Decibel	Mty	Million Tonnes per Year
DGMS	Director General of Mine safety	MUV	Multi Steered Vehicle
E&M	Electrical & Mechanical	MVA	Mega Volt Ampere
e.o.t/ E.O.T	Electric Overhead Travelling	OC	Opencast
Env.	Environment	OCP	Open Cast Project
FSV	Free Steered Vehicle	PAF	Project Affected Family
GCV	Gross Calorific value	PGT	Performance Guarantee Test
GEB	Gujrat Electricity Board	PT	Potential Transformer
GoG	Government of Gujrat	ROM	Run Off Mine
GSECL	Gujrat State Electricity Corporation Limited	RPM	Respiratory Particulate Matter
GSI	Geological Survey of India	RQP	Recognised Qualified Person
GUVNL	Gujrat Urja Vikas Nigam Limited	SECL	South Eastern Coalfields
Ha/ha	Hectare	SMS	Site Mix Slurry
HEMM	Heavy earth Moving Machinery	SPM	Suspended Particulate Matter
HPSV	High Pressure Sodium Vapour	tph	Tonnes per hour
ISO	Indian Standard Organisation	TSS	Total Suspended Solid
		UG	Underground
Kcal	Kilo Calorie	UHV	Ultimate Heat Value
Kg	Kilogram	UVM	Ultimate Heat Value
Km	Kilometre		
kV	Kilo Volt	VCB	Vacuum Circuit Breaker
LHD	Load Haul and Dump	VM	Volatile Mater
m^2	Square metre	WPI	Wholesale Price index
MCR	Mineral concession rule	Wt	Weight

B. DOCUMENTS / ANNEXURES

Annexure-I

COPY OF THE ALLOTMENT

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: **Gare Palma Sector – I Coal Mine** (the "mine") particulars of which is specified in **Annexure 1**

Order no.: 103/27/2015/NA

Date: September 14, 2015

In favour of: **Gujarat State Electricity Corporation Limited** incorporated in India under the Companies Act, 1956 with corporate identity number U40100GJ1993SGC019988, whose registered office is at Vidyut Bhavan, Race Course, Vadodra, Gujarat-390007, India (the "Allottee").

For utilisation in: End Use Plants situated at 1) Taluka Fort Songadh, District Tapi, Gujarat 2) District Gandhinagar, Gujarat 3) Taluka Thasara, District Kheda, Gujarat 4) District Jamnagar, Gujarat 5) Dhuvaran – District Anand, Gujarat and 6) Sinor- District Vadodara, Gujarat, as more particularly described below (the "End Use Plant")

S. No.	Name of Specified End Use Plant	Address	Configuration	Capacity
1	Ukai Thermal Power Plant (Unit 1 to 6)	Taluka Fort Songadh, District Tapi, Gujarat	2x 120 MW 2x 200 MW 1x 210 MW 1x 500 MW	1350 MW
2	Gandhi Nagar Thermal Power Plant (Unit 1 to 5)	District Gandhinagar, Gujarat	2x 120 MW 3x 210 MW	870 MW
3	Wanakbori Thermal Power Plant (Unit 1 to 7)	Taluka Thasara, District Kheda, Gujarat	7 x 210 MW	1470 MW
4	Sikka Thermal Power Plant	District		

GSECL

Received

ORDER

S. No.	Name of Specified End Use Plant	Address	Configuration	Capacity
	(Unit 1 & 2) (Unit 3 & 4)	Jamnagar, Gujarat	2 x 120 MW 2 x 250 MW	740 MW
5	Wanakbori Thermal Power Plant (Unit 8)	Taluka Thasara, District Kheda, Gujarat	1 x 800 MW	800 MW
6	Dhuvaran Thermal Power Plant (Unit 1 & 2)	Dhuvaran - District Anand, Gujarat	2 x 800 MW	1600 MW
7	Sinor Thermal Power Plant (Unit 2)	Sinor- District Vadodara, Guiarat	1 x 800 MW	800 MW

**MW stands for Mega Watt*

WHEREAS, the nominated authority has, in accordance with the provisions the Coal Mines (Special Provisions) Act, 2015 (the "Act") and the Coal Mines (Special Provisions) Rules 2014 (the "rules") conducted the allotment of the relevant Schedule I coal mine;

AND WHEREAS the allottee is eligible to receive this allotment order with respect to the mine, 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

(b) any existing mine infrastructure as defined in clause (j) of sub-section (1) of section 3 of the Act;

AND WHEREAS the allottee has furnished performance bank guarantees dated a) April 22, 2015 for an amount equal to INR 2,00,00,00,000 (Indian Rupees Two Hundred Crore) issued by Indian Overseas Bank and b) April 23, 2015 for an amount equal to INR 97,00,00,000 (Indian Rupees Ninety Seven Crore) issued by State Bank of India in accordance with the allotment document and in accordance with the provisions of sub-section (6) and sub-section (12) of section 8 of the Act;

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 September 14, 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 and interest of the prior allottee in and over the land and mine infrastructure free from all encumbrances;

(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) any subsisting contract in relation to coal mining operations, to which the prior allottee was a party and which is assumed, adopted and continued by the Allottee and listed in the **Annexure 5** shall stand novated (by virtue of a deemed consent from the relevant party(ies)), in accordance with the provisions of sub-section (1) of section 11 of the Act in favour of the allottee for the residual term or residual performance of such contract;

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. Hereinafter, the Allottee shall be entitled to take possession of the mine as specified in Annexure-1 without let or hindrance;

3. This allotment order is liable to be cancelled in accordance with the provisions of sub-rule (6) of rule 13.

Govt. of India, Min Coal, Nominated Authority

Vivek Bharadwaj

(By the nominated authority)

Annexures

Annexure 1: Particulars of the mine

Part A – Description of the mine

Name of Coal Mine	Gare Palma Sector I
Latitude	22°04'00" N to 22°08'48.9" N
Longitude	83°25'24.15" E to 83°33'55.97" E
Coalfield	Mand Raigarh
Villages	Kuruslenga, Prinja, Ravanpara, Amgaon, Taparannga, Dhaurabhanta, Libra, Jhikabahal, Horapida, Tomnas, Fusurguda, Bhudia, Baghbari, Mahloi, Jhangaon, Patrapara, Raypara, Jharna
District	Raigarh
State	Chhattisgarh

Part B – Description of Land in relation to the mine

Not applicable

Part C – Description of Mine Infrastructure in relation to the mine

Not applicable

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

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

Annexure 4: Particulars of statutory licences, permits, permissions, approvals or consents issued by the State Government to be obtained on application by the Allottee.

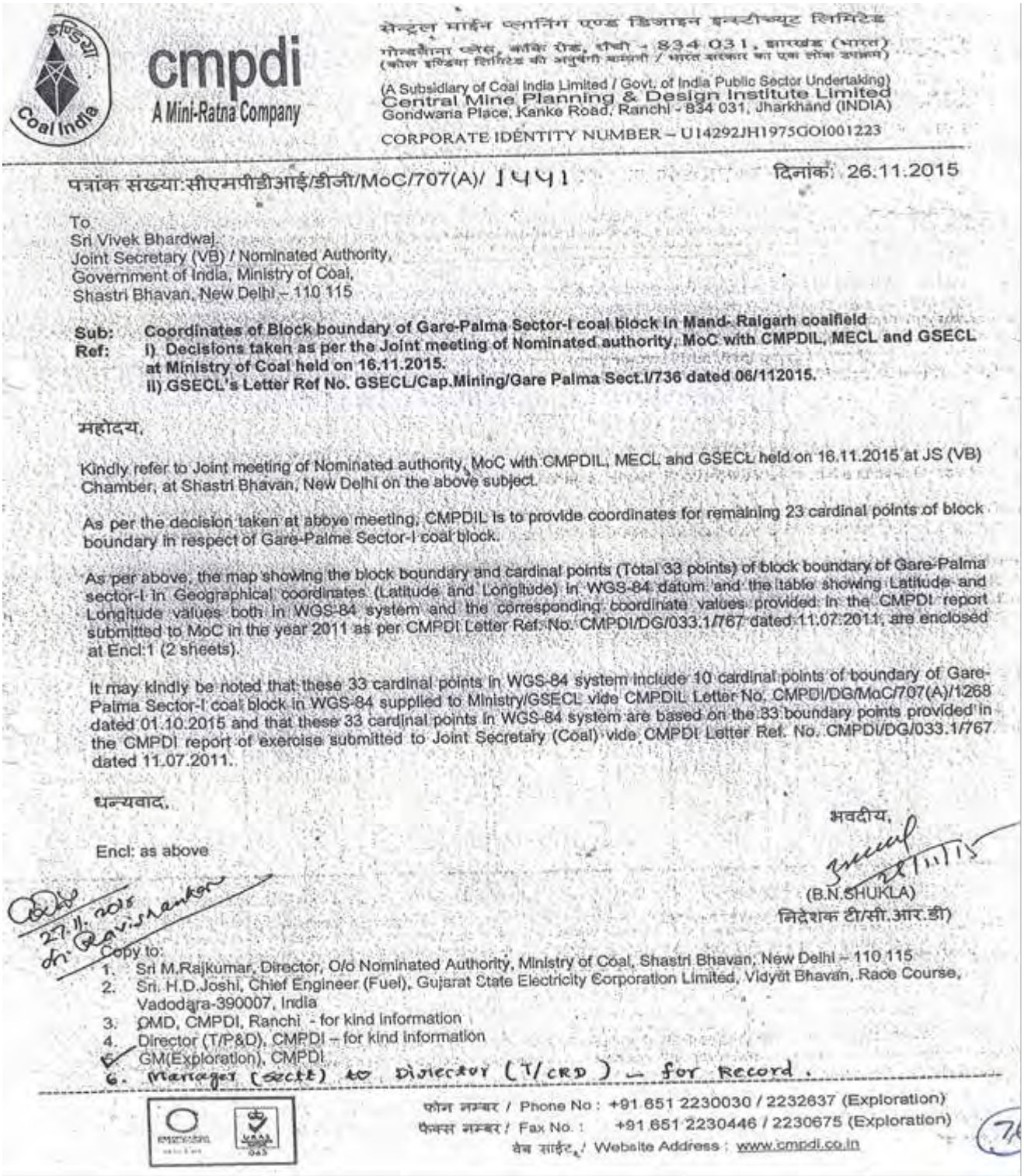
Not applicable

Annexure 5: Particulars of the contracts adopted by the Allottee.

The Allottee does not intend to adopt and continue with any of the contracts of the Prior Allottee.

Annexure-I (A)

CO-ORDINATES OF THE GARE PALMA SECTOR-I COAL BLOCK



सेन्ट्रल माईन प्लानिंग एण्ड डिजाइन इन्स्टीच्यूट लिमिटेड
गोण्डवाना प्लेस, कांके रोड, राँची - 834 031, झारखंड (भारत)
(कोल इण्डिया लिमिटेड की अनुषंगी कम्पनी / भारत सरकार का एक लोक उपक्रम)

cmpdi
A Mini-Ratna Company

(A Subsidiary of Coal India Limited / Govt. of India Public Sector Undertaking)
Central Mine Planning & Design Institute Limited
Gondwana Place, Kanke Road, Ranchi - 834 031, Jharkhand (INDIA)
CORPORATE IDENTITY NUMBER – U14292JH1975GOI001223

पत्रांक संख्या:सीएमपीडीआई/डीजी/MoC/707(A)/ 1441 दिनांक: 26.11.2015

To
Sri Vivek Bhardwaj,
Joint Secretary (VB) / Nominated Authority,
Government of India, Ministry of Coal,
Shastri Bhavan, New Delhi – 110 115

Sub: Coordinates of Block boundary of Gare-Palma Sector-I coal block in Mand- Raigarh coalfield
Ref: i) Decisions taken as per the Joint meeting of Nominated authority, MoC with CMPDIL, MECL and GSECL at Ministry of Coal held on 16.11.2015.
ii) GSECL's Letter Ref No. GSECL/Cap.Mining/Gare Palma Sect.I/736 dated 06/112015.

महोदय,

Kindly refer to Joint meeting of Nominated authority, MoC with CMPDIL, MECL and GSECL held on 16.11.2015 at JS (VB) Chamber, at Shastri Bhavan, New Delhi on the above subject.

As per the decision taken at above meeting, CMPDIL is to provide coordinates for remaining 23 cardinal points of block boundary in respect of Gare-Palma Sector-I coal block.

As per above, the map showing the block boundary and cardinal points (Total 33 points) of block boundary of Gare-Palma sector-I in Geographical coordinates (Latitude and Longitude) in WGS-84 datum and the table showing Latitude and Longitude values both in WGS-84 system and the corresponding coordinate values provided in the CMPDI report submitted to MoC in the year 2011 as per CMPDI Letter Ref. No. CMPDI/DG/033.1/767 dated 11.07.2011, are enclosed at Encl:1 (2 sheets).

It may kindly be noted that these 33 cardinal points in WGS-84 system include 10 cardinal points of boundary of Gare-Palma Sector-I coal block in WGS-84 supplied to Ministry/GSECL vide CMPDIL Letter No. CMPDI/DG/MoC/707(A)/1268 dated 01.10.2015 and that these 33 cardinal points in WGS-84 system are based on the 33 boundary points provided in the CMPDI report of exercise submitted to Joint Secretary (Coal) vide CMPDI Letter Ref. No. CMPDI/DG/033.1/767 dated 11.07.2011.

धन्यवाद,

Encl: as above

भवदीय,

(B.N.SHUKLA)
निदेशक टी/सी.आर.डी)

27.11.2015 Dr. Ravishankar

Copy to:
1. Sri M.Rajkumar, Director, O/o Nominated Authority, Ministry of Coal, Shastri Bhavan, New Delhi – 110 115
2. Sri. H.D.Joshi, Chief Engineer (Fuel), Gujarat State Electricity Corporation Limited, Vidyut Bhavan, Race Course, Vadodara-390007, India
3. CMD, CMPDI, Ranchi - for kind information
4. Director (T/P&D), CMPDI – for kind information
5. GM(Exploration), CMPDI
6. Manager (Sectt) to Director (T/CRD) – for Record.

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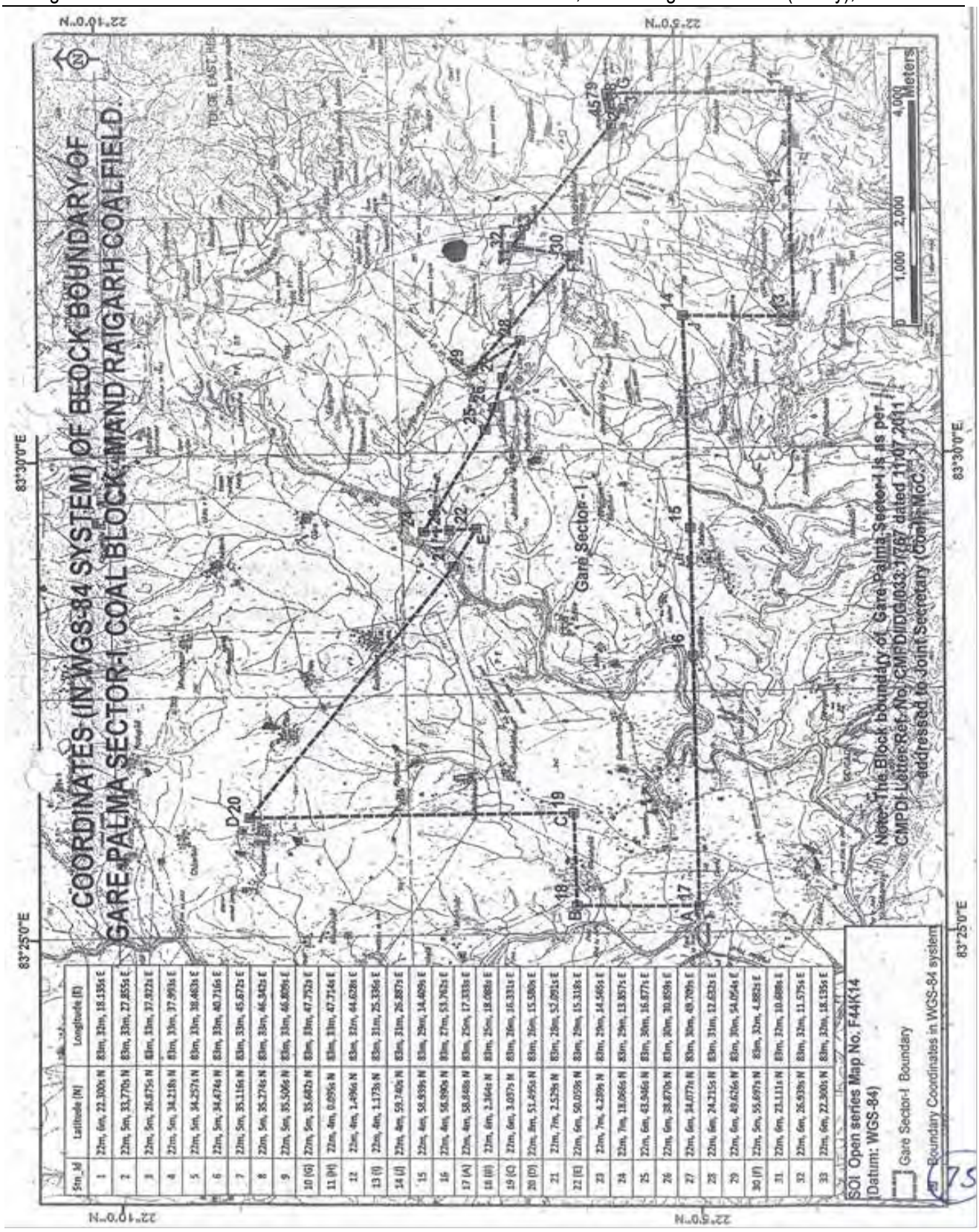


Stn_Id	Latitude (N)	Longitude (E)
1	22m, 6m, 22.300s N	83m, 32m, 18.135s E
2	22m, 5m, 33.770s N	83m, 33m, 27.855s E
3	22m, 5m, 26.875s N	83m, 33m, 37.922s E
4	22m, 5m, 34.218s N	83m, 33m, 37.993s E
5	22m, 5m, 34.257s N	83m, 33m, 38.463s E
6	22m, 5m, 34.474s N	83m, 33m, 40.716s E
7	23m, 5m, 35.116s N	83m, 33m, 45.872s E
8	22m, 5m, 35.274s N	83m, 33m, 46.342s E
9	22m, 5m, 35.506s N	83m, 33m, 46.809s E
10 (G)	22m, 5m, 35.682s N	83m, 33m, 47.792s E
11 (H)	22m, 4m, 0.095s N	83m, 33m, 47.714s E
12	23m, 4m, 1.496s N	83m, 32m, 44.628s E
13 (I)	22m, 4m, 1.173s N	83m, 31m, 25.336s E
14 (J)	22m, 4m, 59.740s N	83m, 31m, 26.887s E
15	22m, 4m, 58.939s N	83m, 29m, 14.409s E
16	23m, 4m, 58.980s N	83m, 27m, 53.762s E
17 (A)	22m, 4m, 58.868s N	83m, 25m, 17.333s E
18 (B)	22m, 6m, 2.364s N	83m, 25m, 18.088s E
19 (C)	22m, 6m, 3.037s N	83m, 26m, 16.331s E
20 (D)	22m, 8m, 51.495s N	83m, 26m, 15.580s E
21	22m, 7m, 2.529s N	83m, 28m, 52.091s E
22 (E)	22m, 6m, 50.059s N	83m, 29m, 15.318s E
23	22m, 7m, 4.289s N	83m, 29m, 14.565s E
24	22m, 7m, 18.066s N	83m, 29m, 13.857s E
25	22m, 6m, 43.846s N	83m, 30m, 16.877s E
26	22m, 6m, 38.870s N	83m, 30m, 30.859s E
27	22m, 6m, 34.077s N	83m, 30m, 43.709s E
28	22m, 6m, 24.215s N	83m, 31m, 12.632s E
29	22m, 6m, 49.426s N	83m, 30m, 54.054s E
30 (F)	22m, 5m, 55.697s N	83m, 32m, 4.882s E
31	22m, 6m, 23.111s N	83m, 32m, 10.889s E
32	23m, 6m, 26.938s N	83m, 32m, 11.575s E
33	22m, 6m, 22.300s N	83m, 32m, 18.135s E

GEOGRAPHICAL COORDINATES OF BLOCK BOUNDARY OF GARE PALMA SECTOR-I COAL BLOCK IN BOTH SYSTEMS:
I) BASED ON 2011 EXERCISE USING OLD SOI MAP (IN MOD. EVEREST SYSTEM) - Ref: CMPDI letter No. CMPDI/DG/033.1/767 dt. 11.07.2011
2) BASED ON WGS 84 SYSTEM SUBMITTED TO MoC IN 2015 - Ref: CMPDI/DG/MoC/707(A)/1268 dated 01.10.2015

As per 2011 CMPDI exercise Report	As supplied to MoC in 2015 (in WGS84)	New ID	GEOGRAPHICAL Coordinates (In WGS84 System) - submitted to MoC vide CMPDI Letter Ref. CMPDI/DG/MoC/707(A)/1268 dated 01.10.2015		GEOGRAPHICAL Coordinates (In Mod. Everest System) - As per report submitted to MoC vide CMPDI letter No. CMPDI/DG/033.1/767 dt. 11.07.2011	
ID	ID	Stn_Id	Latitude (N)	Longitude (E)	Latitude (N)	Longitude (E)
1		1	22m, 6m, 22.300s N	83m, 32m, 18.135s E	22d ,6m ,20.413s N	83d ,32m ,24.609s E
2		2	22m, 5m, 33.770s N	83m, 33m, 27.855s E	22d ,5m ,31.882s N	83d ,33m ,34.339s E
3		3	22m, 5m, 26.875s N	83m, 33m, 37.922s E	22d ,5m ,24.987s N	83d ,33m ,44.407s E
4		4	22m, 5m, 34.218s N	83m, 33m, 37.993s E	22d ,5m ,32.331s N	83d ,33m ,44.478s E
5		5	22m, 5m, 34.257s N	83m, 33m, 38.463s E	22d ,5m ,32.369s N	83d ,33m ,44.948s E
6		6	22m, 5m, 34.474s N	83m, 33m, 40.716s E	22d ,5m ,32.587s N	83d ,33m ,47.202s E
7		7	22m, 5m, 35.116s N	83m, 33m, 45.672s E	22d ,5m ,33.228s N	83d ,33m ,52.158s E
8		8	22m, 5m, 35.274s N	83m, 33m, 46.342s E	22d ,5m ,33.386s N	83d ,33m ,52.829s E
9		9	22m, 5m, 35.506s N	83m, 33m, 46.809s E	22d ,5m ,33.618s N	83d ,33m ,53.296s E
10	G	10 (G)	22m, 5m, 35.682s N	83m, 33m, 47.752s E	22d ,5m ,33.794s N	83d ,33m ,54.239s E
11	H	11 (H)	22m, 4m, 0.095s N	83m, 33m, 47.714s E	22d ,3m ,58.208s N	83d ,33m ,54.199s E
12		12	22m, 4m, 1.496s N	83m, 32m, 44.628s E	22d ,3m ,59.61s N	83d ,32m ,51.104s E
13	I	13 (I)	22m, 4m, 1.173s N	83m, 31m, 25.336s E	22d ,3m ,59.288s N	83d ,31m ,31.801s E
14	J	14 (J)	22m, 4m, 59.740s N	83m, 31m, 26.887s E	22d ,4m ,57.854s N	83d ,31m ,33.352s E
15		15	22m, 4m, 58.939s N	83m, 29m, 14.409s E	22d ,4m ,57.055s N	83d ,29m ,20.855s E
16		16	22m, 4m, 58.990s N	83m, 27m, 53.762s E	22d ,4m ,57.107s N	83d ,28m ,0.196s E
17	A	17 (A)	22m, 4m, 58.848s N	83m, 25m, 17.333s E	22d ,4m ,56.966s N	83d ,25m ,23.743s E
18	B	18 (B)	22m, 6m, 2.364s N	83m, 25m, 18.088s E	22d ,6m ,0.482s N	83d ,25m ,24.499s E
19	C	19 (C)	22m, 6m, 3.037s N	83m, 26m, 16.331s E	22d ,6m ,1.154s N	83d ,26m ,22.751s E
20	D	20 (D)	22m, 8m, 51.495s N	83m, 26m, 15.580s E	22d ,8m ,49.611s N	83d ,26m ,22.002s E
21		21	22m, 7m, 2.529s N	83m, 28m, 52.091s E	22d ,7m ,0.644s N	83d ,28m ,58.534s E
22	E	22 (E)	22m, 6m, 50.059s N	83m, 29m, 15.318s E	22d ,6m ,48.174s N	83d ,29m ,21.765s E
23		23	22m, 7m, 4.289s N	83m, 29m, 14.565s E	22d ,7m ,2.403s N	83d ,29m ,21.012s E
24		24	22m, 7m, 18.066s N	83m, 29m, 13.857s E	22d ,7m ,16.18s N	83d ,29m ,20.304s E
25		25	22m, 6m, 43.946s N	83m, 30m, 16.877s E	22d ,6m ,42.06s N	83d ,30m ,23.333s E
26		26	22m, 6m, 38.870s N	83m, 30m, 30.859s E	22d ,6m ,36.984s N	83d ,30m ,37.317s E
27		27	22m, 6m, 34.077s N	83m, 30m, 49.709s E	22d ,6m ,32.191s N	83d ,30m ,56.17s E
28		28	22m, 6m, 24.215s N	83m, 31m, 12.632s E	22d ,6m ,22.329s N	83d ,31m ,19.096s E
29		29	22m, 6m, 49.626s N	83m, 30m, 54.054s E	22d ,6m ,47.739s N	83d ,31m ,0.516s E
30	F	30 (F)	22m, 5m, 55.697s N	83m, 32m, 4.882s E	22d ,5m ,53.811s N	83d ,32m ,11.354s E
31		31	22m, 6m, 23.111s N	83m, 32m, 10.688s E	22d ,6m ,21.223s N	83d ,32m ,17.161s E
32		32	22m, 6m, 26.939s N	83m, 32m, 11.575s E	22d ,6m ,25.052s N	83d ,32m ,18.048s E
33		33	22m, 6m, 22.300s N	83m, 32m, 18.135s E	22d ,6m ,20.413s N	83d ,32m ,24.609s E

Annexure-II

COPIES OF EARLIER APPROVED MINING PLAN

Mining Plan of Gare Palma Sector-I Coal Block is being prepared for the first time and therefore, there is no previous approved Mining Plan.

Annexure-III

COPY OF MOC'S LETTER GRANTING RECOGNITION TO RQP

By Registered Post.

No. 34011/(22)/2005-CPAM
Government of India
Ministry of Coal
Shastri Bhavan

TS/399
17/3

New Delhi, 20th February 2007.

To
Chairman-cum-Managing Director,
Central Mine Planning & Design Institute,
Gondwana Place,
Kanke Road,
Ranchi-834012 (Jharkhand).

Subject **Grant of recognition to 3 technically qualified executives of CMPDI as competent person to prepare Mining Plan for Coal/Lignite block(s).**

Sir,

I am directed to refer to CMPDIL's letter No.CMPDI:TS/2007/41.01/09 dated 4.1.2007 on the above mentioned subject and to convey approval of the Central Government to the grant of recognition in favour of 3 technically qualified executives of CMPDI (i) Shri Arun Kumar Bal, (ii) Shri Nikhil Ranjan Haldar and (iii) Shri Raj Kapur Meena) **as competent person to prepare Mining Plan for the assignment/jobs undertaken only by CMPDI under Rule 22© of Mineral Concession Rule, 1960 from the date of issue of this letter.**

2. Your attention is also invited to this Ministry's letter No. 34011/(4)/2004-CPAM dated 4.5.2005 (copy enclosed) for information and compliance.

Yours faithfully,

(Sandeep Gupta)
Under Secretary to the Govt. of India
Phone No. 23389132

BY REGD POST

No.34011/4/2004-CPAM
Government of India
Ministry of Coal

Shastri Bhavan, New Delhi, the 26th October, 2005.

To

Shri A.K. F Haque,
Milk Scheme Co. Op. Housing Society,
Near G.P.O. Square
206, Civil Lines,
Nagpur – 440 001

Subject	Guidelines for Recognized Qualified Persons for preparing Mining Plan under Rule 22© of Mineral Concession Rule, 1960.

Sir,

I am directed to refer to your letter dated 16.5.2005 on the above subject and to say that it has been decided that the additional area beyond the block boundary may be considered in a mining plan subject to condition that proper justification is given in the mining plan, and that the annexed area is non-coal bearing and does not infringe upon any already allotted or identified coal/lignite block(s).

Yours faithfully,

(Sandeep Gupta)
Under Secretary to the Govt. of India.

Copy to:-

1	Dr. Biswajit Paul, J.C. Mallick Road, Bear Bethel House, Hirapur, Dhanbad-826001 (Jharkhand).
2	Shri K.A. Sinha, Flat No.7455, D-7, Vasant Kunj, New Delhi - 110 070
3	Shri M.S. Mathur, N-3, Plot No. 217, IRC Village, Nayapalli, Bhubaneswar – 751015
4	Shri Dharni Dher Sahay, Consultant, Mining & Environment, Ranibagan, P.O. R.M.C.H., Ranchi-834009 (Jharkhand).
5	Shri P.P. Unny, Unnikandath House, Ambet Road, P.O. Chittur - Palakkad, KERALA-678 101.
6	Shri M.K. Sinha, 706, Residency Estate, Modi Compound, H.B. Road, Ranchi (Jharkhand).
7	Shri G.C. Mrig, 898, Sector-14, Gurgaon-122 001 (Haryana).
8	Dr. R. Srikanth, Chief (Q.Ry. E), Tata Steel, West Bokaro Division, P.O. Ghatotand, District Hazaribagh (Jharkhand).
9	Shri K.B. Trehan, R-2A, Windsor Court, DLF City, Phase-IV, Gurgaon – 122002 (Haryana).
10	Shri R.B. Mathur, 2474, D-2, Vasant Kunj, New Delhi-110070.
11	Shri V.K. Singh, Hill Top, Chandwe Mohalla, Kanke Road, Ranchi - 834008 (Jharkhand)
12	Shri A.P. Malik, House No.611, Sector-14, Gurgaon-122001 (Haryana).
13	Shhri R.L. Bhati, Deputy General Manager (Mines), Gujarat Mineral & Industrial Consultancy Services Ltd., Khanij Bhavan, 6th floor, "A" Tower, 132 - Ring Road, Near University Ground, Vastrapur, Ahmedabad-380052.
14	Shri Subhash Chandra Chatterjee, Street No.1, Hindustan Park, P.O. Asansol-713304, Distt. Burdwan (West Bengal)
15	Shri. M.S. Reddy, General Manager (Planning) SCCL, Koghagudam Collieries, Khammam Distt. (A.P.)
16	Shri R.S. Mantri, Additional General Manager (Projects & Planning) SCCL, Kothagudam Collieries, Khammam Distt. A.P.
17	Shri B.D. Sharma, Min Mec Consultancy Pvt. Ltd., 121-Paryavaran Complex, IGNOU Road, New Delhi - 110030. Phone No (s). 29532236, 29534777, 29535891
18	Shri Abdul Kalam 10/5, Sarvapriya Vihar, First Floor, New Delhi-110016.
19	Shri Udaya Kumar Mohanty, 1903 – Ratnakar Bagh-2, Tankapani Road, Bhubaneshwar-751 002.
20	Shri G. Radhajkrishnan*, 173-A-2 D.N. Apartment, South Park Road, Ambattur O.T. Chennai 600053 (Tamilnadu) *(Restricted to Opencast Mining Plan(s) only).
21	Shri Ashok Mehta, B-9/2, Vasant Vihar, New Delhi - 110 057
22	Shri Shri M.P. Jain, 87-GF, Sadiqabad Colony, P.O. N.A.D.T. Nagpur-440029
23	Dr. Man Mohan Seam, 289, S.F.S. Flats Ashok Vihar-IV, Delhi – 110052
24	Shri V.K. Machharial ,C-2, Kanchan-Malini Apartments, Kinkhede Layout, Amravati Road, Bharat Nagar, Nagpur-440033 (Tel: No.0712-2554386)
25	Shri K.P. Varma, H-69, Argora Housing Colony, Argora Chowk, Ranchi - 834012 (Jharkhand). Phone No.0651-2242160
26	Shri R. M. Purekar, 203/6, "Vaibhav", Cement Road, Shivaji Nagar, Nagpur - 440 0410 (Phone No.0712-2543883)
27	Shri John Mathai, 204, Friends Colony, Katol Road, Nagpur-440 013 (Phone No.0712-2571399)
28	Shri R.S. Singh, GM's Office, TATA STEEL, P.O. Jamodoba, Distt. Dhanbad-828 112 (Jharkhand
29	Shri K.S. Anandan, H-3, J.N. Salai, Block-24, Neyveli-607 801 (Tamil Nadu).
30	Shri Jagdish Prasad Singh, 303, Rajasthali Palace, Kanke Road, Ranchi-834 008 (Jharkhand)
31	Bhaskar Dev Rudra, Radium Road, Ranchi - 834001 (Jharkhand)

New folder (recognition of qualified person to prepare mining plan)

Annexure-IV

LETTER OF AUTHORISATION BY THE BLOCK ALLOTTEE/APPLICANT TO THE RQP FOR PREPARATION OF MINING PLAN

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VidyutBhavan,RaceCourse,Vadodara,India –390007.Ph. : 91-265-6612341, Fax: 91-265-23 55195
e-mail: cefuel.gseci@gebmail.com Website: www.gsecl.in
CIN: U40100GJ1993SOC019988

Annexure-IV

Certificate

To,
Shri Arun Kumar Bal
Chief Manager, OC Division
Central Mine Planning & Design Institute.
Gondwana place, Kanke Road.
Ranchi. (Jharkhand) 834008.
RQP NO. 34011/(22)/2005-CPAM dated: 20.02.17

Sub :- **Authorization as Recognized Qualified Person for Preparation of Mining Plan &Mine Closure Plan for Gare Palma Sector-I Opencast & Underground mine, MandRaigarh Coalfields, Chhattisgarh.**

Dear Sir,

We hereby authorize you as Recognized Qualified Person for preparation, discussion if any, required for the purpose of approval of Mining Plan &Mine Closure Plan for **Gare Palma Sector-I Opencast & Underground mine, MandRaigarh Coalfields, Chhattisgarh of Gujrat State Electricity Corporation Ltd. (GSECL).**

Place:- VADODARA
Date:- 22/11/2016.

(H. D. Joshi)
Chief Engineer (Fuel)
Gujarat State Electricity Corporation Ltd.

GSECL

CHIEF ENGINEER (Fuel)
Gujarat State Electricity Corporation
Vidyut Bhavan, Race Course,
Vadodara - 390 007

Annexure-V

A CERTIFICATE BY THE RQP THAT HE HAS BEEN DULY AUTHORISED BY THE MINING COMPANY TO PREPARE MINING PLAN 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 HAVE BEEN CONSIDERED WHILE PREPARING THE MINING PLAN

सेन्ट्रल माईन प्लानिंग एण्ड डिजाइन इन्स्टीच्यूट लिमिटेड
(कोल इण्डिया लिमिटेड की अनुषंगी कम्पनी / भारत सरकार का एक मिनि रत्नम)
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 (CIN): U14292JH1975GOI001223

CERTIFICATE BY RQP

ANNEXURE-V

I, Arun Kumar Bal do hereby certify that I have been duly authorised by Gujrat State Electricity Corporation Limited (GSECL) as Recognised Qualified Person for preparation of Mining Plan and Mine Closure Plan for Gare Palma Sector-I Opencast and Underground Mines, Mand Raigarh Coalfield, Chhattisgarh on their behalf.

I am having a valid recognition vide registration no. 34011/(22)/2005-CPAM dated 20.02.07, from MoC, under MCR, 1960 to prepare the Mining Plan and that provisions of all relevant rules and regulations there under have been observed in the preparation of the Mining Plan & Mine Closure Plan.

The Mining Plan & Mine Closure Plan has been prepared, considering the guidelines pertaining to Mining Plan & Mine Closure Plan issued by MoC, GOI and whatever specific permission will be required, the applicant will approach the concerned authority.

Arun Kumar Bal
Chief Manager (OC Division)
Central Mine Planning and Design Institute
Gondwana Place, Kanke Road
Ranchi-834008
RQP. NO. 34011/(22)/2005-CPAM dt: 20.02.07

Place: Ranchi
Date: 20/12/2016

फोन नम्बर / Phone No : +91 651 2230456
फैक्स नम्बर / Fax No. : +91 651 2230456,+91 651 2231447
वेब साईट / Website Address : www.cmpdi.co.in

Annexure-VI

CERTIFICATE FROM EMPOWERED REPRESENTATIVE OF/OR BLOCK ALLOTTEE/APPLICANT THAT THE 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.

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VidyutBhavan,RaceCourse,Vadodara,India –390007.Ph. : 91-265-6612341, Fax: 91-265-23 55195
e-mail: cefuel.gseci@gebmail.com Website: www.gseci.in
CIN: U40100GJ1993SGC019988

Annexure-VI

Certificate

It is certified that the Gare Palma Sector-I Coal Mine will be developed as per the approval of Mining Plan& Mine Closure Plan from Ministry of Coal and all other approvals, as required will be obtained from relevant authorities.

Place:- VADODARA
Date:- 22/11/2016.

(H. D. Joshi)
Chief Engineer (Fuel)
Gujarat State Electricity Corporation Ltd.

CHIEF ENGINEER (Fuel)
Gujarat State Electricity Corporation Ltd.
Vidyut Bhavan, Race Course,
Vadodara - 390 007

Annexure-VII

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 OR LIGNITE BLOCK.

सेन्ट्रल माईन प्लानिंग एण्ड डिजाइन इन्स्टीच्यूट लिमिटेड
(कोल इण्डिया लिमिटेड की अनुषंगी कम्पनी / भारत सरकार का एक लोक उपक्रम)
गोन्डवाना 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 (CIN): U14292JH1975GOI001223

CONFIRMATION OF THE RQP THAT THE MINING PLAN DOES NOT ENCROACH IN ANY OTHER BLOCK

ANNEXURE-VII

I, Arun Kumar Bal, duly authorised by Gujrat State Electricity Corporation Limited (GSECL) as Recognised Qualified Person for preparation of Mining Plan and Mine Closure Plan for Gare Palma Sector-I Opencast and Underground Mines, Mand Raigarh Coalfield, Chhattisgarh on their behalf, have verified the block area with relevant plans supplied by CMPDI and area covered by the Mining Plan does not encroach into any other coal/Lignite Block.

Arun Kumar Bal
Chief Manager (OC Division)
Central Mine Planning and Design Institute
Gondwana Place, Kanke Road
Ranchi-834008
RQP. NO. 34011/(22)/2005-CPAM dt: 20.02.07

Place: Ranchi
Date: 20/12/2016

फोन नम्बर / Phone No : +91 651 2230456
फैक्स नम्बर / Fax No. : +91 651 2230456,+91 651 2231447
वेब साईट / Website Address : www.cmpdi.co.in

Annexure-VIII

COPY OF THE DOCUMENT TO ESTABLISH THAT THE GEOLOGICAL REPORT HAS BEEN DULY PURCHASED FROM MECL

GUJARAT STATE ELECTRICITY CORPORATION LIMITED

/idyutBhavan,RaceCourse,Vadodara,India –390007.Ph.91-265-6612341, Fax: 91265-23 55195
e-mail: cefuel.gseci@gebmail.com \Website: www.gseci.in
CIN: U40100GJ1993SGC019988

No. GSECL/Capt. Mining/Gare Palma Sect. I/ 533 Date: 08/09/2015

By Speed Post:

To,
The Nominated Authority,
Ministry of Coal, GoI, Shastri Bhavan,
New Delhi – 110 001.

Sub: Payment of Fixed Amount towards GR Cost for Gare Palma Sector-I Coal Mine.

Ref: Intimation received by e-mail on dated 03/09/2015.

Respected Sir,

In reference to an intimation received by e-mail on 03/09/2015, for payment of Fixed Amount as per Clause 3.1.(d) of the Allotment Agreement, it is to confirm that, today (i.e. on 8/09/2015) GSECL has deposited the Fixed Amount Rs. 65,14,43,285.00 towards GR Cost, in your designated Bank : United Bank of India in A/c No. 0276050414586.

The details of total payment of Rs. 65,14,43,285.00 made by RTGS from our Bank : State Bank Of India from A/c No. 00000030052331664 is as under:

Date	RTGS Transfer UTR Number:	Amount transferred in Rs.
08-Sep-15	SBINR52015090819716024	25,00,00,000.00
08-Sep-15	SBINR52015090819719073	25,00,00,000.00
08-Sep-15	SBINR52015090819719303	15,14,43,285.00

Please acknowledge the receipt of above payment and confirm the date for collection of Vesting Order for Gare Palma Sector-I Coal Block.

Thanking you.

Yours faithfully,

(H.D. Joshi)
Chief Engineer Fuel
GSECL, Vadodara.

CFWCs to:
[1] MD, GSECL, Vadodara – for information please.

[2] OSD, EPD, GoG, Sachivalay, G'nagar – for information please. - Fax No. 079-23250797.

[3] Sr. CGM (F&A), Corporate Office, Vadodara – for information please.

Annexure-IX

INDEX OF CHAPTERS CONTAINED IN THE MINING PLAN

INDEX

CHAPTERS

Annexure-X

NO. OF VOLUMES IN THE MINING PLAN AND THEIR CONTENT

Volume-I

Text

Volume-II

Plans and Sections

Volume-III

Khasra-wise Land-use Detail

Annexure-XI

PLANS & SECTIONS

Sl.No	NAME OF PLANS AND SECTIONS	DRG. NO.
1	LOCATION PLAN	HQ-OCM-002550
2	PLAN SHOWING APPROVED BLOCK BOUNDARY VIS-A-VIS PROPOSED MINING LEASE & ADJACENT COAL BLOCKS	HQ-OCM-002551
3	GEOLOGICAL PLAN	HQ-OCM-002552
4	SURFACE FEATURE PLAN	HQ-OCM-002553
5	LAND USE PLAN	HQ-OCM-002554
6	SEAM-X-TOP FLOOR CONTOUR, FOLIO & ISO-GRADE PLAN	HQ-OCM-002555
7	SEAM-X-BOTTOM FLOOR CONTOUR, FOLIO & ISO-GRADE PLAN	HQ-OCM-002556
8	SEAM-IX-L2 FLOOR CONTOUR, FOLIO & ISO-GRADE PLAN	HQ-OCM-002557
9	SEAM-IX-L1 FLOOR CONTOUR, FOLIO & ISO-GRADE PLAN	HQ-OCM-002558
10	SEAM-LOCAL-1 FOLIO & ISO-GRADE PLAN	HQ-OCM-002559
11	SEAM-IX FLOOR CONTOUR, FOLIO & ISO-GRADE PLAN	HQ-OCM-002560
12	SEAM-LOCAL-2 FOLIO & ISO-GRADE PLAN	HQ-OCM-002561
13	SEAM-VIII FOLIO & ISO-GRADE PLAN	HQ-OCM-002562
14	SEAM-VII FLOOR CONTOUR, FOLIO & ISO-GRADE PLAN	HQ-OCM-002563
15	SEAM-VI-A FLOOR CONTOUR, FOLIO & ISO-GRADE PLAN	HQ-OCM-002564
16	SEAM-VI B & VI-(A+B) FLOOR CONTOUR, FOLIO & ISO-GRADE PLAN	HQ-OCM-002565
17	SEAM-VI C, VI-(B+C) & VI-(A+B+C) FLOOR CONTOUR, FOLIO & ISO-GRADE PLAN	HQ-OCM-002566
18	SEAM-VID, VI(C+D), VI(B+C+D) & VI(A+B+C+D) FLOOR CONTOUR, FOLIO & ISO-GRADE PLAN	HQ-OCM-002567
19	SEAM-VI-LOCAL FLOOR CONTOUR, FOLIO & ISO-GRADE PLAN	HQ-OCM-002568
20	SEAM-BAND-1 FOLIO & ISO-GRADE PLAN	HQ-OCM-002569
21	SEAM-V-TOP FOLIO & ISO-GRADE PLAN	HQ-OCM-002570
22	SEAM-LOCAL-3 FOLIO & ISO-GRADE PLAN	HQ-OCM-002571
23	SEAM-V-BOT FOLIO & ISO-GRADE PLAN	HQ-OCM-002572
24	SEAM-BAND-2 FOLIO & ISO-GRADE PLAN	HQ-OCM-002573
25	SEAM-IV FLOOR CONTOUR, FOLIO & ISO-GRADE PLAN	HQ-OCM-002574
26	SEAM-BAND-3 FOLIO & ISO-GRADE PLAN	HQ-OCM-002575
27	SEAM-III FLOOR CONTOUR, FOLIO & ISO-GRADE PLAN	HQ-OCM-002576
28	SEAM-II-TOP FOLIO & ISO-GRADE PLAN	HQ-OCM-002577
29	SEAM-II-BOT & II-COMB FLOOR CONTOUR PLAN, FOLIO & ISOGRADE PLAN	HQ-OCM-002578
30	GEOLOGICAL CROSS-SECTIONS ALONG SECTIONLINES - S1-S1' TO S4-S4'	HQ-OCM-002579
31	GEOLOGICAL CROSS-SECTION ALONG SECTIONLINES - S5-S5' TO S8-S8'	HQ-OCM-002580
32	GEOLOGICAL CROSS-SECTIONS ALONG SECTIONLINES - S9-S9' TO S10-S10'	HQ-OCM-002581
33	PROPOSED SURFACE LAYOUT & CONCEPTUAL PLAN	HQ-OCM-002582
34	PLAN SHOWING TOTAL COAL THICKNESS, TOTAL OB THICKNESS & STRIPPING RATIO CONTOURS	HQ-OCM-002583
35	FINAL STAGE QUARRY PLAN	HQ-OCM-002584
36	FINAL STAGE DUMP PLAN	HQ-OCM-002585
37	1ST YEAR STAGE QUARRY PLAN	HQ-OCM-002586
38	3RD YEAR STAGE QUARRY PLAN	HQ-OCM-002587
39	5TH YEAR STAGE QUARRY PLAN	HQ-OCM-002588
40	10TH YEAR STAGE QUARRY PLAN	HQ-OCM-002589
41	20TH YEAR STAGE QUARRY PLAN	HQ-OCM-002590
42	RECLAMATION PLAN	HQ-OCM-002591
43	COAL FLOW DIAGRAM	HQ-E&M-301504
44	GENERAL LAYOUT OF WORKSHOP & STORE	HQ-E&M-301502
45	COAL WASHERY PROCESS FLOWSHEET	HQ-CMP-021015205/04/001
46	SCHEMATIC PROJECTION PLAN FOR UNDERGROUND WORKING OF SEAM-X-BOTTOM	HQ-UMD-300791
47	SCHEDULE OF IMPLEMENTATION FOR GARE PALMA SECTOR-I PROJECT	HQ-OCM-002592

Annexures-XII

LIST OF DOCUMENTS / ANNEXURES

ANNEXURE	Type of Document	Remark	Page No.
I	Copy of the Allotment Order	Enclosed	180-189
I(A)	Co-ordinates of the Gare Palma Sector-I Coal Block	Enclosed	190-192
II	Copies of earlier approved Mining Plan		193
III	Copy of MOC's letter granting recognition to RQP for preparation of Mining Plan	Enclosed	194-195
IV	Letter of Authorization by the Block Allotee/Applicant to the RQP for preparing Mining Plan.	Enclosed	196
V	A certificate by the RQP that he has been duly authorized by the mining company to prepare mining plan 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 have been considered while preparing the mining plan.	Enclosed	197
VI	Certificate from empowered representative of/or Block Allotee/Applicant that the 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.	Enclosed	198
VII	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.	Enclosed	199
VIII	Copy of the document to establish that the Geological Report has been duly purchased from CMPDI, GSI/MECL as the case may be.	Enclosed	200
IX	Index of chapter contained in the Mining Plan	Enclosed	201-203
X	No. of Volumes in the Mining Plan and their content		204
XI	List of Darwings		205-206
XII	List of Annexures		207-208
XIII	List of Abbreviations used		209
XIV	Copies of approvals regarding the setting up of end use plant	Enclosed	210-220

ANNEXURE	Type of Document	Remark	Page No.
XV	Certificate from CMPDI that the Geological Co-ordinates (Longitude & Latitude) used in preparation of Mining Plan is in accordance with the Vesting Order and Geological Coordinates covered by the Mining Plan do not encroach into any other / adjacent coal block.	Enclosed	221-222
XVI	Certificate from the Block Allottee regarding reclamation and rehabilitation work	Enclosed	223
XVII	Khasra-wise Land Detail	Enclosed	Volume-III

Annexure-XIII

LIST OF ABBREVIATIONS

Abbrn.	Expanded form	Abbrn.	Expanded form
ACGIH	American Conference of Governmental Industrial Hygienists	Mcum	Million Cubic Metre
BHs/bhs	Boreholes		
BOD	Bio-Chemical Oxygen Demand	MDO	Mine Developer and Operator
CGPCL	Chhattigarh Power Corporation Limited	MECL	Mineral Exploration Limited
CHP	Coal Handling Plant	MGD	Million Gallon per Day
CMDCL	Chhattisgarh Mineral Development Corporation Limited	MoC	Ministry of Coal
CMPDI	Central Mine Planning and Design Institute	MoEF	Ministry of Environment and Forest
CMR	Coal Mine Regulation	MSL	Mean Sea Level
CPCB	Central Pollution Control Board	Mt	Million Tonne
CT	Current Transformer	Mtpa/MTPA	Million Tonnes per Annum
dB	Decibel	Mty	Million Tonnes per Year
DGMS	Director General of Mine safety	MUV	Multi Steered Vehicle
E&M	Electrical & Mechanical	MVA	Mega Volt Ampere
e.o.t/ E.O.T	Electric Overhead Travelling	OC	Opencast
Env.	Environment	OCP	Open Cast Project
FSV	Free Steered Vehicle	PAF	Project Affected Family
GCV	Gross Calorific value	PGT	Performance Guarantee Test
GEB	Gujrat Electricity Board	PT	Potential Transformer
GoG	Government of Gujrat	ROM	Run Off Mine
GSECL	Gujrat State Electricity Corporation Limited	RPM	Respiratory Particulate Matter
GSI	Geological Survey of India	RQP	Recognised Qualified Person
GUVNL	Gujrat Urja Vikas Nigam Limited	SECL	South Eastern Coalfields
Ha/ha	Hectare	SMS	Site Mix Slurry
HEMM	Heavy earth Moving Machinery	SPM	Suspended Particulate Matter
HPSV	High Pressure Sodium Vapour	tph	Tonnes per hour
ISO	Indian Standard Organisation	TSS	Total Suspended Solid
		UG	Underground
Kcal	Kilo Calorie	UHV	Ultimate Heat Value
Kg	Kilogram	UVM	Ultimate Heat Value
Km	Kilometre		
kV	Kilo Volt	VCB	Vacuum Circuit Breaker
LHD	Load Haul and Dump	VM	Volatile Mater
m^2	Square metre	WPI	Wholesale Price index
MCR	Mineral concession rule	Wt	Weight

Annexure-XIV

COPIES OF APPROVAL REGARDING SETTING UP OF END USE PLANT

SCHEDULE-B

Particulars of the Specified End Use Plants Linked with Gare Palma Sector-I Coal Block - as per Schedule – B of the Allotment Agreement.

Sr. No	Specified End Use Plant	Address	Configuration	Status	Capacity
1	Ukai Thermal Power Plant (Unit 1 to 6)	Taluka : Fort Songadh, District : Tapi. Gujarat	2 x 120 MW 2 x 200 MW 1 x 210 MW 1 x 500 MW	Operating Operating Operating Operating Operating	1350 MW
2	Gandhi Nagar Thermal Power Plant (Unit 1 to 5)	District : Gandhinagar, Gujarat	2 x 120 MW 3 x 210 MW	Operating Operating	870 MW
3	Wanakbori Thermal Power Plant (Unit 1 to 7)	Taluka : Thasara, District : Kheda, Gujarat	7 x 210 MW	Operating	1470 MW
4	Sikka Thermal Power Plant (Unit 1 to 2) (Unit 3 to 4)	District Jamnagar, Gujarat	2 x 120 MW 2 x 250 MW	Unit 1 & 2 – Operating, Unit 3 & 4 - Under Commissioning & Const.	740 MW
5	Wanakbori Thermal Power Plant (Unit 8)	Taluka : Thasara, District : Kheda, Gujarat	1 x 800 MW	Under Const.	800 MW
6	Dhuvaran Thermal Power Plant (Unit 1 & 2)	Dhuvaran, -District : Anand, Gujarat	2 x 800 MW	Under Proposal Stage	1600 MW
7	Sinor Thermal Power Plant (Unit 2)	Sinor, District : Vadodara, Gujarat	1 x 800 MW	Under Clearance Stage	800 MW
Total					7630 MW

1st page of consent to establish approval from GPCB for Wanakbori unit no.-8

60725

GUJARAT POLLUTION CONTROL BOARD
PARYAVARAN BHAVAN
Sector-10-A, Gandhinagar-382 021.
Website : www.gpcb.gov.in

GPCB

R.P.A.D.

Consent to Establish
CTE - 62549

No: GPCB/CCA-KH-62(6)/ID: 17415/222249 **Date: 16/8/2014**

To,
M/s. Gujarat State Electricity Corporation Ltd,
Plot No: 615, Hectare, Wanakbori Thermal Power Station,
Village: Wanakbori,
Ta: Thasra,
Dist: Kheda – 388 239.

SUB: - Amendment in CTE of this Board.

REF: - 1. Your CTE - Amendment application Inward ID No. 78263 Dated: 19/03/2014.
2. CCA order No. GPCB/CCA-KH-62(5)/ID: 17415/154754 Dated: 25/07/2013.

In exercise of the power conferred under section-25 of the Water (Prevention and Control of Pollution) Act-1974, under section-21 of the Air (Prevention and Control of Pollution) Act-1981 and Authorization under rule 3(c) & 5(5) of the Hazardous Waste (Management Handling and Transboundary Movement) Rules'2008, framed under the EP Act-1986 and without reducing your responsibility under the said acts / Rules in any way; this Board is empowered to amend consent order conditions. Accordingly the CTE order under reference (1) stands amended in respect of the following conditions:

1. The Condition of Products as amended as and read as under. (After Proposed Expansion).

Sr. No.	Products	Existing Quantity	Proposed Quantity	Total Quantity
1.	Electricity Generation	10,58,400 MWH/Month	5,76,000 MWH/Month	16,34,400 MWH/Month

SPECIFIC CONDITIONS:

1. **Applicant shall have to increase the stack height of Boiler up to 275 mt.**
2. **Applicant shall have to use coal having sulpher content less than 0.6% and Ash content less than 34% only.**
3. **Applicant shall comply with the flyash Notification for handling disposal of flyash.**
4. **Applicant in consultation with Regional office, GPCB shall put up ambient air quantity monitoring stations and submit the report.**
5. **Applicant shall provide outline continues stack monitoring facilities and connect to GPCB server.**

2. The quantity of the industrial effluent from the manufacturing process and other ancillary industrial operations shall not exceed **121665 KLPD.** (After Expansion)

3. The quantity of domestic sewage effluent from the factory shall not exceed **3155 KLPD.** (After Expansion)

Clean Gujarat Green Gujarat
ISO - 9001 - 2008 & ISO - 14001 - 2004 Certified Organisation

Approval from MoEF for Wanakbori unit no.-8

5:18 From: To:02652344734 Page:1

J-13012/108/2008-IA.II (T)
Government of India
Ministry of Environment, Forests and Climate Change

3rd Floor, Vayu Block,
Indira Paryavaran Bhawan, Jor Bagh Road,
Aliganj, New Delhi-110003

Dated: 04.07. 2014

To
M/s Gujarat State Electricity Corpn. Ltd.
Project & Planning Department,
Vidyut Bhawan, Race Course,
Vadodara- 390007.

Ph: 0265-6612131, Fax: 0265-2341588

Sub: **Expansion by addition of 1x800 MW (Extension Unit-8) Super-Critical Coal Based Thermal Power Plant at Wanakbori, in Thasara Taluk, in Distt. Kheda, in Gujarat by M/s. Gujarat State Electricity Corpn. Ltd. – reg. amendment in EC.**

Sir,

This has reference to your letters dated 03.12.2013, 16.12.2013, 16.01.2014 and 06.02.2014 requesting for amendment of the Specific Condition No. 1 in the environmental clearance accorded for the above mentioned project vide letter of even no. dated 02.12.2013.

2. The matter was placed before the Expert Appraisal Committee (Thermal Power) in its 11th Meeting held during February 13-14, 2014. In acceptance of the recommendation of the EAC and in view of the information/clarification furnished by you with respect to the above mentioned project, the Specific Conditions nos. i and ii of the said EC shall be substituted with the following.

(a) The 5x120 units located at Gandhinagar, Ukai and Sikka TPP(s) would remain shut down and coal meant for these units would be diverted to meet the need of 800 MW unit at Wanakbori till Machhakata Coal block gets EC & FC and becomes operational within three years of getting EC & FC (whichever is later), otherwise, the Bank Guarantee of Rs. 100 crores, furnished by M/s. GSECL would be forfeited.

(b) In case EC and/or FC is not accorded to Machhakata Coal block, GSECL shall dismantle the 5x120 MW units located at Gandhinagar, Ukai and Sikka. M/s. GSECL shall submit an undertaking in this regard.

(c) M/s. GSECL would get all the 7x210 Units Wanakbori studied by experts to assess their Residual Life and ensure necessary replacements/ retrofitting of electrostatic precipitators so that the particulate emission does not exceed 50 mg/Nm³.

3. All other conditions stipulated in this Ministry's letter of even no. dated 02.12.2013 shall remain the same.

Page 1 of 2

From: To:02652344734 Page:2/2

4. This issues with the approval of the Competent Authority.

(Dr. Saroj)
Director

Copy to:

1. The Secretary, Ministry of Power, Shram Shakti Bhawan, Rafi Marg, New Delhi 110001.
2. The Secretary (Environment), Forests and Environment Department Government of Gujarat.
3. The Chairman, Central Electricity Authority, Sewa Bhawan, R.K. Puram, New Delhi-110066.
4. The Chairman, Gujarat Pollution Control Board, Paryavaran Bhawan, Sector 10-A, Gandhi Nagar- 382010
5. The Chairman, Central Pollution Control Board, Parivesh Bhawan, CBD-cum-Office Complex, East Arjun Nagar, Delhi- 110032.
6. The Chief Conservator of Forests, Regional Office (WZ), E-5, Kendriya Paryavaran Bhawan, Arera Colony, Ravishankar Nagar, Bhopal - 462016.
7. The District Collector, Kheda District, Govt. of Gujarat.
8. The Director (EI), MOEF.
9. Guard file.

(Dr. Saroj)
Director

Page 2 of 2

CEA's LETTER FOR SIKKA UNIT # 3 & 4

फोन फेक्स/ Telefax. 01126105075
ई-मेल/ E-mail: cea-tmd @nic.in

भारत सरकार
Government of India
केन्द्रीय विद्युत प्राधिकरण
Central Electricity Authority
टी.पी.एम.प्रभाग-II
Thermal Project Monitoring Division-II
सेवा भवन, आर. के. पुरम, नई दिल्ली-110066
Sewa Bhawan R.K. Puram, New Delhi – 110066

[ISO: 9001-2008]

विषय: Sikka TPS Extn., Unit-4 (250 मेगावाट) इकाई की Commissioning (i.e. Achieving of full load) के बारे में ।

सूचित किया जाता है कि Gujarat State Electricity Corporation Limited द्वारा गुजरात राज्य में निष्पादित Sikka TPS Extn., Unit-4 (250 मेगावाट) इकाई की Commissioning (i.e. Achieving of full load) दिनांक 25.09.2015 को हो गई है।

RECEIVED 2015 SE(P&P) STENO

(फूल चन्द्र)
मुख्य अभियंता

1. अध्यक्ष,के.वि.प्रा.
2. सदस्य(तापीय/योजना/पावर सिस्टम/जल विद्युत/ई&सी/ग्रिड आपरेशन&डिस्ट्रीवुशन) के.वि.प्रा.
3. मुख्य अभियंता (पीडीएम/पीएस&एलएफ/ओपीएम/एफएम/पीएफए /सीडी/आईआरपी/सदस्य सचिव,WRPC)के.वि.प्रा.

सं: CEA/TPM/WR/56/2015/44 दिनांक 28/09/2015

प्रतिलिपि प्रेषित:

1. विशेष सचिव (Additional Secretary),विद्युत मंत्रालय, श्रम शक्ति भवन,नई दिल्ली
2. सयुक्त सचिव(ताप विद्युत) विद्युत मंत्रालय,श्रम शक्ति भवन,नई दिल्ली
3. निदेशक(योजना), विद्युत मंत्रालय,श्रम शक्ति भवन,नई दिल्ली.
4. Chief Engineer(P&P), GSECL, Vidyut Bhawan, Race Course Vadodara-390007(Email:cepnp.gsecl@gebmail.com)

STPS

भारत सरकार
केन्द्रीय विद्युत प्राधिकरण
तापीय परियोजना प्रबोधन प्रभाग
9 वीं मंजिल (दक्षिण), सेवा भवन,
आर.के. पुरम,दिल्ली - 110066 [आई.एस.ओ. : 9001-2008]

विषय: Sikka TPS Extn., Unit-3 (250 मेगावाट) इकाई की Commissioning (i.e. Achieving of full load) के बारे में ।

सूचित किया जाता है कि Gujarat State Electricity Corporation Limited द्वारा गुजरात् राज्य में निष्पादित Sikka TPS Extn., Unit-3 (250 मेगावाट) इकाई की Commissioning (i.e. Achieving of full load) दिनांक 29.03.2015 को हो गई है।

1-4-15

(फूल चन्द्र)
निदेशक(ता.प.प्र)

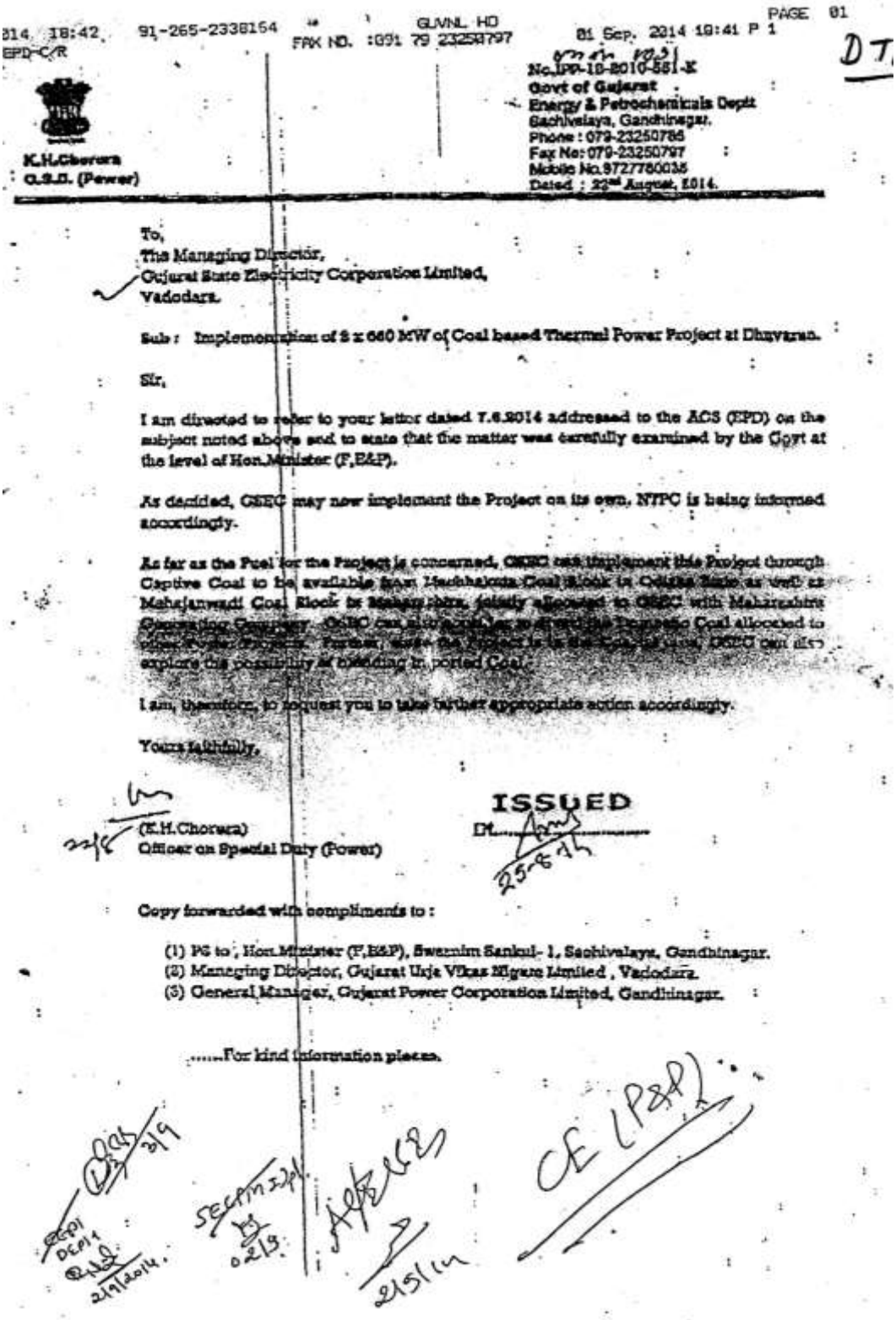
1. अध्यक्ष,के.वि.प्रा.
2. सदस्य(तापीय/योजना/पावर सिस्टम/जल विद्युत/ई&सी/ग्रिड आपरेशन&डिस्ट्रीवुशन) के.वि.प्रा.
3. मुख्य अभियंता (डीएमएलएफ/(ओपीएम/ओ एम/सीडी/आईआरपी/सदस्य सचिव,WRPC)के.वि.प्रा.

सं: CEA/TPM/WR/56/2015/ 431 दिनांक 1-4-2015

प्रतिलिपि प्रेषित:

1. विशेष सचिव (डी सी),विद्युत मंत्रालय, श्रम शक्ति भवन,नई दिल्ली
2. सयुक्त सचिव(ताप विद्युत) विद्युत मंत्रालय,श्रम शक्ति भवन,नई दिल्ली
3. निदेशक(योजना), विद्युत मंत्रालय,श्रम शक्ति भवन,नई दिल्ली.
4. Shri J.C.Mali, Chief Engineer(P&P), GSECL, Vidyut Bhawan, Race Course Vadodara-390007(Email:cepnp.gsecl@gebmail.com)

State Govt approval for Dhuvaran Thermal Power Plant



314 18:42 91-265-2338154 GUVNL HO PAGE 01
EPD-C/R FAX NO. :091 79 23258797 01 Sep. 2014 19:41 P 1

K.H.Chorera
O.S.D. (Power)

No.IPP-10-2010-551-E
Govt of Gujarat
Energy & Petrochemicals Deptt
Sachivalaya, Gandhinagar.
Phone : 079-23250786
Fax No: 079-23250797
Mobile No.9727760035
Dated : 22nd August, 2014.

To,
The Managing Director,
Gujarat State Electricity Corporation Limited,
Vadodara.

Sub : Implementation of 2 x 660 MW of Coal based Thermal Power Project at Dhuvaran.

Sir,

I am directed to refer to your letter dated 7.6.2014 addressed to the ACS (EPD) on the subject noted above and to state that the matter was carefully examined by the Govt at the level of Hon.Minister (F,E&P).

As decided, GSEC may now implement the Project on its own. NTPC is being informed accordingly.

As far as the Fuel for the Project is concerned, GSEC can implement this Project through Captive Coal to be available from Machhakata Coal Block in Odisha State as well as Mahajanwadi Coal Block in Maharashtra, jointly allocated to GSEC with Maharashtra Generation Company. GSEC can also explore to avail the Domestic Coal allocated to other Power Projects. Further, since the Project is in the Coastal area, GSEC can also explore the possibility of blending to ported Coal.

I am, therefore, to request you to take further appropriate action accordingly.

Yours faithfully,

(K.H.Chorera)
Officer on Special Duty (Power)

ISSUED
Dt. 25-8-14

Copy forwarded with compliments to :

(1) PS to, Hon.Minister (F,E&P), Swarnim Sankul- 1, Sachivalaya, Gandhinagar.
(2) Managing Director, Gujarat Urja Vikas Nigam Limited , Vadodara.
(3) General Manager, Gujarat Power Corporation Limited, Gandhinagar.

.....For kind information please.

CE (P&P)

PPA signed betn. GSECL & GUVNL for Sinor Thermal Power Plant

Power Purchase Agreement between

Gujarat State Electricity Corporation Limited

(The Seller)

and

Gujarat Urja Vikas Nigam Limited

(The Procurer)

IN RESPECT OF

SINOR 1600 MW

COAL BASED THERMAL POWER STATION

BEING SET UP AT SINOR

GUVNL

I

Gujarat State Electricity Corporation Ltd. VADODARA

GSECL


भारतीय गैर न्यायिक

एक सौ रुपये

Rs. 100

रु. 100

ONE HUNDRED RUPEES

सत्यमेव जयते

भारत INDIA

INDIA NON JUDICIAL

ગુજરાત गुजरात GUJARAT

T 164476

This Agreement is made on 1st day of January 2011

Between

(1) Gujarat State Electricity Corporation Limited (hereinafter referred to as the "GSECL")having its registered office at Vidyut Bhavan, Race Course, Vadodara, 390007, hereinafter called "Seller" which expressions unless repugnant to the context and meaning hereof shall include its successors and assigns

And

GUVNL

IV

GSECL

(2) Gujarat Urja Vikas Nigam Limited (hereinafter referred to as the GUVNL), having its registered office at Sardar Patel Vidyut Bhavan, Race Course, Vadodara, 390007 hereinafter called "Procurer" which expressions unless repugnant to the context and meaning hereof shall include its successors and assigns

(Each of the "Procurer", and "Seller" are individually referred to as "Party" and collectively to as the "Parties")

Whereas:

A. The Procurer intends to procure generation capacity and purchase electricity in bulk.

B. The Seller has offered the generation capacity of its 1600 MW Coal Based Thermal Power Plant at SINOR Dist. Vadodara and sale and supply of electricity in bulk there from to the Prccurer;

C. The Seller being a State Government PSU, has been exempted from competitive bidding, as per the Government of India guidelines.

D. The Seller intends to sell the generation capacity and supply of electricity in bulk to the Procurer to the extent of 1600 MW capacity in aggregate on the terms and conditions contained in this Power Purchase Agreement (PPA) (the Agreement);

E. The Procurer has been authorised by the Distribution Licensees of the State viz. Madhya Gujarat Vij Co. Ltd. (MGVCL), Uttar Gujarat Vij Co. Ltd. (UGVCL), Dakshin Gujarat Vij Co. Ltd. (DGVCL) and Pashchim Gujarat Vij Co. Ltd. (PGVCL) to execute the PPA for Procurement of Power from the Seller. The Distribution Licensees also confer to the commitments given by the Procurer to the Seller and have agreed to be bound by the PPA and all decisions of the Procurer for the same.

F. Accordingly, the Parties have to sign this PPA setting out the terms and conditions of the sale of generation capacity and supply of electricity in bulk by the Seller to the Procurer.

Now therefore, in consideration of the premises and mutual agreements, covenants and conditions set forth herein, it is hereby agreed by and between the Parties as follows:

GUVNL

GUJARAT URJA VIKAS NIGAM LIMITED VADODARA

V

GSECL

18.18 Scheduled Generation

Notwithstanding anything contained to the contrary in this Agreement, wherever a reference is made to a Procurer or SLDC issuing a Scheduled Generation to the Seller, where law so requires that Scheduled Generation be issued only by a control centre, such references shall be construed as being references to the Seller receiving Scheduled Generation from the said control centre and the same shall apply in relation to any other functions being exercised by any other entity or organisation in the future, from time to time.

IN WITNESS WHEREOF the Parties have executed these presents through their authorized representatives at Vadodara.

For and on behalf of Procurer by	For and on behalf of Seller by
(S.V. Vachhrajani)	(P.H.Rana)
Chief Finance Manager (IPP)	Managing Director
and witnessed by	
(R.P.Soni)	(M.B.Kaka)
Deputy Engineer (IPP)	General. Manager(F & A)
(S.S.Mistry)	(P.M.Parmar)
Deputy Engineer (IPP)	Chief Engineer(Generation)

GUVNL GSECL

ANNEXURE-XV

CERTIFICATE FROM CMPDI THAT THE GEOLOGICAL CO-ORDINATES (LONGITUDE & LATITUDE) USED IN PREPARATION OF MINING PLAN IS IN ACCORDANCE WITH THE VESTING ORDER AND GEOLOGICAL COORDINATES COVERED BY THE MINING PLAN DO NOT ENCROACH INTO ANY OTHER / ADJACENT COAL BLOCK.

Annexure-XVI

CERTIFICATE FROM THE BLOCK ALLOTTEE REGARDING RECLAMATION AND REHABILITATION WORK

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VidyutBhavan,RaceCourse,Vadodara,India –390007.Ph. : 91-265-6612341, Fax: 91-265-23 55195
e-mail: cefuel.gseci@gebmail.com Website: www.gseci.in
CIN: U40100GJ1993SGC019988

Annexure-XVI

Certificate

It is certified that the reclamation & rehabilitation work shall be carried out in accordance with the approved Mining Plan &Mine Closure Plan of Gare Palma Sector-I Coal Mine and any modification / amendments which may be made in the Mining Plan &Mine Closure Plan by Ministry of Coal, from time to time.

Place:-VADODARA
Date:- 22/11/2016.

GSECL

(H. D. Joshi)
Chief Engineer (Fuel)
Gujarat State Electricity Corporation Ltd.

CHIEF ENGINEER (Fuel)
Gujarat State Electricity Corporation
Vidyut Bhavan, Race Course,
Vadodara - 390 007

C. SUMMARISED DATA

1.	**GENERAL**	
a.	Name and address of the Applicant Company	GUJRAT STATE ELECTRICITY CORPORATION LIMITED Vidyut Bhavan, Race Course, Vadodara-390007, India
b.	Name and address of the Block Allottee	Same as above
c.	Relationship between the applicant and allottee company	Same company
d.	Status of applicant company	State Government undertaking
e.	Name of the Block together with the name of the Coalfield and State where located	**GARE PALMA SECTOR-I.** Mand Raigarh Coalfield. State-Chhattisgarh
f.	Date of allotment	September 14, 2015
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	Opencast: 15 Mty Underground: 6 Mty
i.	Norms adopted for calculating ROM quantity requirement in case it differs from the quantity indicated in the Allotment order	Quantity not indicated in the Allotment Order
j.	Whether beneficiation required	Yes
k.	Requirement of beneficiated coal and expected availability thereof.	Requirement: 35.063 Mty at GCV of 4000 Kcal/Kg. After yield the expected availability would be 13.65 Mty at approximate GCV band of G-10 (4300-4600 Kcal/kg)
l.	Period for which Mining Lease is to be applied for	Upto the Maximum limit
m.	Date of expiry of earlier Mining Lease	The area is Virgin and therefore Mining lease will be for the 1st time.
n.	RQP who has prepared the Mining Plan Name: Address: Phone No./Fax/ Email ID: Registration no. and date till valid: Date of grant/ renewal of RQP Status: Validity:	 Arun Kumar Bal Opencast Division, CMPDI (Hqs.), Kanke Road, Ranchi-834008, Jharkhand. +918987788961, +916512792371/ email:arun.bal@coalindia.in 34011/(22)/2005-CPAM and valid till 19.02.2017 20.02.2007 Valid upto 19th February 2017 10 years

D	**INFORMATION REGARDING EARLIER MINING PLAN**	
		The Mining Plan is being prepared for the 1st time for the block.
E	**LOCATION**	
a.	Location of the Block	**Village:** Tamnar, Khuruslenga, Godhi, Basanpali, Salihabhata, Uttar Regaon, Dakshin Regaon, Dolesera, Samkera, Aamgaon, Tapranga, Dhourabhata, Libra, Jhikabahal, Telaipara, Bijna, Tehli Rampur, Kunjemura, Nagramunda, Budhiya, Baghbadi, Mahloi, Raipara, Jharna, Pata, Tangarghat. **District:** Raigarh **State:** Chhattisgarh
b.	Name of the Coalfield	Mand Raigarh
c.	Particulars of the adjacent blocks	**North:** Gare Palma Sector-II, Gare Palma Sectors - IV/1, IV/2 & IV/3 **North West:** Bhalumura **North East:** Jamkani **West:** Dolesara, Jarekela **East:** Jharpalam Thangarghat, Kesarchuan Lamdand. **South:** Gorhi-Mahloi East and west
d.	Area of the Allottee Block (Hectare) <u>Geological Block area</u> <u>Proposed Lease area:</u> i. Mining Block area without Rail, conveyor etc. in the East of Kelo river. ii. Rail, conveyor and diverted road etc. in the West of Kelo River. iii. Proposed total Lease area. (i+ii)	 5738.75 3513.70 70.11 **3583.81**
	Note: Due to presence of power plant and other structures of JINDAL on the Western part of the Kelo river, only the part of the block in the Eastern side of the Kelo river has been considered for mining in the 1st phase.	
e.	Reference no. of the plan of block boundary issued by CMPDI (A copy of the plan along with the coordinates of the boundaries has been annexed as Annexure-I)	Letter no. CMPDI/DG/MoC/707(A)/1441 dated: 26.11.2015 to Sh. Vivek Bhardwaj, Jt. Secretary (VB)/Nominated Authority, GoI, MoC

<table>
<tr><td>f.</td><td>Whether the lease boundary/ required boundary is same as demarcated by CMPDI</td><td>It is less than the demarcated boundary of the block area as East side of the Kelo river has only been considered for mining in the 1st phase.</td></tr>
<tr><td>g.</td><td>Existing Mining Lease Area in case of existing mines</td><td>This is a green field project.</td></tr>
<tr><td>h.</td><td>Applied lease Area as per the Mining Plan under consideration (Ha)</td><td>3583.81</td></tr>
<tr><td>i.</td><td>Whether the lease area, falls within the allotted block</td><td>Yes</td></tr>
<tr><td>j.</td><td>Area of lease, which falls outside the block (Ha)</td><td>NIL</td></tr>
<tr><td>k.</td><td>Details of outside area</td><td>NA</td></tr>
<tr><td>l.</td><td>Whether some parts of the allotted block has not been applied for Mining Lease
Total area of such part (Ha)

Total Reserves in such part i.e. West side of Kelo river: (Mt)

Brief reasoning for leaving such part</td><td>

2154.94 (Including Kelo river)

Proved 437.89
Indicated 207.37
Total 645.25
Due to presence of power plant and other structures of JINDAL on the Western part of the Kelo river, only the part of the block in the Eastern side of the Kelo river has been considered for mining in the 1st phase.</td></tr>
<tr><td>m.</td><td>Type of land involved in the projected area (Ha)

Forest Land
Non-forest Land
-Tenancy
-Govt.
TOTAL</td><td>

182.76

3232.15
168.90
3583.81</td></tr>
<tr><td>n.</td><td>Broad land use pattern</td><td>
<table>
<tr><th colspan="3">Land Use Break-up of GP I (Ph-1) Coal Block in Ha</th></tr>
<tr><td rowspan="3">Forest Land</td><td>Reserve Forest</td><td>0.00</td></tr>
<tr><td>Protected Forest</td><td>48.22</td></tr>
<tr><td>Chote bade jhar ka Jungle</td><td>134.54</td></tr>
<tr><td rowspan="5">Tenancy Land</td><td>Village/Town area</td><td>58.66</td></tr>
<tr><td>Industrial land</td><td>71.29</td></tr>
<tr><td>Agricultural land</td><td>3058.81</td></tr>
<tr><td>Grazing land</td><td>43.39</td></tr>
<tr><td>Barren land</td><td>0.00</td></tr>
<tr><td>Government land</td><td>Total Govt Land</td><td>168.90</td></tr>
<tr><td colspan="2">Grand Total</td><td>3583.81</td></tr>
</table>
</td></tr>
<tr><td>o.</td><td>Proximity of public road/ railway line/ major water body</td><td>The block is connected by road from Raigarh via Punjipathara by state Highway. Punjipathara village is</td></tr>
</table>

	if any and approximate distance	situated half way on Raigarh-Gharghoda main road. The distance from Raigarh to Gharghoda is around 40 km. From Punjipathara the road leads to the Gare Palma area via Tamnar village situated at a distance of 10 Km. on Punjipathara- Lelunga road, which passes through the block. Tamnar is situated in the South-western part of the Gare Palma Sector-I Coal Block. It is about 35 kms north-east of Raigarh, the district head quarter which is also the nearest railway station on Mumbai-Howrah main line of SE railways.
p.	Topo sheet no. with Latitude and Longitude (as per GR prepared by MECL)	Toposheet Nos. 64 N/8 & 12 (R.F. 1:50,000). **Latitude :** N 22° 04' 00" to N 22°08'51.495" **Longitude :** E 83°25'18.088" to E 83 ° 33' 47.714"
q	Co-ordinates as per Revised Vesting Order in WGS-84 datum	MINIMUM / MAXIMUM LATITUDE 22°4'2.667"N 22°8'52.895"N LONGITUDE 83°25'15.207"E 83°33'50.324"E
F	**GEOLOGY AND EXPLORATION**	
a.	Name of the Geological Block and area in Ha	GARE PALMA SECTOR-I BLOCK 5738.75
b.	Name of the Geological Report (GR) with year of preparation	INTEGRATED GEOLOGICAL REPORT ON DETAILED EXPLORATION FOR COAL, GARE PALMA SECTOR-I BLOCK (SUB BLOCK A,B,C,D,E,F), MAND RAIGARH COALFIELD, DISTRICT RAIGARH, CHHATTISGARH, February-2016
c.	Name of the agency which conducted exploration and prepared GR	Mineral Exploration Corporation Ltd. and Directorate of Geology & Mines, Chhattisgargh and Shreeram Gemicon have carried out detailed exploration in **Gare Palma Sub Block B, C, D, E, F** and **Sub Block A** respectively. The Integrated GR was prepared by Mineral Exploration Corporation Ltd. (MECL).
d.	Period of conducting exploration	24.06.2007 to 13.11.2011 (Sub-block 'B','C',`D','E' & 'F') by MECL and April to November 2011 (Sub Block-A) by SHREERAM GEMICON.
e.	Details of drilling	**Agency** / **No.of BHs** / **Meterage(m)** / **BH Name** MECL 294 109286.95 MGP SHREERAM GEMICON 42 18008.50 CMG GSI 4 1904.40 RGP DGM 18 7576.50 CGGD **Total** **358** **136776.35**
f.	No. of BHs drilled within the block	All the BHs are within/on the boundary of the block

g.	Overall BH density within the block (BHs per Sq. Km.)	6.24
h.	Area covered by 'detailed' exploration within the block (Ha)	The upper seams are covered by detailed drilling in an area of 5224.44 Ha
i.	Area covered by 'detailed' exploration outside the block (Ha)	Outside blocks in the north have been covered by detailed boreholes by other agencies. In the other sides the areas are under exploration.
	No of BHs drilled outside the block	NA
	Bore hole density for outside area (no. per sq. km)	NA
j.	Whether entire lease area has been covered by 'detailed' exploration	There will be requirement of additional drilling for proving reserves of lower seams to be mined by underground method for the entire area.
k.	Whether any further exploration is required or suggested and time frame in which it is to be completed	Additional boreholes are required in part-B area to increase the density to 12 boreholes per square kilometres from existing 6.24 bhs/sq. km for underground mining. Boreholes in the lower seams are very scanty. Before considering these lower seams for underground mining, fresh drilling upto a density of 12 bhs/sq. km. needs to be carried out. The exploration in part B side should be completed before the area is covered by external dumping, which is likely to continue for about 16 years after start of quarry operation in the Part-A. In the part-A area, where quarry has been proposed, about 25 boreholes, in the central to dip side area, may be required for proving reserves of lower seams before they are considered for underground mining. The exploration in part-A side should be completed before quarrying is done in the area where exploration is needed.
l.	Number of coal seams/horizons including splits	**34**

Thickness range of coal seams, full thickness, mean and standard deviation in (m)

SEAM	**Min**	**Max**	**Mean**	**S.D**
X - Top	0.05	5.60	1.71	0.83
X- Bott.	0.14	6.00	1.86	0.78
IX- L2	0.06	2.54	0.72	0.40
IX- L1	0.09	5.41	0.84	0.42
Local-1	0.05	1.48	0.44	0.36
IX	0.27	13.67	4.15	1.95
Local-2	0.02	3.77	0.43	0.49
VIII	0.03	6.68	0.77	0.93
VII	0.06	4.24	1.81	1.06

		VI-A	0.32	5.73	1.62	0.85
		VI-B	0.15	6.45	1.97	1.47
		VIA+VIB	1.70	9.26	4.75	1.83
		VI-C	0.48	6.77	2.46	1.74
		VIB+VIC	0.73	12.47	5.31	2.57
		VIA+VIB+VIC	0.54	10.89	6.13	1.57
		VI-D	0.05	8.22	1.81	1.58
		VIC+VID	1.61	14.58	5.82	3.20
		VIB+VIC+VID	3.13	17.16	10.3	3.95
		VIA+VIB+VIC +VID	1.80	17.13	9.70	3.09
		VI-Local	0.02	3.25	2.27	1.96
		Band-1	0.05	1.62	0.43	0.26
		V-Top	0.07	2.19	0.54	0.28
		Local-3	0.06	1.24	0.52	0.22
		V-Bot	0.05	6.39	1.47	1.34
		Band-2	0.02	3.85	0.53	0.52
		IV	0.04	2.25	0.59	0.47
		Band-3	0.02	2.06	0.41	0.4
		III	0.04	4.78	1.89	0.95
		II Local	0.12	1.67	0.57	0.37
		II COMB	0.02	12.12	2.96	3.2
		II TOP	0.50	8.06	2.79	2.3
		II BOT	0.35	11.98	2.38	2.67
		Band-4	0.04	1.39	0.33	0.33
		I	0.06	1.1	0.58	0.33
	Mean thickness of total coal horizon, full thickness (m). Only combined thickness of seams	**35.52**				
	Minimum & Maximum depth of coal seams	**Seam**	**Minimum Depth**		**Maximum Depth**	
		X - Top	44.08		330.01	
		X – Bott.	52.65		340.26	
		IX- L2	74.40		351.93	
		IX- L1	79.98		368.26	
		Local-1	90.40		374.69	
		IX	99.91		388.34	
		Local-2	101.64		396.10	
		VIII	109.39		393.13	
		VII	126.52		426.16	
		VI-A	146.85		407.36	
		VI-B	160.99		295.85	
		VIA+VIB	122.50		275.86	
		VI-C	146.06		298.30	
		VIB+VIC	170.27		311.64	
		VIA+VIB+VIC	169.03		443.20	
		VI-D	170.00		434.51	

		VIC+VID		131.00		282.40
		VIB+VIC+VID		152.86		412.27
		VIA+VIB+VIC +VID		138.87		435.27
		VI-Local		134.13		450.20
		Band-1		162.90		374.93
		V-Top		172.62		464.20
		Local-3		176.49		469.54
		V-Bot		198.09		492.22
		Band-2		203.06		493.31
		IV		220.06		477.02
		Band-3		248.00		500.51
		III		281.59		557.16
		II Local		318.54		488.26
		II COMB		321.93		524.00
		II TOP		358.98		496.50
		II BOT		366.74		501.00
		Band-4		326.23		498.28
		I		552.30		561.33
m.	GCV and UHV in Kcal/kg on **I30** basis	**SEAM**	**GCV in Kcal/Kg**		**Grade**	
			Min	**Max**	**Min**	**Max**
		X-TOP	2223	5340	G17	G7
		X-BOTT.	2440	5220	G17	G7
		IX-L2	2252	5776	G17	G6
		IX-L1	2889	5729	G15	G6
		LOCAL-1	2466	5730	G17	G6
		IX	2283	5661	G17	G6
		LOCAL-2	2375	4849	G17	G9
		VIII	2373	4850	G17	G9
		VII	2584	5310	G16	G7
		VI-A	2627	5200	G16	G8
		VI-B	2773	4291	G16	G11
		VIA+VIB	2881	4330	G15	G10
		VI-C	2794	4942	G16	G8
		VIB+VIC	2814	4531	G15	G10
		VIA+VIB+ VIC	2844	4165	G15	G11
		VI-D	2464	5240	G17	G7
		VIC+VID	2795	4690	G16	G9
		VIB+VIC+ VID	2930	4322	G15	G10
		VIA+VIB+ VIC+VID	2796	4430	G16	G10
		VI-LOCAL	2390	5190	G17	G8
		BAND-1	2215	5230	G17	G7
		V-TOP	2535	5918	G16	G5
		LOCAL-3	2643	5650	G16	G6
		V-BOT	2216	5120	G17	G8
		BAND-2	2564	5684	G16	G6

		IV	2250	5530	G17	G6
		BAND-3	2423	6100	G17	G5
		III	2774	6230	G16	G4
		II LOCAL	3439	5946	G13	G5
		II TOP	2918	5996	G15	G5
		II BOT	3998	6440	G12	G3
		II COMB	2575	6616	G16	G3
		BAND-4	4815	5655	G9	G6
		I	3802	6514	G12	G3
n.	GCV and UHV in Kcal/kg on **I100** basis	**SEAM**	**GCV in Kcal/Kg**		**Grade**	
			Min	**Max**	**Min**	**Max**
		X-TOP	2223	5340	G17	G7
		X-BOTT.	2440	5220	G17	G7
		IX-L2	2252	5776	G17	G6
		IX-L1	2889	5729	G15	G6
		LOCAL-1	2466	5730	G17	G6
		IX	2283	5661	G17	G6
		LOCAL-2	2375	4849	G17	G9
		VIII	2373	4850	G17	G9
		VII	2584	5310	G16	G7
		VI-A	2627	5200	G16	G8
		VI-B	2773	4291	G16	G11
		VIA+VIB	2881	4321	G15	G10
		VI-C	2714	4942	G16	G8
		VIB+VIC	2725	4531	G16	G10
		VIA+VIB+ VIC	2727	4053	G16	G11
		VI-D	2464	5240	G17	G7
		VIC+VID	2795	4690	G16	G9
		VIB+VIC+ VID	2854	4322	G15	G10
		VIA+VIB+ VIC+VID	2375	4430	G17	G10
		VI-LOCAL	2390	5190	G17	G8
		BAND-1	2215	5230	G17	G7
		V-TOP	2535	5918	G16	G5
		LOCAL-3	2643	5650	G16	G6
		V-BOT	2216	5120	G17	G8
		BAND-2	2564	5684	G16	G6
		IV	2250	5530	G17	G6
		BAND-3	2423	6100	G17	G5
		III	2774	6230	G16	G4
		II LOCAL	3439	5946	G13	G5
		II TOP	2918	5996	G15	G5
		II BOT	3998	6440	G12	G3
		II COMB	2575	6616	G16	G3
		BAND-4	4815	5655	G9	G6
		I	3802	6514	G12	G3

o.	Total geological reserves in the block. In Million Tonne **(Mt)**	Seam thickness >0.9 m for all seams	Seam thickness 0.5 to 0.9 m for seams upto seam VI-Local	**TOTAL**
	Proved Indicated **Total**	1636.52 194.42 **1830.94**	92.15 12.99 **105.14**	1728.68 207.38 **1936.08**
p.	Depletion of reserves in case of running mines **(Mt)**	Virgin deposit		
q.	Additional reserves established (if any for running mines)	NA		
r.	Geological reserves considered for mining **(Milllion tonnes)** By opencast By underground **Total**	 606.91 683.91 **1290.82** Reserves in the East of Kelo river is projectised		
s.	Corresponding extractable reserves **(Milllion tonnes)** By opencast By underground **Total**	 427.86 297.90 **725.76**		
t.	Percentage of recovery w.r.t geological reserves in **%age** By opencast By underground	 70.50 43.56		
G	**MINING**			
a.	Existing and proposed method of mining **Opencast** **OB** **Coal**	 Shovel and dumper combination Surface miner, loader and dumper combination		
	Underground	Longwall with Shearer and self-advancing Powered Supports Continuous Miner, where longwall is not applicable Development of longwall panels by Bolter Miners		
b.	The peak capacity as well in addition to targeted capacity in **Mtpa** By opencast By underground **Total**	 15 6 **21**		
c.	Life of the Project in years			
	Opencast working	34 including 2 years construction period		
	Underground working (approx.)	34 years. For balance reserves, revision of Mining Plan is proposed		

d. Quantum of production

Year	Underground (Mt)	Opencast			ROM Coal (Mt)	Beneficiated Coal (Mt)	Washery Reject (Mt)
		OBR (Mcum)	Coal (Mt)	Stripping Ratio (cum/t)			
P1		33.10					
P2		76.67	3.40	22.55	3.40	2.21	1.19
P3		91.16	5.00	18.23	5.00	3.25	1.75
P4		91.45	12.00	7.62	12.00	7.8	4.20
P5		103.70	14.00	7.41	14.00	9.1	4.90
P6		107.58	15.00	7.17	15.00	9.75	5.25
P7		107.58	15.00	7.17	15.00	9.75	5.25
P8		107.58	15.00	7.17	15.00	9.75	5.25
P9		107.58	15.00	7.17	15.00	9.75	5.25
P10		93.63	15.00	6.24	15.00	9.75	5.25
P11		93.63	15.00	6.24	15.00	9.75	5.25
P12		98.75	15.00	6.58	15.00	9.75	5.25
P13		99.43	15.00	6.63	15.00	9.75	5.25
P14		99.43	15.00	6.63	15.00	9.75	5.25
P15	0.36	99.43	15.00	6.63	15.36	9.984	5.38
P16	0.86	99.43	15.00	6.63	15.86	10.309	5.55
P17	1.60	101.22	15.00	6.75	16.60	10.79	5.81
P18	1.60	102.42	15.00	6.83	16.60	10.79	5.81
P19	3.00	102.42	15.00	6.83	18.00	11.7	6.30
P20	3.50	97.33	15.00	6.49	18.50	12.025	6.48
P21	3.50	97.25	15.00	6.48	18.50	12.025	6.48
P22	6.00	94.95	15.00	6.33	21.00	13.65	7.35
P23	6.00	94.95	15.00	6.33	21.00	13.65	7.35
P24	6.00	68.37	15.00	4.56	21.00	13.65	7.35
P25	6.00	68.37	15.00	4.56	21.00	13.65	7.35
P26	6.00	68.37	15.00	4.56	21.00	13.65	7.35
P27	6.00	68.37	15.00	4.56	21.00	13.65	7.35
P28	6.00	78.00	15.00	5.20	21.00	13.65	7.35
P29	6.00	78.00	15.00	5.20	21.00	13.65	7.35
P30	6.00	78.00	15.00	5.20	21.00	13.65	7.35
P31	6.00	78.00	15.00	5.20	21.00	13.65	7.35
P32	6.00	17.99	3.46	5.20	9.46	6.149	3.31
	80.42	**2804.11**	**427.86**	**6.55**	**508.28**	**330.382**	**177.898**

e.	Whether the proposed external OB dump site is coal bearing:	Yes
	If so, whether coal below waste disposal is extractable	Yes, by underground method
f.	Whether negative proving for coal in the propose site of OB	The area is coal bearing

	dump has been done		
g.	Proposed configuration of equipment		
	HEMM for (Coal & OB) OC mine	**Top OB:** 42 cum ERS + 240T Rear Dumpers & 10-12 cum Hydraulic shovels +100T Rear Dumpers. **Partings:** 10-12 cum Hydraulic shovels +100T Rear Dumpers. **Coal:** 100-110t (machine weight) Surface Miner + 10-12 cum FEL + 60T Coal Body Rear Dumpers.	
	Equipment for Underground mine	Continuous/ Bolter miner set: • Continuous miner/ Bolter miner • Shuttle/ ram cars • Mobile roof bolting machine (not required with bolter miner) • Feeder-breaker • Utility vehicle/ LHD • Power centre • Gate-belt conveyor Longwall set: • Self-advancing powered supports • Armoured face conveyor • Shearer • Stage-loader crusher • Gate-belt conveyor • Power pack	
h.	Mode of entry to UG mines	Incline	
i.	Operations that are proposed to be outsourced	The entire operation is proposed to be done by MDO	
j.	Proposed coal evacuation system		
	Incline mouth/ Face to surface	Conveyor belt (Conventional + High angled)	
	Surface to end use plant	To washery by conveyor belt + Washery to Rly. siding by conveyor belt + Rly siding to end use plants by Railway.	
H	**END USE OF COAL**		
a & b	Capacity of the approved end use plants and coal requirement	Capacity in **MW**	Coal required in **Mtpa based on GCV of 4000 kcal/kg**
	Ukai Thermal Power Plan (Unit 1 to 5).	850	4.36
	Ukai Thermal Power Plan (Unit 6)	500	2.22
	Gandhi Nagar Thermal Power Plant (Unit 1 to 4)	660	3.42
	Gandhi Nagar Thermal Power Plant (Unit 5)	210	0.96

	Wanakbori Thermal Power Plant (Unit 1 to 6)	1260	6.16
	Wanakbori Thermal Power Plant (Unit 7)	210	0.96
	Sikka Thermal Power Plant (Unit 1 & 2)	240	1.35
	Sikka Thermal Power Plant (Unit 3 to 4)	500	2.23
	Wanakbori Thermal Power Plant (Unit 8)	800	3.351
	Dhuvaran Thermal Power Plant (Unit 1 & 2)	1600	6.701
	Sinor Thermal Power Plant (Unit2)	800	3.351
	TOTAL	**7630**	**35.063**
c.	%age of end use requirement to be met from this mine	Till 14th (P14) years only upto about **30%** will be met by opencast mine. Beyond that, after start of Underground operation, maximum upto about **40.00%** will be met in the year P22.	
d.	Nature of the beneficiation and recovery rate with consumption of water	Washing by Heavy Media (HM) cyclone with closed water circuit arrangement. Estimated Yield of washed coal = 65% Consumption of water = 1.67 MGD	
e.	Proposed use of rejects/Middlings	Rejects will be disposed through e-auction	
I	**ENVIRONMENTAL MANAGEMENT**		
a.	Existing land use pattern of the projected leasehold area (Ha)		

Land Use Break-up of GP I (Ph-1) Coal Block in Ha

Forest Land	Reserve Forest	0.00
	Protected Forest	48.22
	Chote bade jhar ka Jungle	134.54
Tenancy Land	Village/Town area	58.66
	Industrial land	71.29
	Agricultural land	3058.81
	Grazing land	43.39
	Barren land	0.00
Government land	Total Govt Land	168.90
Grand Total		**3583.81**

b. (i)	Area likely to be degraded inside leasehold (OC+UG) due to	
	Quarry	1620.31
	External Dump	1447.50
	Washery + W/S + Infra + office & others (OC+UG)	147.94

<table>
<tr><td></td><td>Colony</td><td>48.68</td></tr>
<tr><td></td><td>Road, embankment and others</td><td>212.19</td></tr>
<tr><td></td><td>Conveyor and Rail</td><td>71.74</td></tr>
<tr><td></td><td>UG below protected Forest</td><td>35.46</td></tr>
<tr><td>(ii)</td><td>Area likely to be degraded outside leasehold due to</td><td></td></tr>
<tr><td></td><td>Colony (location not decided)</td><td>15.00</td></tr>
<tr><td></td><td>R&R (approximately)</td><td>20.00</td></tr>
<tr><td>c.</td><td>Surface features over the block area</td><td>River KELO, Jindal Power Plant, JINDAL Ash Pond, Part of JINDAL Colony, Part of JINDAL washery/CHP, Piped conveyor from JINDAL washery/CHP to JINDAL Power Plant. High Tension power line etc.</td></tr>
<tr><td>d.</td><td>No. of villages/ houses to be rehabilitated</td><td>20 villages (Fully or partly)</td></tr>
<tr><td>e.</td><td>Population to be affected (approx.)</td><td>Land oustees, Home oustees, Home & Land oustees & other Project Affected Persons (PAPs): 6157nos.
Total Project Affected Families (PAFs): 3208nos.
(Home oustees: 222 + Home & Land oustees: 2986)</td></tr>
<tr><td>f.</td><td>Year wise proposal for reclamation of land affected by mining activities</td><td>
<table>
<tr><th rowspan="2">Year</th><th colspan="3">Proposed area of reclamation in Ha</th></tr>
<tr><th>External Dump area</th><th>Quarry backfilled area</th><th>Total</th></tr>
<tr><td>P3</td><td>149.78</td><td></td><td>149.78</td></tr>
<tr><td>P4</td><td>83.255</td><td></td><td>83.26</td></tr>
<tr><td>P5</td><td>83.255</td><td></td><td>83.26</td></tr>
<tr><td>Sub-total after P5</td><td>316.29</td><td></td><td>316.29</td></tr>
<tr><td>P6</td><td>89.692</td><td></td><td>89.69</td></tr>
<tr><td>P7</td><td>89.692</td><td></td><td>89.69</td></tr>
<tr><td>P8</td><td>89.692</td><td></td><td>89.69</td></tr>
<tr><td>P9</td><td>89.692</td><td></td><td>89.69</td></tr>
<tr><td>P10</td><td>89.692</td><td>24.66</td><td>114.35</td></tr>
<tr><td>Sub-total after P6 to P10</td><td>448.46</td><td>24.66</td><td>473.12</td></tr>
<tr><td>P11</td><td>97.54</td><td>16.21</td><td>113.75</td></tr>
<tr><td>P12</td><td>97.54</td><td>16.21</td><td>113.75</td></tr>
<tr><td>P13</td><td>97.54</td><td>16.21</td><td>113.75</td></tr>
<tr><td>P14</td><td>97.54</td><td>16.21</td><td>113.75</td></tr>
<tr><td>P15</td><td>97.54</td><td>16.21</td><td>113.75</td></tr>
<tr><td>Sub-total P11 to P15</td><td>487.68</td><td>81.07</td><td>568.74</td></tr>
<tr><td>P16</td><td>97.54</td><td>16.21</td><td>113.75</td></tr>
<tr><td>P17</td><td>97.54</td><td>16.21</td><td>113.75</td></tr>
<tr><td>P18</td><td></td><td>16.21</td><td>16.21</td></tr>
<tr><td>P19</td><td></td><td>16.21</td><td>16.21</td></tr>
</table>
</td></tr>
</table>

		P20		16.21	16.21
		Sub-total P16 to P20	**195.07**	**81.07**	**276.14**
		P21		53.21	53.21
		P22		53.21	53.21
		P23		53.21	53.21
		P24		53.21	53.21
		P25		53.21	53.21
		Sub-total P20 to P25		**266.07**	**266.07**
		P26		53.21	53.21
		P27		53.21	53.21
		P28		53.21	53.21
		P29		53.21	53.21
		P30		53.21	53.21
		Sub-total P26 to P30		**266.07**	**266.07**
		P31		53.21	53.21
		P32		53.21	53.21
		Sub-total P31 to P32		**106.43**	**106.43**
		Grand Total	**1447.50**	**825.36**	**2272.86**
g.	Monitoring schedules for different environmental components after the commencement of mining and other related activities	**For air, water and noise, monitoring:** **Ambient Air** :4 Stations (Minimum) (Quarterly) **Water** :6 Stations (Minimum) Effluent points: 2 stations (Minm.). 4 parameters of which shall be monitored on quarterly basis and rest parameters on yearly basis. Drinking water sampling points: 2 stations (Minm.). Shall be monitored on quarterly basis. Surface water sampling points: 2 stations (Minm.). Shall be monitored on quarterly basis. **Noise** :4 Stations (Minimum) (Quarterly) **Plantation** : continuous monitoring of the growth and survival/mortality rates of the plantation till the end of 3 years. **Health:** Periodical medical examination for the work persons associated with the mining operation as per mines rules.			

J	PROGRESSIVE AND FINAL MINE CLOSURE PLAN	
	Estimated total capital expenditure on mine closure activities Opencast Underground	 ₹. 29788.34 Lakhs (as on November, 2016) ₹.119.73 Lakhs (as on November, 2016)
	Major closure activities with proposed Capital	
	OPENCAST	
	Activity	**Mine closure cost in ₹ Lakhs**
	Dismantling of Structures	
	Service Buildings	149.06
	Residential Buildings	1989.94
	Industrial structures like CHP, Workshop, field sub-station, etc.	223.59
	Permanent fencing of mine void and other dangerous area	
	Random rubble masonry of height 1.2 metre including levelling up in cement concrete 1:6:12 in mud mortar	1117.94
	Grading of high-wall slopes	
	Levelling and grading of high-wall slopes	1319.17
	OB Dump Reclamation	
	Handling/Dozing of OB Dump and backfilling	66077.86
	Technical and Bio-reclamation including plantation and post care.	298.11
	Landscaping	
	Landscaping of the open space in leasehold area for improving its aesthetics an eco-value	223.59
	Plantation	
	Plantation over cleared area obtained after dismantling	372.65
	Plantation around the quarry area and in safety zone	149.06
	Plantation over the external OB Dump	14.90
	Post Closure Env. Monitoring/testing of parameters for three years	
	Air Quality	163.97
	Water Quality	149.06
	Entrepreneurship Development (Vocational/skill development training for sustainable income of affected people	193.79
	Miscellaneous and other mitigative measures	1490.59
	Post Closure Manpower cost for supervision	596.24
	TOTAL	**74529.50**

	UNDERGROUND	
	Activity	**Mine closure cost in ₹ Lakhs**
	Dismantling of Structures	
	Service Buildings	13.72
	Residential Buildings	41.47
	Industrial structures like CHP, Workshop, field sub-station, etc.	24.81
	Permanent sealing of mine entries (incline mouth and air shaft)	
	Sealing of incline mouths and air shafts	20.85
	Subsidence Management	18.62
	Landscaping	
	Landscaping of the cleared land for improving its aesthetic	34.49
	Plantation	
	Plantation over leasehold area and on other open spaces	50.96
	Post Closure Env Monitoring / testing of parameters for three years	
	Air Quality	26.77
	Water Quality	24.85
	Entrepreneurship Development (Vocational/skill development training for sustainable income of affected people	29.98
	Miscellaneous and other mitigate measures	57.23
	Post Closure Manpower cost for supervision	48.21
	TOTAL	**391.94**
K	**OTHERS**	
a.	Base date of Mining Plan	December 2016
b.	Calendar year from which the production will start from zero date i.e. date of approval of Mining Plan	5 years
c.	Results of any investigation carried out for scientific mining, conservation of minerals and protection of environment; future proposals	Hydrogeological study Slope stability study Study of applicability of High wall mining in the batters
	Signature of RQP	
	Date:	
	Place:	

CHAPTER-1

INTRODUCTION

1.1 BACKGROUND OF THE ALLOTTEE COMPANY

Gujarat State Electricity Corporation Limited (GSECL) was incorporated in August 1993 and is registered under the Companies Act, 1956 with the objectives to initiate a process of restructuring of Power Sector and to mobilize resources from the market for adding to the generating capacity of the State and improving the quality and cost of existing generation. The Company was promoted by erstwhile Gujarat Electricity Board (GEB) as it's wholly owned subsidiary in the context of liberalization and as a part of efforts towards restructuring of the Power Sector. The Memorandum and Articles of Association of GSECL envisage a wide spectrum of activities to improve the electricity infrastructure of Gujarat. GSECL has initiated its activities in the field of Generation of Power.

The Government of Gujarat (GoG) has also given to the GSECL the status of Independent Power Producer (IPP) with approval to undertake new power projects. The Company commenced its commercial operation in the year 1998. However, the operations of GSECL were limited to Power Stations units Gandhinagar 5, Wanakbori 7, Utran GBPS & Dhuvaran CCPP till the complete unbundling of erstwhile GEB was undertaken, i.e. up to 31st March 2005.

As a part of the reform process, the Government of Gujarat has unbundled the various functions of GEB. As a result of this unbundling, Gujarat State Electricity Corporation Limited (GSECL) has taken up the responsibility of electricity generation. Electricity Transmission has been entrusted to the already existing company - GETCO. Distribution network in the state has been split up among four distribution companies, which cater to the northern, central, southern, and western parts of the state respectively. All these companies have been structured as subsidiaries of a holding company, Gujarat Urja Vikas Nigam Limited (GUVNL). GUVNL is also the single bulk buyer in the state as well as the bulk supplier to distribution companies.

1.2 PROPOSAL OF THE MINING PLAN

Due to presence of power plant and other structures of JINDAL in the Western part of the Kelo River, only the part of the block in the Eastern side of the Kelo River has been considered for mining in the ***1st phase***.

1.3 END USE PLANTS

1.3.1 LOCATION OF END USE PLANTS

Sl. No	Power plants	Address	Distance in Km.	Status
1	Ukai Thermal Power Plan (Unit 1 to 5).	Taluka Fort, Songadh, dist. Tapi, Gujrat	1200	Operating
	Ukai Thermal Power Plan (Unit 6)			
2	Gandhi Nagar Thermal Power Plant (Unit 1 to 4)	Dist. Gandhinagar, Gujrat	1500	Operating
	Gandhi Nagar Thermal Power Plant (Unit 5)			
3	Wanakbori Thermal Power Plant (Unit 1 to 6)	Taluka Thasra, Dist. Kheda, Gujrat	1350	Operating
	Wanakbori Thermal Power Plant (Unit 7)			
4	Sikka Thermal Power Plant (Unit 1 & 2)	Dist. Jamnagar, Gujrat	1850	Operating
	Sikka Thermal Power Plant (Unit 3 to 4)			
5	Wanakbori Thermal Power Plant (Unit 8)	Taluka Thasra, Dist. Kheda, Gujrat	1350	Proposed
6	Dhuvaran Thermal Power Plant (Unit 1 & 2)	Dist. Anand, Gujrat	1450	Proposed
7	Sinor Thermal Power Plant (Unit 2)	Dist. Vadodara, Gujrat	1425	Proposed

1.3.2 COAL REQUIREMENT WITH QUALITY, QUANTITY AND TIMEFRAME

Sl. No	Power plants	Quality	Reqd. Quantity in MTPA	Time frame
1	Ukai Thermal Power Plan (Unit 1 to 5).	GCV of 4000 Kcal/Kg	4.36	Operating
	Ukai Thermal Power Plan (Unit 6)		2.22	
2	Gandhi Nagar Thermal Power Plant (Unit 1 to 4)		3.42	Operating
	Gandhi Nagar Thermal Power Plant (Unit 5)		0.96	
3	Wanakbori Thermal Power Plant (Unit 1 to 6)		6.16	Operating
	Wanakbori Thermal Power Plant (Unit 7)		0.96	
4	Sikka Thermal Power Plant (Unit 1 & 2)		1.35	Operating
	Sikka Thermal Power Plant (Unit 3 to 4)		2.23	
5	Wanakbori Thermal Power Plant (Unit 8)		3.351	2018-19
6	Dhuvaran Thermal Power Plant (Unit 1 & 2)		6.701	2020-21
7	Sinor Thermal Power Plant (Unit 2)		3.351	2020-21
	TOTAL		**35.063**	

1.3.3 NORMS USED FOR COMPUTING CONSUMPTION

Coal quantity is calculated considering coal GCV of 4000 Kcal/kg and PLF of 85%. Heat rate for all operating units are considered as approved by GERC and for new upcoming units as proposed by MoC in allotment document.

1.3.4 ANY VARIATION SOUGHT W.R.T COMPETENT APPROVAL

NIL.

1.3.5 PERCENTAGE OF REQUREMENT CAN BE MET FROM THE MINING PROJECT

Till 14th (P14) year maximum up to about **30.00%** only will be met by opencast mine. Beyond that, after start of Underground operation, maximum up to about **40.00%** will be met from year P22.

1.3.6 THE AMOUNT OF EXISTING LINKAGE CAN BE REPLACED

Existing linkage is as follows:

Sl. No	Power plants	Existing Linkage in MTPA
1	Ukai Thermal Power Plan (Unit 1 to 5).	3.240 with SECL 0.930 with WCL
	Ukai Thermal Power Plan (Unit 6)	
2	Gandhi Nagar Thermal Power Plant (Unit 1 to 4)	3.46 with SECL
	Gandhi Nagar Thermal Power Plant (Unit 5)	
3	Wanakbori Thermal Power Plant (Unit 1 to 6)	8.52 with SECL
	Wanakbori Thermal Power Plant (Unit 7)	
4	Sikka Thermal Power Plant (Unit 1 & 2)	1.22 with SECL
	Sikka Thermal Power Plant (Unit 3 to 4)	
5	Wanakbori Thermal Power Plant (Unit 8)	
6	Dhuvaran Thermal Power Plant (Unit 1 & 2)	
7	Sinor Thermal Power Plant (Unit 2)	
	Total	**17.37**

Initially for the first 15 years only 15 MTPA from opencast and thereafter additional maximum up to 6 MTPA from underground ROM coal will be available from this project. For the 1st 14 years, considering yield of 65% after washing, the available quantity would be 9.75 Mt only. Thereafter, maximum up to 3.9 Mt of coal from underground mining will be added, resulting a total of 13.65 Mt. in the year P22 at tentative GCV band of G-10

(4300 kcal/kg – 4600 kcal/kg). Considering total requirement of about 35 Million tonnes of coal with GCV of 4000 Kcal/Kg, replacement of the existing linkage from the available coal from the mining project is not likely.

1.3.7 MODE OF DISPATCH OF COAL

The coal dispatch from the mine will be as follows:

- From the Pit to the Washery, by conveyor belt.
- From Washery to the Silo, by conveyor belt.
- Loading to the Wagons at proposed Siding, through Silo.
- From Siding, via East Rail Corridor to the power plants.

1.3.8 WASHING OF COAL

Washing of coal is proposed at the pithead. A washery will be set up in the coal bearing area in the East side of the Kelo River within the block.

CHAPTER-2

DETAILS OF EARLIER APPROVED MINING PLAN

Mining plan of this geological block is being presented first time to the Ministry of Coal. The proposal of presentation of details of earlier Mining Plan, therefore, does not arise.

CHAPTER-3

LOCATION TOPOGRAPHY AND COMMUNICATION

3.1 LOCATION

The Gare Palma Sector-I Coal Block is located in the South-Eastern part of Mand-Raigarh Coalfield and is about 35 kms North-East of Raigarh, the district head quarter. The block covers an area of about 57.39 Sq. Km. and fall within Survey of India Topo-sheet Nos. 64 N/8 & 12 (R.F. 1:50,000).

3.2 ACCESS TO THE LOCATION

The Gare Palma Sector-I Coal Block is situated around 35 km away from Raigarh Township, which is also the nearest railway station on Mumbai-Howrah main line of SE Railways. The block is connected by road from Raigarh via Punjipathara by state Highway. Punjipathara village is situated on Raigarh-Gharghoda main road. The distance from Raigarh to Gharghoda is around 40 km. The road distance between Raigarh to Punjipathara is about 20 Km and Punjipathara to Gharghoda is 20 Km towards North. From Punjipathara the road leads to the Gare Palma Sector-I Coal Block via Tamnar situated at a distance of 10 Km on Punjipathara-Lelunga road, which passes through the block. Tamnar is situated in the South-Western part of the Gare Palma Sector-I Block (Sub Block 'F'). Another village namely Dhourabhata is situated in Sub Block 'B' of Gare Palma Sector-I Block. This village is about 40 Km. from Gharghoda and it is connected by all-weather Dhourabhata – Tamnar - Gharghoda road. Gare Palma Sector-I Block area is practically inaccessible during monsoon due to wide spread paddy cultivation in the complete area under investigation.

Further North a tar road connects Gharghoda with Dharamjaygarh town situated at the Northern periphery of the coalfield, which leads to Ambikapur in the North. The distance from Raigarh to Dharamjaygarh is 75 kms. and to Ambikapur is 120 Km. Kharsia is another railway station located on Howrah – Nagpur section of South Eastern Railway. The distance from Dharamjaygarh to Kharsia is 60 kms.

3.3 AVAILABILITY OF POWER

Power is proposed to be drawn from Gherwani sub-station of CGPCL located at a distance of about 20 Km.

3.4 AVAILABILITY OF WATER

Pumped out mine water will mostly be used for mining purposes. However, if permitted, water from Kelo River may be drawn to substantiate any additional requirement. Kelo River flows across the block.

3.5 PHYSIOGRAPHICAL FEATURES, DRAINAGE ETC.

The topography of Gare–Palma Area is mostly covered by softer horizon and in general represents an undulating terrain, more resistant sedimentary rocks stand out as ridges, rising as high as 580m (Silot Pahar) in the North-West and 600m (Morga Pahar) in the North-East. The general ground elevation of the Gare Palma Sector-I area under investigation varies between 280m and 340m above MSL. The minimum ground level is 262.56m (borehole MGP-45) and maximum ground elevation is 311.13 m (borehole MGP-3) pertaining to sub block 'B'. However, in phase-I side, RLs of maximum of 318.00m and minimum 244m can be seen in the surface contour plan of the block.

Kelo River is flowing in the Western part of the Phase-I area and it constitutes the main drainage system. The main subsidiary stream channels draining in the block flow from North-West and South-East & joins the Kelo River at the extreme Western part of the area. This subsidiary stream channel is fed by number of small tributaries rising from hills both from North and South.

The drainage pattern of the coalfield is characterised by the Southerly flowing perennial Mand River with its tributaries constitute the main drainage of the area. The Kelo River, a tributary of Mahanadi, drains the Eastern part of the coalfield.

A public road from village Hukraodepa (Kunjumepa) located in the Western side of the Kelo River to village Amgaon located in the extreme East of the block has been proposed to be diverted along the northern fringe of the proposed quarry area. At village Hukraodepa (Kunjumepa) the road connects to the road to Tamnar.

3.6 LAND USE

Major part of the block is covered by cultivated land. Main cultivation is paddy. The soil of the area is having fair to medium range of fertility. A number of villages are found scattered in the block. The villages located within the block area are:

West of Kelo river: Tamnar, Godhi, Basanpali, Salihabhata, Uttar Regaon, Dakshin Regaon, Dolesera, Pata, Telaipara, Tangarghat, Kunjemura.
East of Kelo River: Budhiya, Baghbadi, Libra, Jharna, Raipara, Jhikabahal, Samkera, Dhourabhata, Tapranga, Mahloi, Khuruslenga, Bijna, Nagramunda, Tehli Rampur, Aamgaon.

Forest cover is noticed in the Northern part of the block in 4 small isolated patches. A strip of protected forest occupies the northern part of the block. Besides, the forest cover is also found in small isolated patches in the northern part of the block. The forest constitutes Sal, Teak, Bija, Mango, Neem, Tendu trees etc. The common wild animals found in this area are elephant, wild dog & wild bear etc. The remaining part of the area is covered by cultivated land.

3.7 IMPORTANT SURFACE FEATURES AND THEIR SHIFTING

The existing surface features available in the block are as follows:

Public road- A public road from village Kunjemura located in the Western side of the Kelo river to village Aamgaon located in the extreme East of the block has been proposed to be diverted along the Northern fringe of the block. At village Kunjemura the road connects to the road to Tamnar.

Kelo river- bifurcating the block into East and West. The river has been proposed not to be disturbed.

Jindal Power Plant and Jindal Ash pond- This plant is located in the West side of the Kelo River. In the first phase, the activity has only been proposed in the East side of the Kelo river except the railway siding and conveyor belts. These structures have not, therefore, been disturbed in this Mining plan.

Jindal Washery, Jindal colony fenced area- Parts of these structures are located within the Northern boundary of the Eastern part of the block. The parts of these structures within the block are to be removed before mining in the area.

Pipe conveyor connecting Jindal Washery and Jindal Power Plant- A pipe conveyor runs across the block from east to west for carrying washed coal from Jindal Washery to power plant. This conveyor will need to be removed from the block area to allow external dumping and construction of infrastructure for the project.

High Tension Power line- High Tension Power line passes diagonally from the central part of the block. This power line will need to be diverted away from the mining area.

Explosive & Detonator units and some Quarters: Explosive & detonator units and some quarters, in the North of the quarry, will need to be shifted.

CHAPTER-4

GEOLOGY AND EXPLORATION

4.1 EXPLORATION

4.1.1 QUANTUM OF WORK

Mineral Exploration Corporation Ltd., Directorate of Geology & Mines, Chhattisgargh and Shreeram Gemicon have carried out detailed exploration in Gare Palma Sub Block B, C, D, E, F and Sub Block A respectively, involving various activities like geological mapping, surveying, drilling, lithological logging, coal sampling, chemical analyses, sample generation to conduct special tests, geophysical logging etc. The quantum of work done under different activities is summarised in Table below.

Sl. No	Item of work	Work done
1.	Area of the block	60.75 Sq.km. (As per physical work carried out)
2.	***Geological Mapping*** MECL SHREERAM GEMICON Total	 53.35 Sq.km 7.40 Sq.km **60.75 Sq.Km**
3.	Surveying	
	Triangulation MECL SHREERAM GEMICON **Total**	 53.35 Sq.km 7.40 Sq.km **60.75 Sq.Km**
	R.L of BHs MECL SHREERAM GEMICON GSI DGM **Total**	 294 BHs (MGP series) 42 BHs* (CMG series) 4 BHs (RGP series) 18 BHs (CGGD series) **358 Bhs**
	Surface features & surface contouring MECL SHREERAM GEMICON **Total**	 53.35 Sq.km 7.40 Sq.km **60.75 Sq.Km**

Sl. No	Item of work	Work done
4.	***Exploratory Drilling*** MECL SHREERAM GEMICON GSI DGM **Total**	 109286.95m (MGP Series) 18008.50m (CMG Series) 1904.40m (RGP Series) 7576.50 m (CGGD Series) **136776.35m**
5.	***Geological Core logging*** MECL SHREERAM GEMICON GSI DGM **Total**	 109286.95m (MGP Series) 18008.50m (CMG Series) 1904.40 m (RGP (Series) 7576.50m (CGGD Series) **136776.35 m**

4.1.2 SEAMWISE BOREHOLE INTERSECTION AND BOREHOLE DENSITY

Seam wise borehole intersection and borehole density in bus per sq. Km is as follows:

Sl. No.	Seam	No. of Bhs intersected	Density in Bhs/Sq. Km
1	X-TOP	357	5.89
2	X-BOTT.	357	5.89
3	IX-L2	357	5.89
4	IX-L1	357	5.89
5	LOCAL-1	357	5.89
6	IX	358	5.91
7	LOCAL-2	351	5.79
8	VIII	357	5.89
9	VII	357	5.89
10	VI-A	354	5.84
11	VI-B	356	5.88
12	VIA+VIB	30	
13	VI-C	356	5.88
14	VIB+VIC	23	
15	VIA+VIB+ VIC	83	
16	VI-D	353	5.83
17	VIC+VID	25	
18	VIB+VIC+ VID	32	
19	VIA+VIB+ VIC+VID	353	5.83
20	VI-LOCAL	318	5.25
21	BAND-1	215	3.55
22	V-TOP	211	3.48
23	LOCAL-3	211	3.48
24	V-BOT	211	3.48

Sl. No.	Seam	No. of Bhs intersected	Density in Bhs/Sq. Km
25	BAND-2	211	3.48
26	IV	40	0.66
27	BAND-3	210	3.47
28	III	202	3.33
29	II LOCAL	85	1.40
30	II COMB	84	1.39
31	II TOP	106	1.75
32	II BOT	106	1.75
33	BAND-4	71	1.17
34	I	12	0.20

4.1.3 REQUIREMENT OF ADDITIONAL EXPLORATION WITH TIME FRAME

The proposed phase-I area of the block can further be subdivided into Part-A and Part-B. The proposed quarry area is part-A and the balance of the area in the East side of Kelo River is part-B. For opencast mining in the part –A area, no further drilling is proposed.

There is requirement of further exploration in the Part-B side, where underground mining has been proposed by longwall technology. The additional drill should be up to the lowermost seam and will have to be completed before external dumping operation starts from the quarry in part-A area. The additional exploration should be such that the overall density of boreholes in the area becomes 12 numbers per square kilometer.

4.2 GEOLOGY

4.2.1 MAND RAIGARH COALFIELD

Mand-Raigarh Coalfield lies in the drainage basin of Mahanadi. It represents a part of the south-eastern periphery of a vast cauldron of sedimentary terrain, known as Son-Mahanadi Gondwana Master Basin. Mand-Raigarh Coalfield along with Ib-Himgiri coalfield towards south-east and Korba-Hasdo towards west and north-west constitute the large NW-SE trending asymmetrical synformal master basin.

The coalfield is characterised by undulatory rolling topography consisting of hills interspersed with broad valleys. The general elevation of the ground is around 300m above M.S.L. The slope is either towards southwest or south-east. The hills are relict type and rise about 450m. above the Sea level. The southerly flowing perennial Mand River with its tributaries constitutes the main drainage of the area. The Kelo River, a tributary of Mahanadi drains the eastern part of the coalfield.

4.2.2 REGIONAL GEOLOGY

4.2.2.1. Geological Succession

The extensive occurrences of Barakar and Supra-Barakar rocks amidst isolated Talchir outcrops spanned between latitudes N21045' to N22042' and longitudes E83001' to E83044', constitute Mand-Raigarh Coalfield. It is situated between Ib-River Coalfield in the south-east and Korba Coalfield in the south-west with more or less similar stratigraphic and tectonic setting. The coal measures in the Mand-Raigarh basin are exposed in three well defined patches due to erosion of the overlying Kamthi rocks along the drainage of the prominent rivers.

The generalised stratigraphy of Mand-Raigarh Coalfield is enumerated below in following.

Generalised Stratigraphic Succession

Age	Formation	Thickness (m)	Lithology
Recent	Soil Alluvial	3	Alluvial soil pebbly to bouldary bed with silty clay band, laterite etc.
Cretaceous to Eocene	Deccan Traps	-	Basalt flows & dolerite dykes
Lw. to Mid. Triassic	Kamthi	2851	Poorly sorted, frequently ferruginous, coarse to very coarse grained, locally graded to pebbly, mega cross bedded sandstone containing, brownish grey to buff coloured clay clasts. A fossiliferous red claystone to siltstone bed occurs at the base.

Age	Formation	Thickness (m)	Lithology
Up. Permian to Lw. Permian	Raniganj	180	Mostly fine to medium grained, greyish white, micaceous sandstone and siltstone with claystone, shale, minor coarse grained sandstone and two coal seams of inferior grade.
	Barren Measure	300	Dominantly grey claystone/grey shale with siltstone and iron stone bands; interbanded sequence of fine to medium grained sandstone and shale
	Barakar	425 - 800	Medium to coarse and very coarse grained even gritty, sandstone at the lower part followed upward by fine to medium grained assemblage with grey claystone/shale which becomes predominant towards the upper part, coal and carbonaceous shale.
	Karharbari (?)	23	Mottled at places carbonaceous sandstone, frequently associated with pebbles of quartzite, granite etc. of various shapes and sizes
Up. Carboni-ferous to Lw. Permian	Talchir	150+	Very fine to fine grained sandstone with siltstone and shale, occasionally greenish in nature, at places with matrix based variegated polymictic conglomerate.

4.2.2.2. Geological Formations

The geological formations of Mand-Raigarh Coalfield are briefly described below:

Precambrian: The Precambrian rocks comprising granite gneiss, mica schist, phyllites and quartzites along with quartz veins & pegmatites occur along the northern, north-eastern periphery. The strike of the foliation varies from E-W to N70^{o}W – S70^{o}E with 50^{o} to 70^{o} dip towards west.

Talchir Formation: The Talchir sequence begins with tillite at the base and overlies the basement unconformably. It occurs as a continuous strip along the northern periphery of the basin. Along the southern boundary, Talchirs crop out as narrow, elongated discontinuous strips disrupted by faults. The Mand-Raigarh basin shows widespread development of basal tillite pointing to advancement of ice from the surrounding Precambrian uplands.

Karharbari Formation: Karharbari formation is developed in a limited area. It consists of mottled, at places carbonaceous sandstone, frequently associated with pebbles of quartzite, granite etc. of various shapes and sizes

Barakar Formation: The Barakar formation conformably overlies the Talchir sediments over the major part of coalfield and covers a large tract within the coalfield. It is represented predominantly by multistoried cross-bedded feldspathic sandstones which are highly kaolinised and friable with subordinate shales, carbonaceous shales and coal seams. The sandstones are mostly medium to very coarse grained and milky white to greyish white in colour. The sandstone is arkosic in nature and often shows pronounced kaolinisation. Exposures of fine-grained sandstone and grey to greyish black shale are very limited.

Barren Measure Formation: Barren Measure formation overlies conformably over Barakar formation. Barren Measure formation can be traced in the south eastern part between Gharghoda and Gare, besides sporadic occurrence in vicinity of Chhal and Kurumkela. This formation comprises of predominantly grey claystone/grey shale with siltstone and iron stone bands and interbanded occurrence of fine to medium grained sandstone & shale.

Raniganj Formation: Raniganj formation has been demarcated in south-eastern and south-western part, besides patchy occurrence in north-western part. It is represented by mostly fine to medium grained sandstone, siltstone with clay stone, shale, fine to coarse grained sandstone and coal seams / bands of inferior grade.

Kamthi Formation: The rocks of Kamthi formation are well exposed at higher contours of the flat topped hills. They not only occur in the intervening area between Mand Valley and Hasdo-Arand on the one side and the Raigarh Coalfield on the other, but also occur as irregular patches along the axial region of the Mand Valley. It is represented dominantly by coarse, friable, porous, and brownish to red cross bedded sandstone and argillaceous beds. The nature of the contact between Kamthis & Barakars is variable and is somewhat discordant and at places the Kamthi strata overlap the older units.

Intrusives / Deccan Trap: A number of basic dykes, sills and flows have been observed in the Uprora-Porea area in the northern part of the coalfield. The basic rock comprises fine-grained basalts to coarse-grained gabbroid type. The flows at places have been altered to laterite. A dyke exposed north of Amaldih has been traced over a distance of 26.5 Km. in an east-west direction and another dyke exposed 0.8 Km. south of Porea is over 6 Km. length.

4.2.2.3. Coal Seams:

The regional exploration so far conducted & continuing till date in this Coalfields especially in the western part of Mand-Raigarh coalfield along the eastern bank of Mand River and northern part of Dharamjaygarh-Khargaon, Ongana - Potia as well as Chhal area have revealed the presence of a number of coal seams in this coalfield. Exploration in the north-western and western part of the coalfield reveals number of coal seams and these have been numbered as I to XXII and so on in ascending order.

The coal of this coalfield is generally banded in nature and it is not devolatilised. In general coal is low in rank, high in volatile and non-coking type.

4.2.2.4. Regional Structure:

The Mand-Raigarh Coalfield is an asymmetrical basin with an approximately NW-SE axis. It is a part of Ib-Mand-Korba master basin lying within the Mahanadi Graben. It displays a typical half-graben configuration, with the southern boundary marked by a major NW-SE zone of faulting coinciding with the trend of the Mahanadi Graben and the northern boundary not faulted over the major part. In the Mand Valley proper, the coal measures lying between Kharsia & Dharamjaygarh display a broad synclinal structure with its axis running just south of Sithra. The northern limb of the Mand river basin is exposed to the north of the Sithra-Dharamjaygarh area where the Barakar beds are found to strike broadly in NW-SE direction. The beds dip at low angle of 5^0 to 7^0 towards south-west. In the southern limb, the strike is approximately NW-SE with minor variations and the beds dip towards north-east.

The other structural element in this basin comprises normal gravity faults. The available surface and sub-surface data indicate that the area lying on both sides of Mand River is traversed by number of sub-parallel faults of considerable linear extent, though the surface expressions of faults are very limited or entirely lacking. Two sets of faults trending WNW-ESE to NW-SE and N-S occur. The former generally has down throws against the dip i.e. towards north while the latter has easterly throw. The amount of throw varies from 10m. to 150m.

4.2.3 GEOLOGY OF THE BLOCK

4.2.3.1. Geological Succession

Gare Palma Sector-I Coal Block is located in the south-eastern part of Mand-Raigarh Coalfield. The Geology of the block is in conformity with the regional set up. Major part of Gare Palma Sector-I Coal Block is covered by Barren Measure formations.

The geological succession evolved on the basis of exploration data generated in the block is given in the Table as follows:

GEOLOGICL SUCCESSION IN GARE PALMA SECTOR-I COAL BLOCK

Formation	Thickness (m)	Lithology
Recent	1.00 – 17.00	Soil, alluvium
Barren Measure	3.00– 237.97	Fine to medium grained sandstones shale and intercalation of shale and sandstone, carbonaceous shale & coal lenses.
Barakar	160.50 – 482.29	Fine, medium and coarse grained felspathic, grey sandstone, micaceous and laminated at places. Grey shale, fire clay, intercalation of shale and sandstone and carbonaceous shale with coal
Talchir	2.00 – 8.80	Khakee, greenish shales & sandstone, occasional pebbly
Basement	2.10-8.25	Metamorphics

4.2.3.2. Geological Formation

The geological formations of the block are briefly described below:

Metamorphics: Precambrian metamorphic rock constitutes the basement of the basin. The older metamorphic rocks, which are exposed on northern part beyond the block boundary, are composed of quartzite, mica-schist, granite gneiss and at places intruded by pegmatites and quartz vein. The metamorphics have been intersected in 10 boreholes (MGP-24, 26, 27, 36, 44, 49, 66, 204, CMG-35 & RGP-3). The thickness of metamorphics as intersected in boreholes varies from 2.10m (MGP-36) to 8.25m (RGP-3).

*Talchir Formation***:** It is encountered in 8 boreholes MGP–4, 14, 56, 62, 67, 69, 204 & RGP-1. The thickness of Talchir as intersected in boreholes varies from 2.00m (MGP–4) to 8.80m (RGP-1). Talchir formation consists of greyish white to greenish grey sandstone and shale, occasionally khakee in colour. At places it is embedded with pebbles of quartzite, mica-schist, granite gneiss and of pegmatite. Talchir formation is not exposed in the block. The description is based on boreholes data.

*Barakar Formation***:** The rocks of Barakar formation are not exposed within the block. The thickness of Barakar formation as intersected in boreholes varies from 160.50 (MGP-204) – 482.29 m. (MGP-62) Barakar formation constitute fine to coarse grained, white to grey feldspathic, micaceous sandstone, shale and carbonaceous shale with economic coal horizons. A total of 26 major Coal Seams showing splitting nature have been encountered in this formation besides 7 impersistent local seams / bands.

Barren Measure Formation: The entire area of the block is covered by Barren Measure Formation. This formation is intersected in most of the boreholes drilled in the block. Due to preponderance of shale in the upper part of the Barakar formation it is difficult to draw a clear cut boundary between the Barakar and the Barren Measure formation by which the boundary appears to be gradational. The thickness of this formation as intersected in boreholes varies from 3.00 m (MGP-196) to 237.97 m (MGP-245). Barren Measure Formation is represented predominantly by grey shale with minor sandstone

and intercalation of sandstone and shale. At places carbonaceous and lenses of coal also occur. On an average argillaceous sediments predominate over arenaceous facies.

Igneous Intrusives: The block is free from any igneous intrusives.

4.2.3.3. The characteristics of Litho units

The characteristics of the litho units e.g. coal seams, parting and overburden are provided in the table as follows:

SEQUENCE OF COAL SEAMS AND PARTING IN GARE PALMA SECTOR-I COAL BLOCK

Sl. No.	Coal Seams	Thickness of Coal Seam (m)		Thickness of Parting (m)	
		Minimum	Maximum	Minimum	Maximum
1	X - Top	0.05 (MGP-293)	5.60 (CMG-09)		
	Parting			0.56 (MGP-226)	12.07 (MGP-249)
2	X – Bott.	0.14 (MGP-280)	6.00 (MGP-237)		
	Parting			4.20 (MGP-82)	28.10 (CMG-25)
3	IX- L2	0.06 (MGP-160)	2.54 (MGP-267)		
	Parting			2.03 (MGP-162)	24.02 (MGP-220)
4	IX- L1	0.09 (MGP-57)	5.41 (CMG-25)		
	Parting			2.25 (MGP-196)	20.83 (MGP-137)
5	Local-1	0.05 (MGP-54)	1.48 (CGGD-5)		
	Parting			0.85 (CMG-17)	18.02 (MGP-86)
6	IX	0.27 (MGP-245)	13.67 (MGP-14)		
	Parting			.20 (MGP-127)	15.15 (MGP-250)
7	Local-2	0.02 (CGGD-2)	3.77 (MGP-119)		
	Parting			0.33 (CGGD-2)	28.59 (MGP-46)
8	VIII	0.03 (CGGD-13)	6.68 (CMG-9)		
	Parting			0.96 (CGGD-8)	31.20 (MGP-133)
9	VII	0.06 (MGP-100)	4.24 (MGP-239)		

Sl. No.	Coal Seams	Thickness of Coal Seam (m)		Thickness of Parting (m)	
		Minimum	Maximum	Minimum	Maximum
	Parting			1.64 (MGP-55)	14.10 (MGP-196)
10	VI-A	0.32 (MGP-283)	5.73 (CMG-13)		
	Parting VIA to VIB+C VIA to VIB+C+D			0.90 (MGP-199) 1.04 (MGP-292) 1.03 (MP-264)	5.57 (CMG-14) 3.60 (CMG-13) 6.64 (CMG-17)
11	VI-B	0.15 (MGP-199)	6.45 (CMG-3)		
	Parting VIB to VIC			0.63 (CMG-02) F	7.31 (CMG-12)
12	VIA+VIB	1.70 (MGP-152)	9.26 (MGP-43)		
	Parting			0.75 (MGP-223)	2.58 (MGP-140)
13	VI-C	0.48 (MGP-289)	6.77 (CMG-22)		
	Parting VIC to VID			0.40 (MGP-289)	3.43 (CMG-11)
14	VIB+VIC	0.73 (MGP-130)	12.47 (CGGD-11)		
	Parting VIB+C to VID			0.21 (MGP-162)	4.20 (CMG-01) F
15	VIA+VIB+VIC	0.54 (MGP-80)	10.89 (MGP-132)		
	Parting			0.55 (MGP-102)	3.51 (MGP-222)
16	VI-D	0.05 (MGP-102 & 104)	8.22 (CMG-8)		
	Parting VID to VI LOCAL			0.25 (MGP-280)	20.87 (MGP-60)
17	VIC+VID	1.61 (MGP-25)	14.58 (CMG-28)		
	Parting VIC+D to VI LOC			0.50 (MGP-135)	20.75 (MGP-25)
18	VIB+VIC+VID	3.13 (MGP-182)	17.16 (CGGD-16)		
	Parting VIB+C+D to VI LOCAL			13/8 (MGP-119)	15.69 (MGP-153)
19	VIA+VIB+VIC +VID	1.80 (MGP-98)	17.13 (CGGD-13)		
	Parting			0.70 (MGP-97)	23.45 (MGP-148)
20	VI-Local	0.02 (CGGD-13)	24.65 (MGP-262)		
	Parting			7.87 (MGP-197)	34.65 (MGP-17)
21	Band-1	0.05 (MGP-14)	1.62 (MGP-197)		

Sl. No.	Coal Seams	Thickness of Coal Seam (m)		Thickness of Parting (m)	
		Minimum	Maximum	Minimum	Maximum
	Parting			9.35 (MGP-14)	36.84 (MGP-68)
22	V-Top	0.07 (CGGD-7)	2.19 (CGGD-4)		
	Parting			0.40 (CMG-18)	16.37 (CGGD-2)
23	Local-3	0.06 (MGP-88)	1.24 (MGP-80)		
	Parting			3.95 (MGP-152)	30.12 (CMG-19)
24	V-Bot	0.05 (MGP-55)	6.39 (CGGD-11)		
	Parting			0.10 (MGP-135)	23.13 (MGP-142)
25	Band-2	0.02 (MGP-22)	3.85 (CMG-32)		
	Parting			10.45 (CMG-12)	62.82 (MGP-158)
26	IV	0.04 (CGGD-12)	2.25 (MGP-8)		
	Parting			5.21 (CMG-18)	48.83 (MGP-52)
27	Band-3	0.02 (MGP-18)	2.06 (CMG-26)		
	Parting			22.13 (CMG-27)	71.77 (MGP-145)
28	III	0.04 (MGP-204)	4.78 (CGGD-12)		
	Parting			36.51 (MGP-14)	60.84 (MGP-20)
29	II Local	0.12 (MGP-4)	1.67 (CGGD-15)		
	Parting II Loc to II Comb. II Loc to II Top			0.48 (MGP-4) 0.29 (CGGD-11)	13.07 (MGP-18) 7.10 (MGP-3)
30	II COMB	0.02 (MGP-146)	12.12 (MGP-20)		
	Parting			26.06 (RGP-15)	50.68 (MGP-146)
31	II TOP	0.50 (MGP-2)	8.06 (MGP-18)		
	Parting			3.12 (MGP-3)	8.28 (CGGD-12)
32	II BOT	0.35 (CGGD-8)	11.98 (CGGD-4)		
	Parting			0.27 (MGP-3)	3.69 (CGGD-12)
33	Band-4	0.04 (CGGD-13)	1.39 (CGGD-14)		

Sl. No.	Coal Seams	Thickness of Coal Seam (m)		Thickness of Parting (m)	
		Minimum	Maximum	Minimum	Maximum
	Parting			N.A	N.A
34	I	0.06 (MGP-56)	1.10 (MGP-146)		
	Parting			N.A	N.A

4.2.3.4. Soil & Alluvium

A major part of the block is covered by a thin layer of soil and alluvium horizon. The weathering has affected all the strata below soil to a varying extent. The thickness of soil ranges from 1.00 to 17.00 m (CMG-30). The depth of weathered zone varies from 3.20 m (MGP-271) to 27.40 m (CGGD-9).

4.2.3.5. Structure of the block

The Gare Palma Sector-I Coal Block is mostly covered with soil. Hence the structural interpretation is mainly based on the sub-surface data obtained during the course of exploratory drilling.

The general strike of coal horizons is NW-SE in the major part of the block which swings to almost east – west in the south-eastern part of the block. The dip of beds varies from 2º to 4º towards south-west.

The block does not show major tectonic disturbances. A total of 4 nos. of faults have been deciphered. The deciphering of fault is mainly attributed to differences in FRL values except in a few cases where the faults have been intersected in boreholes. The majority of faults are of lesser magnitude (around 5m throw). Two faults namely fault F1-F1 & F4-F4 are moderate faults. Most of the faults are restricted to the south-eastern part of the block. Minor slippages at many places cannot be ruled out which appear to be common resulting variation in gradient and the same have been reflected in respective plans.

4.3 COAL SEAMS

4.3.1 SEAM X TOP

Seam X is occurring in Barakar formation as the topmost and youngest seam in the block. Seam X Top is the top most split of X seam. It overlies seam X Bottom with a parting of 0.56m to 12.07m. Seam X Top is a thick seam and mostly workable in the entire block.

The depth of occurrence of seam varies from 44.08m to 330.01m within the block. The full seam thickness varies from 0.05m to 5.60m (prevalent thickness ranges between 1.20m to 3.00m. The seam roof consists dominantly of grey shale. The floor consists dominantly of grey shale.

4.3.1.1. Quality:

The Moisture content of X Top seam varies from 3.40% to 10.30%. The Ash% in seam varies from 21.50% to 64.90%. The GCV varies from 2223 to 5340 K.Cal/Kg. The grade varies from G17 to G7. The variation in quality parameter is tabulated below. The prevalent grade is G15 to G10. The seam consists of 1 to 3 dirt bands in 110 boreholes, while devoid of dirt bands in 241 boreholes intersections.

SEAM : X-TOP

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	285	3.40 (MGP-213)	11.00 (MGP-3)	6.60	1.17
ASH (%)	285	21.50 (CMG-11)	64.90 (MGP-213)	41.30	6.62
VM (%)	129	19.50 (MGP-57)	28.80 (CMG-11)	23.00	1.28
UVM (%)	129	33.43 (MGP-143)	42.03 (CMG-28)	37.93	1.65
GCV(K.Cal/Kg)	285	2223 (MGP-226)	5340 (CMG-11)	3,718.95	3,755.65
GRADE	285	G17 (MGP-226)	G7 (CMG-11)	-	-

SEAM : X-TOP

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	283	3.40 (MGP-213)	10.30 (MGP-3)	6.55	1.13
ASH (%)	283	21.50 (CMG-11)	64.90 (MGP-213)	41.71	6.53
VM (%)	127	19.50 (MGP-57)	28.80 (CMG-11)	22.92	1.30
UVM (%)	127	33.43 (MGP-143)	41.81 (CMG-28)	37.93	1.57
GCV(K.Cal/Kg)	283	2223 (MGP-226)	5340 (CMG-11)	3,688.05	3,725.23
GRADE	283	G17 (MGP-226)	G7 (CMG-11)	-	-

4.3.2 SEAM X BOTTOM

Seam X Bottom is the bottom split of X group of seams occurring distinctly throughout the block and it is fairly developed in the block. Seam X Bottom occurs in Barakar formation and its depth range of occurrence varies from 52.65 to 340.26 m within the block. It overlies seam IX L2 with a parting of 4.20m to 28.10m.

The seam X Bottom has been intersected in 356 boreholes of the block. The full seam thickness varies from 0.14m to 6.00m. Its thickness in general varies from 2.00m to 3.00m. The seam roof consists dominantly of grey shale and its floor consists of arenaceous shale.

4.3.2.1. Quality:

The Moisture content of the seam varies from 3.90% to 10.70%. The Ash% of seam varies from 24.20% to 56.10%. The GCV varies from 2440 to 5220 K.Cal/Kg. The seam grade is G17 to G7. The variation in quality parameter on I30 and I100 analysis is tabulated below. Major part of the seam within the block falls in grade G16 – G10. The seam is devoid of dirt bands in 263 boreholes and in 92 BHs.1 to 3 nos. of dirt bands are present.

SEAM : X-BOTTOM
QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	310	4.00 (MGP-183)	10.70 (MGP-82)	6.85	1.19
ASH (%)	310	24.20 (CMG-23)	56.10 (MGP-192)	42.01	6.94
VM (%)	95	20.20 (MGP-189)	29.60 (CMG-28)	24.60	1.66
UVM (%)	95	35.78 (MGP-189)	45.45 (CMG-34)	39.86	2.06
GCV(K.Cal/Kg)	310	2440 (MGP-1)	5220 (MGP-28)	3,616.51	3,661.29
GRADE	310	G17 (MGP-1)	G7 (MGP-28)	-	-

SEAM : X-BOTT.
QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	307	3.90 (MGP-226)	10.70 (MGP-82)	6.82	1.22
ASH (%)	307	24.20 (CMG-23)	56.10 (MGP-192)	42.17	7.07
VM (%)	92	20.20 (MGP-189)	29.60 (CMG-28)	24.58	1.70
UVM (%)	92	35.78 (MGP-189)	45.45 (CMG-34)	39.85	2.17
GCV(K.Cal/Kg)	307	2440 (MGP-1)	5220 (MGP-28)	3,604.16	3,650.11
GRADE	307	G17 (MGP-1)	G7 (MGP-28)	-	-

4.3.3 SEAM IX L2

Seam IX L2 is the top most split of IX seam. It is developed in major part of the block. It overlies seam IX L1 with a parting of 2.03m to 24.02m.

The seam IXL2 has been intersected in 353 boreholes. The full thickness of the seam varies from 0.06m to 2.54m. In general its thickness varies in between 0.50 to 0.90m. The seam roof consists dominantly of grey shale and its floor consists of Ical of shale and sandstone. The seam occurs between 74.40m to 351.93m depths within the block.

4.3.3.1. Quality

SEAM : IX-L2

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	219	5.00 (MGP-1)	13.10 (MGP-85)	8.34	1.46
ASH (%)	219	15.50 (MGP-24)	58.80 (MGP-172)	31.50	7.30
VM (%)	87	20.10 (MGP-177)	31.00 (MGP-35)	26.20	2.23
UVM (%)	87	35.03 (MGP-275)	47.78 (MGP-72)	40.13	2.15
GCV(K.Cal/Kg)	219	2252 (MGP-172)	5776 (MGP-24)	4,404.76	4,443.11
GRADE	219	G17 (MGP-172)	G6 (MGP-24)	-	-

SEAM : IX-L2

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	216	3.80 (MGP-83)	13.10 (MGP-85)	8.30	1.48
ASH (%)	216	15.50 (MGP-24)	64.90 (MGP-83)	31.70	7.84
VM (%)	85	20.10 (MGP-177)	31.00 (MGP-35)	26.17	2.24
UVM (%)	85	35.03 (MGP-275)	47.78 (MGP-72)	40.09	2.18
GCV(K.Cal/Kg)	216	2252 (MGP-172)	5776 (MGP-24)	4,389.90	4,434.09
GRADE	216	G17 (MGP-172)	G6 (MGP-24)	-	-

4.3.4 SEAM IX L1

Seam IX L1 is a prominent seam and well developed in the upper column of Barakar formation. It overlies seam Local-1 with a parting of 2.25m to 20.83m.

The seam IX-L1 has been fully intersected in 356 boreholes. The seam thickness varies from 0.09m to 5.41m. (The prevalent seam thickness is 0.50 to 1.20m). Its thickness in general is around 1.00m. The seam roof dominantly consists of grye shale and its floor also consists of grey shale. The seam occurs at depth range of 79.98m to 368.26m depths within the block.

4.3.4.1. Quality

SEAM : IX-L1

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	289	3.30 (MGP-270)	12.70 (MGP-96)	8.06	1.45
ASH (%)	289	13.10 (MGP-248)	52.80 (MGP-112)	30.69	6.64
VM (%)	128	21.10 (MGP-142)	31.10 (MGP-254)	25.65	1.78
UVM (%)	128	34.98 (MGP-137)	44.61 (CMG-03)	38.86	1.57
GCV(K.Cal/Kg)	289	2889 (MGP-112)	5729 (MGP-273)	4,514.73	4,542.82
GRADE	289	G15 (MGP-112)	G6 (MGP-273)	-	-

SEAM : IX-L1

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	286	3.30 (MGP-270)	12.70 (MGP-96)	8.07	1.45
ASH (%)	286	13.10 (MGP-248)	52.80 (MGP-112)	30.69	6.70
VM (%)	125	21.10 (MGP-142)	31.10 (MGP-254)	25.65	1.91
UVM (%)	125	34.98 (MGP-137)	44.61 (CMG-03)	38.87	1.63
GCV(K.Cal/Kg)	286	2889 (MGP-112)	5729 (MGP-273)	4,512.91	4,541.40
GRADE	286	G15 (MGP-112)	G6 (MGP-273)	-	-

4.3.5 SEAM LOCAL-1

Seam Local-1 overlies seam IX with a parting of 0.85m to 18.02m. Seam Local-1 is developed in the major part of eastern side of the block The seam occurs at a depth range of 90.40 m to 374.69 m within the block.

Seam Local-1 has been intersected in 281 boreholes and not developed in 76 boreholes. The full seam thickness varies from 0.05m to 1.48m. The prevalent seam thickness is 0.50 to 0.90m. The seam roof consists dominantly of grey shale and its floor consists of Ical of shale and sandstone.

4.3.5.1. Quality

SEAM : LOCAL-1

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	81	3.50 (MGP-291)	10.90 (CMG-19)	7.15	1.75
ASH (%)	81	15.80 (MGP-18)	62.60 (MGP-291)	32.38	10.92
VM (%)	26	22.00 (MGP-234)	31.20 (CMG-33)	27.64	1.91
UVM (%)	26	36.42 (MGP-28)	44.14 (CMG-16)	39.34	1.68
GCV(K.Cal/Kg)	81	2466 (MGP-176)	5730 (MGP-35)	4,476.80	4,550.45
GRADE	81	G17 (MGP-176)	G6 (MGP-35)	-	-

SEAM : LOCAL-1

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	81	3.50 (MGP-291)	10.90 (CMG-19)	7.15	1.75
ASH (%)	81	15.80 (MGP-18)	62.60 (MGP-291)	32.38	10.92
VM (%)	26	22.00 (MGP-234)	31.20 (CMG-33)	27.64	1.91
UVM (%)	26	36.42 (MGP-28)	44.14 (CMG-16)	39.34	1.68
GCV(K.Cal/Kg)	81	2466 (MGP-176)	5730 (MGP-35)	4,476.80	4,550.45
GRADE	81	G17 (MGP-176)	G6 (MGP-35)	-	-

4.3.6 SEAM IX

Seam IX overlies seam Local-2 with a parting of 0.20m to 15.15m. Seam IX is most prominent and consistently developed throughout the block.

The seam IX has been intersected in 356 boreholes. The full seam thickness varies from 0.27m to 13.67m. (Prevalent seam thickness is 3.00 to 5.00m. The seam roof consists dominantly of grey shale and its floor consists of grey shale.

SEAM : IX

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	312	3.00 (MGP-221)	11.30 (MGP-104)	6.54	1.15
ASH (%)	312	17.80 (MGP-248)	59.40 (CGGD-2)	36.19	4.92
VM (%)	153	20.50 (MGP-18)	30.50 (MGP-87)	25.29	1.26
UVM (%)	153	35.69 (MGP-129)	46.58 (MGP-240)	39.18	1.55
GCV(K.Cal/Kg)	312	2283 (CGGD-2)	5661 (MGP-248)	4,194.85	4,214.81
GRADE	312	G17 (CGGD-2)	G6 (MGP-248)	-	-

SEAM : IX

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	312	3.00 (MGP-221)	11.30 (MGP-104)	6.53	1.15
ASH (%)	312	17.80 (MGP-248)	59.40 (CGGD-2)	36.33	4.95
VM (%)	150	20.50 (MGP-18)	30.50 (MGP-87)	25.28	1.30
UVM (%)	150	35.69 (MGP-129)	46.58 (MGP-240)	39.17	1.54
GCV(K.Cal/Kg)	312	2283 (CGGD-2)	5661 (MGP-248)	4,184.47	4,204.81
GRADE	312	G17 (CGGD-2)	G6 (MGP-248)	-	-

4.3.7 SEAM LOCAL-2

Seam Local-2 is a thin band developed in the northern side of central part of the block. It overlies seam VIII with a parting of 0.33 m to 28.59m. The seam occurs at a depth range of 101.64m to 396.10m within the block.

The full seam has been intersected in 244 boreholes and it is not developed in 113 boreholes. The full seam thickness varies from 0.02m. to 3.77m. The seam roof consists dominantly of Ical of shale and sandstone and its floor consists of grey shale.

4.3.7.1. Quality

SEAM : LOCAL-2

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	58	3.90 (MGP-177)	7.40 (MGP-4)	5.27	0.74
ASH (%)	58	28.90 (MGP-171)	59.50 (MGP-94)	45.29	6.50
VM (%)	14	21.10 (MGP-61)	26.40 (MGP-74)	23.86	1.29
UVM (%)	14	38.15 (MGP-148)	44.46 (MGP-125)	41.28	2.05
GCV(K.Cal/Kg)	58	2375 (MGP-94)	4849 (MGP-171)	3,496.94	3,537.47
GRADE	58	G17 (MGP-94)	G9 (MGP-171)	-	-

SEAM : LOCAL-2

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	58	3.90 (MGP-177)	7.40 (MGP-4)	5.26	0.68
ASH (%)	58	28.90 (MGP-171)	59.50 (MGP-94)	45.46	6.51
VM (%)	14	21.10 (MGP-61)	26.40 (MGP-74)	23.86	1.29
UVM (%)	14	38.15 (MGP-148)	44.46 (MGP-125)	41.28	2.05
GCV(K.Cal/Kg)	58	2375 (MGP-94)	4849 (MGP-171)	3,483.37	3,524.05
GRADE	58	G17 (MGP-94)	G9 (MGP-171)	-	-

4.3.8 SEAM VIII

Seam VIII is developed in the northern part of the block in sector It overlies seam VII with a parting of 0.96m to 31.20m.

The full seam VIII has been intersected in 258 boreholes. The seam is not developed in 92 BHs. The full seam thickness varies from 0.03m to 6.68m. The seam roof consists dominantly of Ical of shale & sandstone its floor also consists of grey shale. The seam occurs at depth range of 109.39m to 393.13m within the block.

4.3.8.1. Quality

SEAM : VIII

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	101	3.10 (MGP-200)	8.00 (MGP-127)	5.01	1.18
ASH (%)	101	28.00 (MGP-127)	63.90 (MGP-200)	45.94	7.45
VM (%)	34	19.90 (MGP-192)	29.70 (MGP-98)	24.05	2.42
UVM (%)	34	34.14 (MGP-72)	44.16 (MGP-98)	40.51	2.04
GCV(K.Cal/Kg)	101	2373 (MGP-193)	4850 (MGP-173)	3,485.08	3,535.21
GRADE	101	G17 (MGP-193)	G9 (MGP-173)	-	-

SEAM : VIII

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	101	3.10 (MGP-200)	8.00 (MGP-127)	5.00	1.19
ASH (%)	101	28.00 (MGP-127)	63.90 (MGP-200)	46.01	7.50
VM (%)	34	19.90 (MGP-192)	29.70 (MGP-98)	24.05	2.42
UVM (%)	34	34.14 (MGP-72)	44.16 (MGP-98)	40.51	2.04
GCV(K.Cal/Kg)	101	2373 (MGP-193)	4850 (MGP-173)	3,479.57	3,530.78
GRADE	101	G17 (MGP-193)	G9 (MGP-173)	-	-

4.3.9 SEAM VII

Seam VII is developed in major part of the block except central to south eastern region. It overlies seam VI A with a parting of 1.64m to 14.10m.

The full seam has been intersected in 307 boreholes only and it is not developed in 49 boreholes. The full seam thickness varies from 0.06m to 4.24m. The seam roof consists dominantly of grey shale and its floor consists of fine grained sandstone. The seam occurs at depth range of 126.52m to 426.16m within the block.

4.3.9.1. Quality

SEAM : VII

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	223	3.50 (MGP-23)	10.30 (MGP-3)	6.08	1.14
ASH (%)	223	23.20 (MGP-166)	64.90 (MGP-23)	35.18	6.91
VM (%)	122	22.00 (MGP-221)	29.60 (MGP-102)	25.95	1.52
UVM (%)	122	35.04 (MGP-249)	55.36 (MGP-72)	39.66	2.45
GCV(K.Cal/Kg)	223	2584 (MGP-10)	5310 (MGP-262)	4,360.74	4,397.61
GRADE	223	G16 (MGP-10)	G7 (MGP-262)	-	-

SEAM : VII

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	223	3.50 (MGP-23)	10.00 (MGP-104)	6.07	1.14
ASH (%)	223	23.20 (MGP-166)	64.90 (MGP-23)	35.31	6.89
VM (%)	122	21.30 (MGP-4)	29.60 (MGP-102)	25.88	1.55
UVM (%)	122	35.04 (MGP-249)	55.36 (MGP-72)	39.66	2.38
GCV(K.Cal/Kg)	223	2584 (MGP-10)	5310 (MGP-262)	4,349.69	4,387.05
GRADE	223	G16 (MGP-10)	G7 (MGP-262)	-	-

4.3.10 SEAM VIA

Seam VI A is the top split of VI seam and occur separately and distinctly throughout the block in the middle part of coal bearing Barakar formation. It overlies seam VI B with a parting of 0.90m to 5.57m.

The full seam has been intersected in 84 boreholes. The full seam thickness varies from 0.32m to 5.73m. (The prevalent seam thickness is 1.50 to 1.80m). The seam roof consists dominantly of shale and its floor also consists of carbonaceous shale and shale. The seam occurs at depth range of 146.85m to 407.36m within the block.

4.3.10.1. Quality

SEAM : VI-A

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	60	3.50 (CMG-13)	7.60 (MGP-40)	5.70	0.88
ASH (%)	60	27.40 (MGP-49)	56.40 (CMG-22)	39.19	6.90
VM (%)	27	21.90 (MGP-196)	28.30 (MGP-49)	25.23	1.69
UVM (%)	27	35.31 (MGP-153)	44.03 (CMG-30)	39.87	2.19
GCV(K.Cal/Kg)	60	2627 (CMG-07)	5200 (MGP-49)	4,032.87	4,072.41
GRADE	60	G16 (CMG-07)	G8 (MGP-49)	-	-

SEAM : VI-A

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	58	3.50 (CMG-13)	7.60 (MGP-40)	5.56	0.86
ASH (%)	58	27.40 (MGP-49)	56.40 (CMG-22)	40.35	7.28
VM (%)	24	21.90 (MGP-196)	28.30 (MGP-49)	24.98	1.73
UVM (%)	24	35.31 (MGP-153)	43.54 (CMG-14)	39.95	2.20
GCV(K.Cal/Kg)	58	2627 (CMG-07)	5200 (MGP-49)	3,952.83	3,998.42
GRADE	58	G16 (CMG-07)	G8 (MGP-49)	-	-

4.3.11 SEAM VI-B

Seam VI B is a prominent and thick seam occurring consistently throughout the block in the middle column of coal bearing Barakar formation. It overlies seam VIC with a parting of 0.63m to 7.31m. Seam VIB is mostly workable in the entire block.

The full seam has been intersected in 39 boreholes. The full seam thickness varies from 0.15m to 6.45m (The prevalent seam thickness is 1.80 to 3.50m). The seam roof consists dominantly of shale and its floor consists of grey shale. The seam occurs at depth range of 160.99m to 295.85m within the block.

4.3.11.1. Quality

SEAM : VI-B

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	17	4.10 (CMG-14)	7.80 (CMG-28)	5.16	0.97
ASH (%)	17	37.30 (CMG-32)	54.50 (CMG-11)	46.21	4.88
VM (%)	7	21.80 (CMG-28)	24.40 (MGP-15)	23.36	0.80
UVM (%)	7	40.03 (MGP-196)	42.58 (CMG-18)	41.07	0.64
GCV(K.Cal/Kg)	17	2773 (CMG-11)	4291 (CMG-32)	3,461.66	3,487.18
GRADE	17	G16 (CMG-11)	G11 (CMG-32)	-	-

SEAM : VI-B

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	17	4.10 (CMG-14)	7.80 (CMG-28)	5.09	0.98
ASH (%)	17	37.30 (CMG-32)	54.50 (CMG-11)	47.26	5.18
VM (%)	5	21.80 (CMG-28)	24.40 (MGP-15)	23.56	0.95
UVM (%)	5	40.03 (MGP-196)	42.58 (CMG-18)	41.12	0.95
GCV(K.Cal/Kg)	17	2773 (CMG-11)	4291 (CMG-32)	3,368.88	3,397.83
GRADE	17	G16 (CMG-11)	G11 (CMG-32)	-	-

4.3.12 SEAM VIA+VIB

Seam VI A+VI B is middle split of VI seam occurring in the middle column of coal bearing Barakar formation. It overlies seam VI C with a parting of 0.75 m to 2.58 m. Seam VI A+VI B is having a adequate thickness and mostly workable in the entire block. The full seam has been intersected in 30 boreholes. The full seam thickness varies from 1.70m to 9.26m (The prevalent seam thickness is 5.00 to 7.00m). The seam roof consists dominantly of grey shale and its floor consists of carb.shale. The seam occurs at depth range of 122.50m to 275.86m within the block.

4.3.12.1. Quality

SEAM : VIA+VIB

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	26	4.60 (MGP-189)	7.00 (MGP-14)	5.47	0.41
ASH (%)	26	36.20 (MGP-193)	53.20 (MGP-189)	45.06	3.83
VM (%)	3	22.30 (MGP-152)	25.30 (MGP-46)	23.93	1.30
UVM (%)	3	36.79 (MGP-152)	40.02 (MGP-46)	38.20	1.25
GCV(K.Cal/Kg)	26	2881 (MGP-189)	4330 (MGP-46)	3,523.04	3,538.83
GRADE	26	G15 (MGP-189)	G10 (MGP-46)	-	-

SEAM : VIA+VIB

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	26	4.40 (MGP-43)	6.20 (MGP-14)	5.22	0.36
ASH (%)	26	36.20 (MGP-193)	53.20 (MGP-189)	47.76	3.95
VM (%)	3	22.30 (MGP-152)	24.20 (MGP-193)	23.07	0.72
UVM (%)	3	36.79 (MGP-152)	40.00 (MGP-46)	38.19	1.34
GCV(K.Cal/Kg)	26	2881 (MGP-189)	4321 (MGP-193)	3,307.93	3,325.46
GRADE	26	G15 (MGP-189)	G10 (MGP-193)	-	-

4.3.13 SEAM VI C

Seam VI C is middle split of VI seam occurring in the middle column of coal bearing Barakar formation. It overlies seam VI D with a parting of 0.40m to 3.43m Seam VI C is a thick seam and mostly workable in the entire block.

The full seam has been intersected in 50 boreholes. The full seam thickness varies from 0.48m. to 6.77m. (The prevalent seam thickness is 2.00 to 3.00m). The seam roof consists dominantly of carb shale and its floor consists of carb. shale. The seam occurs at depth range of 164.06m to 298.30m within the block.

4.3.13.1. Quality

SEAM : VI-C

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	24	2.80 (MGP-216)	6.50 (CMG-11)	4.72	0.81
ASH (%)	24	29.30 (MGP-223)	64.90 (MGP-216)	47.18	8.29
VM (%)	7	21.50 (CMG-03)	27.60 (MGP-199)	23.91	2.05
UVM (%)	7	38.11 (MGP-193)	42.87 (CMG-18)	40.22	1.51
GCV(K.Cal/Kg)	24	2794 (CMG-22)	4942 (MGP-223)	3,429.81	3,501.48
GRADE	24	G16 (CMG-22)	G8 (MGP-223)	- -	

SEAM : VI-C

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	24	2.80 (MGP-216)	6.10 (CMG-11)	4.64	0.77
ASH (%)	24	29.30 (MGP-223)	64.90 (MGP-216)	47.96	8.42
VM (%)	7	21.50 (CMG-03)	27.60 (MGP-199)	23.91	2.05
UVM (%)	7	38.11 (MGP-193)	42.87 (CMG-18)	40.22	1.51
GCV(K.Cal/Kg)	24	2714 (CMG-22)	4942 (MGP-223)	3,368.36	3,445.29
GRADE	24	G16 (CMG-22)	G8 (MGP-223)	- -	

4.3.14 SEAM VIB+VIC

Seam VI B+VI C is a split of VI seam occurring in Barakar Formation. It is consistent and developed in major part of the block. It overlies seam VI D with a parting of 0.21m to 4.20m.

The full seam has been intersected in 23 boreholes. The full seam thickness varies from 0.73m to 12.47m. (The prevalent seam thickness is 500 to 7.00m). The roof of seam consists dominantly of shale and its floor consists of shale. The seam occurs at depth range of 170.27m to 311.64m within the block.

4.3.14.1. Quality

SEAM : VIB+VIC

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	17	4.20 (CMG-34)	6.60 (MGP-68)	5.49	0.62
ASH (%)	17	33.20 (MGP-195)	53.60 (CMG-26)	44.14	5.64
VM (%)	4	23.00 (CMG-34)	25.10 (CMG-30)	24.25	0.86
UVM (%)	4	37.85 (MGP-195)	42.75 (CMG-30)	40.59	1.77
GCV(K.Cal/Kg)	17	2814 (CMG-26)	4531 (MGP-195)	3,603.36	3,633.97
GRADE	17	G15 (CMG-26)	G10 (MGP-195)	-	-

SEAM : VIB+VIC

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	17	4.20 (CMG-34)	6.40 (MGP-78)	5.28	0.51
ASH (%)	17	33.20 (MGP-195)	54.70 (CMG-26)	46.37	5.88
VM (%)	4	23.00 (CMG-34)	25.10 (CMG-30)	24.13	0.80
UVM (%)	4	37.85 (MGP-195)	42.75 (CMG-30)	40.79	2.01
GCV(K.Cal/Kg)	17	2725 (CMG-26)	4531 (MGP-195)	3,421.98	3,458.21
GRADE	17	G16 (CMG-26)	G10 (MGP-195)	-	-

4.3.15 SEAM VIA+VIB+VIC

Seam VIA+VIB+VIC is a split of VI seam occurring in Barakar Formation. It is consistent and developed in major part of the block. It overlies seam VI-D with a parting of 0.55m to 3.51m.

The full seam has been intersected in 82 boreholes. The full seam thickness varies from 0.54m to 10.89m. (The prevalent seam thickness is 5.00 to 7.00m). The roof of seam consists dominantly of grey shale and its floor consists of Ical of shale and sandstone. The seam occurs at depth range of 169.03 m to 443.20 m within the block.

4.3.15.1. Quality

SEAM : VIA+VIB+VIC

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	75	4.40 (MGP-37)	9.30 (MGP-95)	5.31	0.65
ASH (%)	75	37.40 (MGP-57)	53.90 (MGP-37)	44.98	3.30
VM (%)	0	-	-	-	-
UVM (%)	0	-	-	-	-
GCV(K.Cal/Kg)	75	2844 (MGP-37)	4165 (MGP-57)	3,551.06	3,560.06
GRADE	75	G15 (MGP-37)	G11 (MGP-57)	-	-

SEAM : VIA+VIB+VIC

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	75	2.90 (MGP-60)	8.40 (MGP-95)	5.05	0.63
ASH (%)	75	38.90 (MGP-191)	55.30 (CMG-10)	47.18	3.24
VM (%)	0	-	-	-	-
UVM (%)	0	-	-	-	-
GCV(K.Cal/Kg)	75	2727 (CMG-10)	4053 (MGP-191)	3,381.95	3,392.30
GRADE	75	G16 (CMG-10)	G11 (MGP-191)	-	-

4.3.16 SEAM VI-D

Seam VI D is a split of VI seam occurring in Barakar Formation. It is consistent and developed in major part of the block. It overlies seam VI Local with a parting of 0.25m to 20.87m.

The full seam has been intersected in 139 boreholes. The full seam thickness varies from 0.05m to 8.20m. (The prevalent seam thickness is 0.90 to 1.20m). The roof of seam consists dominantly of grey shale and its floor consists of grey shale. The seam occurs at depth range of 170.00m to 434.51m within the block.

4.3.16.1. Quality

SEAM : VI-D

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	104	2.30 (MGP-224)	8.20 (MGP-95)	4.54	0.95
ASH (%)	104	25.90 (MGP-158)	64.90 (MGP-190)	45.47	6.77
VM (%)	34	20.00 (MGP-136)	27.20 (MGP-158)	23.59	1.65
UVM (%)	34	35.09 (MGP-136)	42.22 (MGP-95)	39.30	1.52
GCV(K.Cal/Kg)	104	2464 (MGP-117)	5240 (MGP-158)	3,623.51	3,668.02
GRADE	104	G17 (MGP-117)	G7 (MGP-158)	-	-

SEAM : VI-D

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	104	2.30 (MGP-224)	8.20 (MGP-95)	4.50	0.96
ASH (%)	104	25.90 (MGP-158)	64.90 (MGP-190)	45.93	7.06
VM (%)	33	18.60 (MGP-136)	27.20 (MGP-158)	23.49	1.75
UVM (%)	33	34.33 (MGP-136)	42.22 (MGP-95)	39.20	1.53
GCV(K.Cal/Kg)	104	2464 (MGP-117)	5240 (MGP-158)	3,584.98	3,633.61
GRADE	104	G17 (MGP-117)	G7 (MGP-158)	-	-

4.3.17 SEAM VIC+VID

Seam VIC+VID Local is the bottom most split of seam VI occurring in Barakar Formation. It overlies seam VI-Local with a parting of 0.50m to 20.75m this seam is developed in major part except southern region of central part of the bloc.

The full seam has been intersected in 25 boreholes. The full seam thickness varies from 1.61m to 14.58m. (The prevalent seam thickness is 3.00m to 5.00m). The seam roof consists dominantly of carb.shale and its floor also consists of grey shale. The seam occurs at depth range of 131.00m to 282.40m within the block.

4.3.17.1. Quality

SEAM : VIC+VID

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	21	3.30 (MGP-44)	5.50 (MGP-183)	4.71	0.53
ASH (%)	21	31.30 (MGP-152)	54.40 (MGP-145)	47.18	5.36
VM (%)	2	23.50 (MGP-44)	26.40 (MGP-152)	24.95	1.45
UVM (%)	2	38.67 (MGP-152)	40.92 (MGP-44)	39.80	0.93
GCV(K.Cal/Kg)	21	2795 (MGP-144)	4690 (MGP-152)	3,427.96	3,457.75
GRADE	21	G16 (MGP-144)	G9 (MGP-152)	-	-

SEAM : VIC+VID

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	21	3.30 (MGP-44)	5.50 (MGP-183)	4.53	0.53
ASH (%)	21	31.30 (MGP-152)	54.50 (MGP-133)	48.83	5.92
VM (%)	2	23.50 (MGP-44)	26.40 (MGP-152)	24.95	1.45
UVM (%)	2	38.67 (MGP-152)	40.92 (MGP-44)	39.80	0.93
GCV(K.Cal/Kg)	21	2795 (MGP-144)	4690 (MGP-152)	3,298.96	3,335.32
GRADE	21	G16 (MGP-144)	G9 (MGP-152)	-	-

4.3.18 SEAM VIB+VIC+VID

Seam VIB+VIC+VID Local is the bottom most split of seam VI occurring in Barakar Formation. It overlies seam VI-Local with a parting of 0.85m to 15.69m this seam is developed in major part except southern region of central part of the bloc.

The full seam has been intersected in 32 boreholes. The full seam thickness varies from 3.13m to 17.16m. (The prevalent seam thickness is 11.00m to 13.00 m). The seam roof consists dominantly of grey shale and its floor also consists of grey shale. The seam occurs at depth range of 152.86m to 412.27m within the block.

4.3.18.1. Quality

SEAM : VIB+VIC+VID
QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	24	4.20 (CMG-27)	5.80 (MGP-269)	4.82	0.35
ASH (%)	24	36.50 (MGP-278)	53.30 (CMG-27)	47.11	4.07
VM (%)	0	-	-	-	-
UVM (%)	0	-	-	-	-
GCV(K.Cal/Kg)	24	2930 (CMG-27)	4322 (MGP-278)	3,422.58	3,438.16
GRADE	24	G15 (CMG-27)	G10 (MGP-278)	-	-

SEAM : VIB+VIC+VID
QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	24	4.20 (MGP-63)	5.80 (MGP-269)	4.70	0.34
ASH (%)	24	36.50 (MGP-278)	54.10 (CMG-27)	48.07	4.59
VM (%)	0	-	-	-	-
UVM (%)	0	-	-	-	-
GCV(K.Cal/Kg)	24	2854 (CMG-27)	4322 (MGP-278)	3,350.33	3,372.09
GRADE	24	G15 (CMG-27)	G10 (MGP-278)	-	-

4.3.19 SEAM VIA+VIB+VIC+VID

Seam VIA+VIB+VIC+VID is the bottom most split of seam VI occurring in Barakar Formation. It overlies seam VI-Local with a parting of 0.70m to 23.45m this seam is developed in major part except southern region of central part of the block.

The full seam has been intersected in 32 boreholes. The full seam thickness varies from 3.13m to 17.16m. (The prevalent seam thickness is 11.00m to 13.00 m). The seam roof consists dominantly of grey shale and its floor also consists of grey shale. The seam occurs at depth range of 152.86m to 412.27m within the block.

4.3.19.1. Quality

SEAM : VIA+VIB+VIC+VID

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	152	4.40 (MGP-134)	7.00 (MGP-4)	5.44	0.42
ASH (%)	152	33.40 (MGP-254)	54.10 (CMG-16)	46.03	3.15
VM (%)	2	23.00 (MGP-30)	26.60 (MGP-254)	24.80	1.80
UVM (%)	2	38.24 (MGP-30)	40.48 (MGP-254)	39.36	1.12
GCV(K.Cal/Kg)	152	2796 (CMG-16)	4430 (MGP-254)	3,433.03	3,442.20
GRADE	152	G16 (CMG-16)	G10 (MGP-254)	-	-

SEAM : VIA+VIB+VIC+VID

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	152	4.00 (CMG-16)	6.70 (MGP-4)	5.20	0.40
ASH (%)	152	33.40 (MGP-254)	59.50 (CMG-16)	48.10	3.01
VM (%)	3	21.20 (MGP-30)	26.60 (MGP-254)	23.23	2.43
UVM (%)	3	37.83 (MGP-30)	40.48 (MGP-254)	39.29	1.21
GCV(K.Cal/Kg)	152	2375 (CMG-16)	4430 (MGP-254)	3,272.57	3,281.42
GRADE	152	G17 (CMG-16)	G10 (MGP-254)	-	-

4.3.20 SEAM VI LOCAL

Seam VI Local is the bottom most split of seam VI occurring in Barakar Formation. It overlies seam Band-1 with a parting of 7.87m to 34.65m this seam is developed in major part except southern region of central part of the bloc.

The full seam has been intersected in 277 boreholes. The full seam thickness varies from 0.02m to 24.65m. (The prevalent seam thickness is 1.50m to 1.80m). The seam roof consists dominantly of grey shale and its floor also consists of grey shale. The seam occurs at depth range of 134.13m to 450.20m within the block.

4.3.20.1. Quality

SEAM : VI-LOCAL
QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	197	2.20 (MGP-28)	8.00 (MGP-90)	4.88	0.85
ASH (%)	197	25.00 (MGP-90)	59.50 (MGP-163)	42.40	5.61
VM (%)	75	21.00 (MGP-20)	28.30 (MGP-90)	24.03	1.30
UVM (%)	75	35.27 (MGP-272)	42.73 (CMG-02)	39.00	1.70
GCV(K.Cal/Kg)	197	2390 (MGP-163)	5190 (MGP-90)	3,845.42	3,875.04
GRADE	197	G17 (MGP-163)	G8 (MGP-90)	-	-

SEAM : VI-LOCAL
QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	197	2.20 (MGP-28)	8.00 (MGP-90)	4.82	0.88
ASH (%)	197	25.00 (MGP-90)	60.00 (MGP-6)	43.02	5.93
VM (%)	74	20.70 (MGP-7)	28.30 (MGP-90)	23.80	1.33
UVM (%)	74	35.27 (MGP-272)	42.73 (CMG-02)	38.88	1.73
GCV(K.Cal/Kg)	197	2390 (MGP-163)	5190 (MGP-90)	3,793.13	3,827.15
GRADE	197	G17 (MGP-163)	G8 (MGP-90)	-	-

4.3.21 SEAM BAND-1

Seam Band-1 is occurring in Barakar formation in the block. It overlies seam V Top with a parting of 9.35m to 36.84m. Band-1 is developed in northern and south-eastern part of the block. In the major part of the block, its thickness is <0.50m or seam is not developed.

The full seam has been intersected in 203 boreholes. The full seam thickness varies from 0.05m to 1.62m. The seam roof consists dominantly of shale and its floor also consists of shale. The seam occurs at depth range of 162.90m to 374.93m within the block.

4.3.21.1. Quality

SEAM : BAND-1

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	48	2.60 (CGGD-1)	7.50 (MGP-77)	4.80	0.97
ASH (%)	48	29.60 (MGP-49)	64.80 (CGGD-1)	43.27	9.70
VM (%)	14	19.80 (CMG-26)	28.70 (MGP-44)	25.70	2.63
UVM (%)	14	31.19 (MGP-72)	51.31 (MGP-71)	40.91	4.55
GCV(K.Cal/Kg)	48	2215 (MGP-64)	5230 (MGP-49)	3,756.71	3,848.65
GRADE	48	G17 (MGP-64)	G7 (MGP-49)	-	-

SEAM : BAND-1

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	48	2.60 (CGGD-1)	7.50 (MGP-77)	4.80	0.97
ASH (%)	48	29.60 (MGP-49)	64.80 (CGGD-1)	43.27	9.70
VM (%)	14	19.80 (CMG-26)	28.70 (MGP-44)	25.70	2.63
UVM (%)	14	31.19 (MGP-72)	51.31 (MGP-71)	40.91	4.55
GCV(K.Cal/Kg)	48	2215 (MGP-64)	5230 (MGP-49)	3,756.71	3,848.65
GRADE	48	G17 (MGP-64)	G7 (MGP-49)	-	-

4.3.22 SEAM V-TOP

Seam V Top is a top split of V seam, occurring distinctly & separately in the middle column of coal bearing Barakar formation. It overlies seam Local-3 with a parting of 0.40m to 16.37m. This seam is developed in the eastern to northern part of the lock

The full seam has been intersected in 199 boreholes. The full seam thickness varies from 0.07m to 2.19m. The seam roof consists dominantly of grey shale and its floor also consists of grey shale. The seam occurs at depth range of 172.62m to 464.20m within the block.

4.3.22.1. Quality

SEAM : V-TOP
QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	93	3.30 (MGP-45)	8.00 (MGP-66)	5.52	1.10
ASH (%)	93	16.00 (MGP-121)	57.80 (CMG-35)	39.33	7.39
VM (%)	46	20.10 (MGP-149)	29.10 (CMG-07)	25.28	2.13
UVM (%)	46	35.83 (MGP-149)	56.06 (CMG-07)	40.96	3.73
GCV(K.Cal/Kg)	93	2535 (CMG-35)	5918 (MGP-121)	4,075.53	4,120.15
GRADE	93	G16 (CMG-35)	G5 (MGP-121)	-	-

SEAM : V-TOP
QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	93	3.30 (MGP-45)	8.00 (MGP-66)	5.52	1.10
ASH (%)	93	16.00 (MGP-121)	57.80 (CMG-35)	39.38	7.44
VM (%)	46	20.10 (MGP-149)	29.10 (CMG-07)	25.28	2.13
UVM (%)	46	35.83 (MGP-149)	56.06 (CMG-07)	40.96	3.73
GCV(K.Cal/Kg)	93	2535 (CMG-35)	5918 (MGP-121)	4,070.97	4,116.39
GRADE	93	G16 (CMG-35)	G5 (MGP-121)	-	-

4.3.23 SEAM LOCAL3

The Seam Local-3 is developed in the central part of the block. In remaining area, the seam is either not developed or not drilled upto the seam. The seam Local-3 occurs in Barakar formation. It overlies seam V Bottom with a parting of 3.95m to 30.12m and its depth of occurrence varies from 176.49m to 469.54m within the block.

The Seam Local-3 has been intersected in 174 boreholes of the block. The full seam thickness varies from 0.06m to 1.24m. The seam roof consists dominantly of grey shale and its floor consists of grey shale.

4.3.23.1. Quality

SEAM : LOCAL-3

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	100	2.80 (MGP-150)	8.10 (MGP-63)	5.31	1.07
ASH (%)	100	21.00 (MGP-76)	57.80 (MGP-21)	38.26	6.35
VM (%)	42	19.10 (MGP-150)	30.20 (MGP-76)	26.05	2.11
UVM (%)	42	34.42 (MGP-149)	47.17 (MGP-67)	41.24	2.86
GCV(K.Cal/Kg)	100	2643 (MGP-145)	5650 (MGP-76)	4,174.72	4,205.90
GRADE	100	G16 (MGP-145)	G6 (MGP-76)	-	-

SEAM : LOCAL-3

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	100	2.80 (MGP-150)	8.10 (MGP-63)	5.32	1.04
ASH (%)	100	21.00 (MGP-76)	57.80 (MGP-21)	38.18	6.24
VM (%)	42	19.10 (MGP-150)	30.20 (MGP-76)	26.05	2.11
UVM (%)	42	34.42 (MGP-149)	47.17 (MGP-67)	41.24	2.86
GCV(K.Cal/Kg)	100	2643 (MGP-145)	5650 (MGP-76)	4,182.05	4,212.25
GRADE	100	G16 (MGP-145)	G6 (MGP-76)	-	-

4.3.24 SEAM V-BOT

Seam V Bottom is occurring in the middle column of coal bearing Barakar formation. It overlies seam Band-2 with a parting of 0.10m to 23.13m. It is developed in the eastern part of the block and in remaining area, the seam is unworkable.

The full seam has been intersected in 143 boreholes and seam not developed in 67 boreholes. The full seam thickness varies from 0.05m to 6.39m. (The prevalent seam thickness is 0.50 to 0.90m). The seam roof consists dominantly of shale and its floor consists of shale. The seam occurs at depth range of 198.09m to 492.22m within in the block.

4.3.24.1. Quality

SEAM : V-BOTTOM

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	81	2.40 (MGP-113)	7.00 (CMG-10)	4.06	0.75
ASH (%)	81	28.90 (CMG-10)	61.50 (MGP-5)	44.80	7.01
VM (%)	27	19.50 (CMG-08)	28.30 (CMG-10)	22.91	2.19
UVM (%)	27	32.95 (MGP-7)	44.92 (MGP-84)	36.83	2.60
GCV(K.Cal/Kg)	81	2216 (MGP-5)	5120 (MGP-45)	3,763.39	3,812.16
GRADE	81	G17 (MGP-5)	G8 (MGP-45)	-	-

SEAM : V-BOT

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	81	2.40 (MGP-113)	7.00 (CMG-10)	3.99	0.78
ASH (%)	81	28.90 (CMG-10)	61.50 (MGP-5)	45.98	7.26
VM (%)	25	19.50 (MGP-4)	28.30 (CMG-10)	22.91	2.22
UVM (%)	25	32.95 (MGP-7)	44.92 (MGP-84)	37.13	2.74
GCV(K.Cal/Kg)	81	2216 (MGP-5)	5120 (MGP-45)	3,664.33	3,718.73
GRADE	81	G17 (MGP-5)	G8 (MGP-45)	-	-

4.3.25 SEAM BAND-2

Seam Band-2 is a local band, which occurs in Barakar formation. It overlies seam IV with a parting of 10.45m to 62.82m. Seam Band-2 occurs in the eastern part of the block. In remaining area, the seam is either not developed or unworkable

The full seam thickness has been intersected in 112 boreholes and it is not developed in 98 bands. The full seam thickness varies from 0.02m to 3.85m. The seam roof consists dominantly of shale and its floor consists of shale. The seam occurs at depth range of 203.06m to 493.31m within the block.

4.3.25.1. Qualaity

SEAM : BAND-2
QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	36	2.30 (CMG-30)	8.80 (CMG-10)	4.24	1.18
ASH (%)	36	23.90 (MGP-53)	64.90 (CMG-30)	43.11	9.69
VM (%)	15	19.80 (MGP-37)	29.60 (CMG-10)	23.87	2.98
UVM (%)	15	33.15 (MGP-39)	42.37 (CMG-10)	37.66	2.69
GCV(K.Cal/Kg)	36	2564 (MGP-204)	5684 (MGP-53)	3,921.46	4,011.16
GRADE	36	G16 (MGP-204)	G6 (MGP-53)	-	-

SEAM : BAND-2
QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	36	2.30 (CMG-30)	8.80 (CMG-10)	4.24	1.18
ASH (%)	36	23.90 (MGP-53)	64.90 (CMG-30)	43.11	9.69
VM (%)	15	19.80 (MGP-37)	29.60 (CMG-10)	23.87	2.98
UVM (%)	15	33.15 (MGP-39)	42.37 (CMG-10)	37.66	2.69
GCV(K.Cal/Kg)	36	2564 (MGP-204)	5684 (MGP-53)	3,921.46	4,011.16
GRADE	36	G16 (MGP-204)	G6 (MGP-53)	-	-

4.3.26 SEAM IV

Seam IV is occurs in the middle column of coal bearing Barakar Formation. It overlies seam Band-3 with a parting of 5.21m to 48.83m. It is developed only in northern part of the block and in remaining area the seam is either not developed or not drilled upto the seam.

The full seam thickness has been intersected in 184 boreholes and it is not developed in 26 boreholes. The full seam thickness varies from 0.04m to 2.25m. The seam roof consists dominantly of sandstone medium grained and its floor consists of shale. The seam occurs at depth range of 220.06 m to 477.02m within the block.

4.3.26.1. Quality

SEAM : IV

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	75	3.10 (MGP-43)	7.50 (MGP-1)	4.78	0.91
ASH (%)	75	23.50 (MGP-15)	61.60 (CMG-37)	40.03	7.71
VM (%)	29	19.40 (MGP-142)	27.10 (MGP-89)	22.93	1.71
UVM (%)	29	31.48 (MGP-147)	41.56 (MGP-89)	36.18	2.72
GCV(K.Cal/Kg)	75	2250 (CMG-37)	5530 (MGP-15)	4,112.54	4,161.73
GRADE	75	G17 (CMG-37)	G6 (MGP-15)	-	-

SEAM : IV

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	75	3.10 (MGP-43)	7.50 (MGP-1)	4.77	0.90
ASH (%)	75	23.50 (MGP-15)	61.60 (CMG-37)	40.19	7.86
VM (%)	29	19.40 (MGP-142)	27.10 (MGP-89)	22.93	1.71
UVM (%)	29	31.48 (MGP-147)	41.56 (MGP-89)	36.18	2.72
GCV(K.Cal/Kg)	75	2250 (CMG-37)	5530 (MGP-15)	4,099.41	4,150.69
GRADE	75	G17 (CMG-37)	G6 (MGP-15)	-	-

4.3.27 SEAM BAND-3

Seam Band-3 is a very thin band attaining >0.50m thickness in the eastern part of the block and is a part of lower column of coal bearing Barakar formation. In the remaining part this band is not developed. It overlies seam III with a parting of 22.13m to 71.77m.

The full seam thickness has been intersected in 160 boreholes. The full seam thickness varies from 0.02m to 2.06m. The seam roof consists dominantly of sandstone medium grained and its floor consists of grey shale. The seam occurs at depth range of 248.00m to 500.51m within the block.

4.3.27.1. Quality

SEAM : BAND-3
QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	37	2.70 (MGP-26)	10.10 (CMG-09)	4.49	1.60
ASH (%)	37	19.80 (MGP-49)	61.00 (MGP-26)	42.24	11.02
VM (%)	16	18.90 (MGP-1)	29.00 (CMG-33)	24.79	2.95
UVM (%)	16	34.24 (MGP-1)	39.85 (CMG-13)	37.74	1.47
GCV(K.Cal/Kg)	37	2423 (MGP-26)	6100 (MGP-49)	3,947.24	4,058.49
GRADE	37	G17 (MGP-26)	G5 (MGP-49)	-	-

SEAM : BAND-3
QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	35	2.70 (MGP-26)	10.10 (CMG-09)	4.51	1.64
ASH (%)	35	19.80 (MGP-49)	61.00 (MGP-26)	43.55	10.57
VM (%)	13	18.90 (MGP-1)	28.40 (MGP-49)	24.12	2.79
UVM (%)	13	34.24 (MGP-1)	39.85 (CMG-13)	37.48	1.59
GCV(K.Cal/Kg)	35	2423 (MGP-26)	6100 (MGP-49)	3,822.57	3,923.90
GRADE	35	G17 (MGP-26)	G5 (MGP-49)	-	-

4.3.28 SEAM III

The seam is developed in the north central to eastern part of the block. In the remaining area, the seam is unworkable. Hence, boreholes have not been drilled upto the seam. It overlies seam II Local with a parting of 36.51m. to 60.84m.

The full seam thickness has been intersected in 181 boreholes and it is not developed in 23 boreholes. The full seam thickness varies from 0.04m to 4.78m (the prevalent seam thickness is 2.00 to 3.00 m). The seam roof consists dominantly of medium grained sandstone and its floor consists of shale. The seam occurs at depth range of 281.59m to 557.16m within the block.

4.3.28.1. Quality

SEAM : III

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	INIMUM	AXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	131	2.60 (MGP-74)	8.90 (CMG-16)	4.23	0.93
ASH (%)	131	18.70 (CMG-06)	56.50 (MGP-36)	37.16	8.36
VM (%)	46	19.70 (MGP-192)	32.80 (CMG-06)	24.92	2.90
UVM (%)	46	31.42 (MGP-150)	41.22 (CMG-06)	36.66	2.35
GCV(K.Cal/Kg)	131	2774 (MGP-36)	6230 (CMG-06)	4,456.45	4,517.48
GRADE	131	G16 (MGP-36)	G4 (CMG-06)	-	-

SEAM : III

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	131	2.50 (MGP-122)	8.90 (CMG-16)	4.17	0.94
ASH (%)	131	18.70 (CMG-06)	56.50 (MGP-36)	38.41	8.52
VM (%)	45	18.90 (MGP-153)	32.80 (CMG-06)	24.46	2.99
UVM (%)	45	30.90 (MGP-153)	41.22 (CMG-06)	36.41	2.51
GCV(K.Cal/Kg)	131	2774 (MGP-36)	6230 (CMG-06)	4,352.87	4,418.21
GRADE	131	G16 (MGP-36)	G4 (CMG-06)	-	-

4.3.29 SEAM II LOCAL

Seam II Local is occurring below seam III in the lower column of coal bearing Barakar formation. It occupies very limited area in the eastern part of the block. It overlies seam II combined with a parting of 0.48m to 13.07m and with seam II Top with a parting of 0.29m to 7.10m.

The full seam thickness has been intersected in 131 boreholes. The full seam thickness varies from 0.12m to 1.67m. The seam roof consists dominantly of gritty sandstone and its floor consists of carb. shale and sandstone. The seam occurs at depth range of 318.54m to 488.26m within the block.

4.3.29.1. Quality

SEAM : II LOCAL
QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	12	2.90 (MGP-16)	6.80 (MGP-1)	4.44	1.09
ASH (%)	12	20.80 (MGP-38)	49.90 (MGP-16)	33.28	8.68
VM (%)	5	22.60 (MGP-1)	30.10 (CMG-18)	26.06	2.62
UVM (%)	5	36.11 (MGP-1)	45.32 (CMG-18)	38.59	3.42
GCV(K.Cal/Kg)	12	3439 (MGP-16)	5946 (MGP-38)	4,765.42	4,833.50
GRADE	12	G13 (MGP-16)	G5 (MGP-38)	-	-

SEAM : II LOCAL
QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	12	2.90 (MGP-16)	6.80 (MGP-1)	4.44	1.09
ASH (%)	12	20.80 (MGP-38)	49.90 (MGP-16)	33.28	8.68
VM (%)	5	22.60 (MGP-1)	30.10 (CMG-18)	26.06	2.62
UVM (%)	5	36.11 (MGP-1)	45.32 (CMG-18)	38.59	3.42
GCV(K.Cal/Kg)	12	3439 (MGP-16)	5946 (MGP-38)	4,765.42	4,833.50
GRADE	12	G13 (MGP-16)	G5 (MGP-38)	-	-

4.3.30 SEAM II TOP

Seam II Top occurs below seam II Local in the lower column of coal bearing Barakar formation. It overlies seam Band 4 with a parting of 3.12m to 8.28m.

The full seam thickness has been intersected in 36 boreholes. The seam is not developed in 8 BHs. The seam is workable in the eastern part only. The full seam thickness varies from 0.50m to 8.06m (the prevalent seam thickness falls in the range of 2.00 to 3.00m. In the southern part of eastern side of the block, due to basement high the seam has not been intersected in MGP-25,45,62,66,67,155,195 & CMG-05F. The seam occurs at depth range of 358.98 m to 496.50m within the block.

4.3.30.1. Quality

SEAM : II TOP
QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	8	2.30 (MGP-1)	6.40 (MGP-2)	3.98	1.22
ASH (%)	8	19.50 (MGP-38)	64.40 (MGP-1)	39.58	14.44
VM (%)	1	24.10 (MGP-18)	24.10 (MGP-18)	-	-
UVM (%)	1	30.63 (MGP-18)	30.63 (MGP-18)	-	-
GCV(K.Cal/Kg)	8	2918 (CGGD-4)	5996 (MGP-38)	4,260.06	4,438.02
GRADE	8	G15 (CGGD-4)	G5 (MGP-38)	-	-

SEAM : II TOP
QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	8	2.30 (MGP-1)	6.40 (MGP-2)	3.98	1.22
ASH (%)	8	19.50 (MGP-38)	64.40 (MGP-1)	39.58	14.44
VM (%)	1	24.10 (MGP-18)	24.10 (MGP-18)	-	-
UVM (%)	1	30.63 (MGP-18)	30.63 (MGP-18)	-	-
GCV(K.Cal/Kg)	8	2918 (CGGD-4)	5996 (MGP-38)	4,260.06	4,438.02
GRADE	8	G15 (CGGD-4)	G5 (MGP-38)	-	-

4.3.31 SEAM II BOT

Seam II Bottom occurs below seam-II Top and II Local in the lower column of coal bearing Barakar formation. It overlies seam Band-4 with a parting of 0.27m to 3.69m.

The full seam thickness has been intersected in 36 boreholes. The seam is not developed in 13 BHs. The seam is workable in the eastern part only. The full seam thickness varies from 0.35m to 11.98m (the prevalent seam thickness falls in the range of 2.00 to 3.00m. In the southern part of eastern side of the block, due to basement high the seam has not been intersected in MGP-44, 49, 52, CMG-26 & 35. The seam occurs at depth range of 366.74m to 501.00m within the block.

4.3.31.1. Quality

SEAM : II BOT

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	9	4.10 (MGP-18)	7.10 (MGP-1)	5.21	0.85
ASH (%)	9	14.70 (MGP-18)	41.80 (MGP-9)	26.88	8.62
VM (%)	4	23.80 (MGP-3)	29.00 (MGP-7)	26.15	2.04
UVM (%)	4	29.14 (MGP-18)	35.48 (MGP-7)	32.70	2.54
GCV(K.Cal/Kg)	9	3998 (MGP-9)	6440 (MGP-18)	5,260.95	5,317.32
GRADE	9	G12 (MGP-9)	G3 (MGP-18)	-	-

SEAM : II BOT

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	9	4.10 (MGP-18)	7.10 (MGP-1)	5.21	0.85
ASH (%)	9	14.70 (MGP-18)	41.80 (MGP-9)	26.88	8.62
VM (%)	4	23.80 (MGP-3)	29.00 (MGP-7)	26.15	2.04
UVM (%)	4	29.14 (MGP-18)	35.48 (MGP-7)	32.70	2.54
GCV(K.Cal/Kg)	9	3998 (MGP-9)	6440 (MGP-18)	5,260.95	5,317.32
GRADE	9	G12 (MGP-9)	G3 (MGP-18)	-	-

4.3.32 SEAM I COMB

Seam II Combined occurs below seam-III and II Local in the lower column of coal bearing Barakar formation. It overlies seam Band-4 with a parting of 26.06m to 50.68m.

The full seam thickness has been intersected in 61 boreholes. The seam is not developed in 15 BHs. The seam is workable in the eastern part only. The full seam thickness varies from 0.02m to 12.12m (the prevalent seam thickness falls in the range of 2.00 to 3.0m. In the south- eastern side of the block, due to basement high the seam has not been intersected in MGP-26, 44, 49, 52, CMG-26, 29 & 35. The seam occurs at depth range of 321.93m to 524.00m within the block.

4.3.32.1. Quality

SEAM : II COMB
QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	38	2.50 (MGP-36)	5.70 (CMG-17)	4.32	0.78
ASH (%)	38	12.30 (MGP-30)	59.70 (MGP-36)	32.71	11.32
VM (%)	11	20.70 (MGP-10)	28.90 (CMG-17)	23.95	2.64
UVM (%)	11	27.25 (MGP-57)	42.55 (CMG-18)	33.84	4.14
GCV(K.Cal/Kg)	38	2575 (MGP-36)	6616 (MGP-30)	4,866.33	4,961.91
GRADE	38	G16 (MGP-36)	G3 (MGP-30)	-	-

SEAM : II COMB
QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	38	2.50 (MGP-36)	5.70 (CMG-17)	4.30	0.82
ASH (%)	38	12.30 (MGP-30)	59.70 (MGP-36)	32.99	11.57
VM (%)	11	20.70 (MGP-10)	28.90 (CMG-17)	23.95	2.64
UVM (%)	11	27.25 (MGP-57)	42.55 (CMG-18)	33.84	4.14
GCV(K.Cal/Kg)	38	2575 (MGP-36)	6616 (MGP-30)	4,842.36	4,942.59
GRADE	38	G16 (MGP-36)	G3 (MGP-30)	-	-

4.3.33 SEAM BAND-4

Seam Band-4 is occurring in Barakar formation as the lower most bands. It occurs below seam II. The thickness of seam varies from 0.04m to 1.39m. It is occurring in patches in the eastern part of the block. In remaining area, the seam is either not developed or unworkable.Hence, boreholes have not been drilled upto the seam.

6.34.3 The seam is intersected in 24 boreholes and is also not developed in 53 boreholes. The seam occurs at a depth range of 326.23m to 498.28m.

4.3.33.1. Quality

SEAM : BAND-4
QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	2	4.70 (MGP-17)	5.40 (MGP-16)	5.05	0.35
ASH (%)	2	22.50 (MGP-16)	32.50 (MGP-17)	27.50	5.00
VM (%)	0	-	-	-	-
UVM (%)	0	-	-	-	-
GCV(K.Cal/Kg)	2	4815 (MGP-17)	5655 (MGP-16)	5,235.32	5,252.12
GRADE	2	G9 (MGP-17)	G6 (MGP-16)	-	-

SEAM : BAND-4
QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	2	4.70 (MGP-17)	5.40 (MGP-16)	5.05	0.35
ASH (%)	2	22.50 (MGP-16)	32.50 (MGP-17)	27.50	5.00
VM (%)	0	-	-	-	-
UVM (%)	0	-	-	-	-
GCV(K.Cal/Kg)	2	4815 (MGP-17)	5655 (MGP-16)	5,235.32	5,252.12
GRADE	2	G9 (MGP-17)	G6 (MGP-16)	-	-

4.3.34 SEAM I

Seam I is occurring in Barakar formation as the lower most bands. It occurs below seam Band 4. The thickness of seam varies from 0.06m to 1.10m. It is occurring in patches in the eastern part of the block. In remaining area, the seam is either not developed or unworkable.Hence, boreholes have not been drilled upto the seam.

The seam is intersected in 10 boreholes and is also not developed in 12 boreholes. The seam occurs at a depth range of 452.30m to 561.33m.

4.3.34.1. Quality

SEAM : I

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I30L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	5	3.90 (RGP-15)	6.10 (MGP-146)	4.72	0.77
ASH (%)	5	12.30 (MGP-146)	44.50 (RGP-15)	31.00	12.15
VM (%)	2	20.60 (MGP-67)	23.40 (MGP-8)	22.00	1.40
UVM (%)	2	29.69 (MGP-8)	30.53 (MGP-67)	30.11	0.42
GCV(K.Cal/Kg)	5	3802 (RGP-15)	6514 (MGP-146)	4,901.29	5,002.20
GRADE	5	G12 (RGP-15)	G3 (MGP-146)	-	-

SEAM : I

QUALITY PARAMETER (ON 60% RH & AT 40 DEG CENTG.) ON I10L BASIS

PARAMETER	NO OF BHS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
MOISTURE (%)	5	3.90 (RGP-15)	6.10 (MGP-146)	4.72	0.77
ASH (%)	5	12.30 (MGP-146)	44.50 (RGP-15)	31.00	12.15
VM (%)	2	20.60 (MGP-67)	23.40 (MGP-8)	22.00	1.40
UVM (%)	2	29.69 (MGP-8)	30.53 (MGP-67)	30.11	0.42
GCV(K.Cal/Kg)	5	3802 (RGP-15)	6514 (MGP-146)	4,901.29	5,002.20
GRADE	5	G12 (RGP-15)	G3 (MGP-146)	-	-

4.4 RESERVES

4.4.1 METHOD OF RESERVES ESTIMATION

4.4.1.1. Process-1

The resource has been estimated with the help of MINEX. The resources have been estimated on I100 thickness basis for all the 19 persistent seams i.e. X Top, X Bottom, IX-L2, IX-L1, Local-1, IX, Local-2, VIII, VII, VI A, VI B, VI A+B, VI C, VI B+C, VI A+B+C, VI D, VI C+D, VI B+C+D & VI A+B+C+D as OCP resources. Also the resources have been estimated on I30 thickness for the remaining 12 seams i.e. VI Local, Band-1, V Top, Local-3, V Bottom, Band-2, IV, Band-3, III, II Top, II Bottom and II Combined.

Besides, for 6 moderately developed seam Local-2, Band-1, V Top, Band-2, Band-3 & Band-4 resources have also be assessed.

4.4.1.2. Process-2

Volume of coal is estimated by Software and resources are by empirical formula of :

Gross Resources = Area X Thickness X Sp. Gravity of Coal

4.4.1.3. Process-3

A 10% deduction has been made from the gross resources to arrive at the net-in-situ proved resources available in the block.

4.4.1.4. Process-4

Resource has been estimated under proved category.

4.4.1.5. Process-5

In this block some permanent infrastructures were developed i.e. Jindal Washery, Ash Pond and Power Plant. So this area was considered as Indicated Resource Category for resource estimation.

4.4.2 RESERVES

4.4.2.1. Estimation of reserves

In this report opencast has been proposed upto seam VI-local, where seam thickness >0.5m has been considered for mining. Therefore, the seam wise and category wise geological reserves of Gare Palma Sector-I has been presented in two sections, depending on mining methods. In section-1, the reserves of seams upto seam VI-local has been shown considering seam thickness >0.5m. In section-2 reserves of seams below seam VI-Local has been shown considering seam thickness >0.9m. The reserves of both the sections are as follows:

SUMMARY OF SEAM-WISE & CATEGORY-WISE RESERVES IN GARE PALMA SECTOR-I COAL BLOCK

(Resources in Million Tonnes)

SEAM	*PROVED*			INDICATED			TOTAL		
	Thickness of >0.9m	*Thickness of >0.5m to 0.9m only upto seam VI -Local*	*Total*	*Thickness of >0.9m*	*Thickness of >0.5m to 0.9m only upto seam VI - Local*	*Total*	Thickness > 0.9m	*Thickness >0.5m to 0.9m only upto seam VI - Local*	TOTAL
Upper seam reserves presented in two scenarios i.e with seam thickness of >0.5m and of >0.9m									
X TOP	120.52	5.63	126.15	6.79	2.71	9.49	127.31	8.34	135.65
X BOT.	145.79	2.03	147.82	24.03		24.03	169.82	2.03	171.85
IX-L2	25.55	19.53	45.08	0.16	3.94	4.1	25.71	23.47	49.18
IX-L1	28.49	30.41	58.9	3.85	4.32	8.17	32.34	34.73	67.07
LOCAL-1	5.46	7.56	13.02		0.03	0.03	5.46	7.59	13.05
IX	306.81	0.33	307.14	33.02		33.02	339.83	0.33	340.16
LOCAL-2	7.73	4.83	12.56	0.44	0.06	0.5	8.17	4.89	13.06
VIII	22.33	7.47	29.8	7.24	1.35	8.59	29.57	8.82	38.39
VII	105.5	3.16	108.66	23.57	0.08	23.65	129.07	3.24	132.31
VIA	21.36	1.21	22.58	1.23	0.03	1.25	22.59	1.24	23.83
VIB	8.98	0.34	9.32				8.98	0.34	9.32
VI A+B	30.92		30.92				30.92		30.92
VI C	14.01	0.23	14.23				14.01	0.23	14.24
VI B+C	18.85		18.85	0.45		0.45	19.3		19.30
VI A+B+C	105.84		105.84	25.57		25.57	131.41		131.41
VI D	40.71	4.61	45.32	7.35	0.41	7.76	48.06	5.02	53.08
VI C+D	28		28	0.87		0.87	28.87		28.87
VI B+C+D	50.65		50.65				50.65		50.65
VI A+B+C+D	342.54		342.54	29.29		29.29	371.83		371.83
VI Local	29.01	4.81	33.83	26.57	0.055	26.62	55.58	4.87	60.45
Sub-Total	**1459.05**	**92.15**	**1551.21**	**190.43**	**12.99**	**203.39**	**1649.48**	**105.14**	**1754.62**

SEAM	*PROVED*			INDICATED			GRAND TOTAL		
	Thickness of >0.9m	*Thickness of >0.5m to 0.9m only upto seam VI -Local*	*Total*	*Thickness of >0.9m*	*Thickness of >0.5m to 0.9m only upto seam VI - Local*	*Total*	Thickness > 0.9m	*Thickness >0.5m to 0.9m only upto seam VI - Local*	*TOTAL*
Lower Seams reserves presented with seam thickness of >0.9m									
BAND-1	0.50		0.50	0.10		0.10	0.60		0.60
V TOP	1.78		1.78	2.57		2.57	4.35		4.35
LOCAL-3	0.26		0.26				0.26		0.26
V BOT.	29.90		29.90				29.90		29.90
BAND-2	1.83		1.83				1.83		1.83
IV	8.58		8.58	0.29		0.29	8.87		8.87
BAND-3	1.15		1.15				1.15		1.15
III	57.61		57.61	0.92		0.92	58.53		58.53
II COMB.	44.31		44.31	0.11		0.11	44.42		44.42
II TOP	25.21		25.21				25.21		25.21
II BOT.	6.34		6.34				6.34		6.34
Total :	**177.47**		**177.47**	**3.99**		**3.99**	**181.46**		**181.46**
Grand Total (Upper+lower):	**1636.52**	**92.15**	**1728.68**	**194.42**	**12.99**	**207.38**	**1830.94**		**1936.08**

4.4.2.2. Grade-wise Reserves

The grade wise reserves is presented for reserves estimated for seam thickness >0.9m for all seams for the entire block and is as follows:

SUMMARY OF GRADE-WISE & CATEGORY-WISE RESERVES IN GARE PALMA SECTOR-I COAL BLOCK

(> 0.90m thickness) Virgin (Resources in Million Tonnes)

GRADE	OPEN CAST			UNDER GROUND			GRAND TOTAL	PERCENT-AGE
	PROVED	INDICATED	TOTAL	PROVED	INDICATED	TOTAL		
G-3				0.385		**0.385**	**0.385**	0.02
G-4				3.104		**3.104**	**3.104**	0.17
G-5				5.020		**5.020**	**5.020**	0.27
G-6	0.010		0.010	7.910		**7.910**	**7.920**	0.43
G-7	1.286		1.286	13.693		**13.693**	**14.979**	0.82
G-8	11.023	3.599	14.622	19.927	0.019	**19.946**	**34.568**	1.89
G-9	68.931	10.557	79.488	27.923	0.392	**28.315**	**107.803**	5.89
G-10	148.041	22.205	170.246	28.736	0.801	**29.537**	**199.783**	10.91
G-11	158.775	20.653	179.428	28.606	4.844	**33.45**	**212.878**	11.63
G-12	207.685	19.649	227.334	31.678	17.721	**49.399**	**276.733**	15.11
G-13	243.200	23.567	266.767	23.087	6.333	**29.42**	**296.187**	16.18
G-14	389.548	55.866	445.414	10.995	0.352	**11.347**	**456.761**	24.95
G-15	176.982	6.509	183.491	3.099	0.005	**3.104**	**186.595**	10.19
G-16	21.861	1.184	23.045	1.252	0.004	**1.256**	**24.301**	1.33
G-17	2.692	0.056	2.748	1.049	0.082	**1.131**	**3.879**	0.21
Total :	**1430.034**	**163.845**	**1593.879**	**206.464**	**30.553**	**237.017**	**1830.896**	

4.4.2.3. Reserves of the Phase-I area

Geological reserves proposed for mining by opencast and underground in phase-I i.e in the East of Kelo river, Considering seam thickness > 0.5m for seams upto seam VI-Local (inclusive) from top and >0.9m for seams below seam VI-Local are as follows:

Geological reserves considered in phase-I

	Reserves in Mt	
Seam	**Total Reserves (Block)**	**Geological Reserves for Ph-I**
X-TOP	135.64	105.25
X-BOTT.	171.85	95.68
IX-L2	49.18	32.73
IX-L1	67.07	39.79
LOCAL-1	13.05	9.51
IX	340.16	237.94
LOCAL-2	13.06	11.72
VIII	38.39	13.65
VII	132.31	45.23
VI-A	23.83	20.07
VI-B	9.32	8.89
VIA+VIB	30.92	26.31
VI-C	14.23	12.37
VIB+VIC	19.30	16.14
VIA+VIB+VIC	131.41	48.70
VI-D	53.08	28.68
VIC+VID	28.87	26.60
VIB+VIC+VID	50.65	44.31
VIA+VIB+VIC+VID	371.83	266.97
VI Local	60.45	24.83
Band -1	0.60	0.50
V Top	4.35	0.56
Local-3	0.26	0.26
V Bot	29.90	29.90
Band-2	1.83	1.83
IV	8.86	8.58
Band-3	1.15	1.15
III	58.54	56.83
IITop	25.21	25.21
II Bot	6.34	6.34
II comb	44.41	44.31
TOTAL	**1936.05**	**1290.82**

4.4.2.4. Reserves for existing mine:

The proposed area is virgin

4.4.3 HYDRO-GEOLOGICAL STUDY

No such study for the block has been carried out by GSECL.

CHAPTER-5

MINING

5.1 METHOD OF MINING

5.1.1 GRADIENT OF THE SEAMS

The general strike of coal horizons is NW-SE in the major part of the block, which swings to almost East–West in the South-Eastern part of the block. The dip of beds varies from 2º to 4º towards South-West.

5.1.2 GEOLOGICAL DISTURBANCES

The block does not show major tectonic disturbances. A total of 4 nos. of faults have been deciphered. The brief of the faults is as follows:

FAULT NO.	LOCATION	NATURE	STRIKE & DIP	THROW (M)
F_1 -F_1	Located in the south central to south eastern part of the block and extending from north of MGP-86 in the west to north of MGP-36 in the east. Its linear extension is 5.5 km.	Oblique	Trending in almost E-W direction and dipping towards north.	0 – 12 dying out at either ends
F_2 -F_2	Located in the southern part of the block and extending from south of MGP-267 in the west to north of MGP-43 in the east. Its linear extension si 8.4 km.	Oblique	Curvilinear dipping due north. In the west it is having E-W trend and swings to SE.	0 – 45 dying out at either ends
F_3 -F_3	Located in the southern part of the block. It extends from south of MGP-133 in the west to west of CMG-37 in the east covering a linear distance of 6.2 km.	Oblique	Striking in WNW-ESE direction dipping northerly.	0 – 10 dying out at either ends
F_4 -F_4	It extends for about 2 km and occupies the southern part of the block . It extends between CMG-2 to CMG-32.	Oblique	Striking NW-SE dipping in the NE direction.	0 – 10 dying out in NW direction

5.1.3 SEAM PARAMETERS

The seam parameters like thickness, depth of occurrence etc., which contribute to choice of method and technology of mining are as follows:

Sl. No.	Coal Seams	Thickness of Coal Seam (m)				Depth range in m	
		Minimum	Maximum	Mean	S.D	Minimum	Maximum
1	X - Top	0.05	5.60	1.71	0.83	44.08	330.01
2	X – Bott.	0.14	6.00	1.86	0.78	52.65	340.26
3	IX- L2	0.06	2.54	0.72	0.40	74.40	351.93
4	IX- L1	0.09	5.41	0.84	0.42	79.98	368.26
5	Local-1	0.05	1.48	0.44	0.36	90.40	374.69
6	IX	0.27	13.67	4.15	1.95	99.91	388.34
7	Local-2	0.02	3.77	0.43	0.49	101.64	396.10
8	VIII	0.03	6.68	0.77	0.93	109.39	393.13
9	VII	0.06	4.24	1.81	1.06	126.52	426.16
10	VI-A	0.32	5.73	1.62	0.85	146.85	407.36
11	VI-B	0.15	6.45	1.97	1.47	160.99	295.85
12	VIA+VIB	1.70	9.26	4.75	1.83	122.50	275.86
13	VI-C	0.48	6.77	2.46	1.74	146.06	298.30
14	VIB+VIC	0.73	12.47	5.31	2.57	170.27	311.64
15	VIA+VIB+VIC	0.54	10.89	6.13	1.57	169.03	443.20
16	VI-D	0.05	8.22	1.81	1.58	170.00	434.51
17	VIC+VID	1.61	14.58	5.82	3.20	131.00	282.40
18	VIB+VIC+VID	3.13	17.16	10.30	3.95	152.86	412.27
19	VIA+VIB+VIC +VID	1.80	17.13	9.70	3.09	138.87	435.27
20	VI-Local	0.02	3.25	2.27	1.96	134.13	450.20
21	Band-1	0.05	1.62	0.43	0.26	162.90	374.93
22	V-Top	0.07	2.19	0.54	0.28	172.62	464.20
23	Local-3	0.06	1.24	0.52	0.22	176.49	469.54
24	V-Bot	0.05	6.39	1.47	1.34	198.09	492.22
25	Band-2	0.02	3.85	0.53	0.52	203.06	493.31
26	IV	0.04	2.25	0.59	0.47	220.06	477.02
27	Band-3	0.02	2.06	0.41	0.40	248.00	500.51
28	III	0.04	4.78	1.89	0.95	281.59	557.16
29	II Local	0.12	1.67	0.57	0.37	318.54	488.26
30	II COMB	0.02	12.12	2.96	3.20	321.93	524.00
31	II TOP	0.50	8.06	2.79	2.30	358.98	496.50
32	II BOT	0.35	11.98	2.38	2.67	366.74	501.00
33	Band-4	0.04	1.39	0.33	0.33	326.23	498.28
34	I	0.06	1.10	0.58	0.33	552.30	561.33

5.1.4 CHOICE OF METHOD OF MINING

5.1.4.1. General considerations

The thickness, depth of occurrence, tectonic disturbances, gradient of seams, availability of land etc. influence the choice of method and technology of mining. Gare Palma Sector-I, block is located in the dip side of Gare Palma Sectos II, IV/I,IV/II and

IV/III. No incrop or outcrop is available for early revenue. However, though the coal seams occur at depths, coal seams upto VI-Local (inclusive) are found to be amenable for **opencast mining** due to reasonable thickness, consistent occurrence, little geological disturbance, reasonable OB to coal thickness ratio and gentle gradient.

The entire phase-I property of the block has been divided into two parts, Part-A and Part-B for selection of method of mining. Part-A is the East most property of the block whereas, Part-B is the property in between Kelo river and Part-A. Seams upto VI-Local (inclusive) of part-A has been considered for opencast mining. The choice of methods has been based on the factors as follows:

- It is observed that the thickness of the seams reduces gradually towards the West of the block. This feature makes the Eastern part of the property more amenable for opencast operation.
- Since the initial depths of the seams are high and due to absence of any incrop/outcrop, large volume of OB will needed to be dumped externally, outside the quarry area requiring huge land for the purpose.
- The block area being surrounded by coal bearing blocks in all sides, availability of any land for external dumping, outside the block area is remote.

Considering the above factors, the quarry area and the external dump area have been optimized to maximise mining operation by opencast method and rest by underground method.

5.1.4.2. Opencast:

The quarry area has been named as *part-A* while the external dump area and proposed infrastructure area as *part-B*. In part-A area, the thickness of most of the seams are relatively better, which shows gradual thinning while progressing towards the West. As described earlier, the quarry has been optimized after adjusting external OB in the adjacent coal bearing area. The thickness ratio line, rationalized for smooth quarry

geometry, of OB to coal of 9:1 has been considered the limiting cutoff in the West of the quarry.

5.1.4.3. Underground:

The external dump in part-B has been considered upto a maximum height of 90(ninety) meters above surface level to reduce land requirement. This will make mining of coal in part-B unviable by opencast method, both technically and economically. It is therefore, proposed that the seams of the part B are mined by underground method. Entire of part-B and seams below seam VI-Local of part-A have been proposed to be mined by underground method. The details of underground scheme has been provided later in this chapter.

5.1.5 CHOICE OF TECHNOLOGY FOR OPENCAST OPERATION

Different technologies like shovel-dumper mining, dragline mining, bucket wheel excavator mining and surface miner- Pay-loader-truck mining are available for opencast mining. Sometimes combination of several methods of mining are adopted to suit particular type of mining situations.

For coal deposits in the block under consideration, bucket wheel excavator mining is inapplicable due to presence of abrasive & hard sandstone and hard carb-shale strata.

The gentle gradient and little structural disturbances allow the application of dragline into the property. However, the dragline has not been proposed due to the following reasons.

- It will take about 8-10 years to reach the floor of the mine and to create sufficient space for deployment of dragline.
- The parting between the lower most seam and the immediate next mineable seam is not adequate.

Surface miner-loader and truck technology is best suited for mining of coal seams of gentle gradient with few geological disturbances. This technology eliminates use of explosives & blasting and crushing, making it most sought after technology wherever

applicable. All the seams of the opencast portion of the block has been proposed to be mined by this technology. The coal loaded truck movement has been restricted within the face only. ***Conveyors*** in the quarry batter have been proposed for evacuation of coal from the quarry.

Shovel-dumper technology is the most flexible technology for opencast mining. The strata above the topmost Seam X-top and the inter-burdens between the seams have been proposed to be removed by shovel dumper combination.

5.2 OPENCAST MINING AND DUMPING STRATEGY

5.2.1 QUARRY BOUNDARY

The proposed boundary of the quarry will be as follows:

5.2.1.1. North:

The existing road connecting the village Kunjumepa in the West and Amgaon in the East is a public road and requires diversion. The diversion of this road has been proposed along the Northern boundary of the block. A barrier of 45 meters has been left from the road for fixing the Northern boundary of the quarry.

5.2.1.2. East:

A barrier of 7.5 meters from the East block boundary has been left for fixing the boundary in the East.

5.2.1.3. South:

In the South-West corner of Sub-block-B, there is presence of a nala. This nala has been proposed for diversion along the Southern boundary. A barrier of 52 metres have been left from this diverted nala for fixing the quarry boundary of this portion. The village Bijana has its boundary in the South side. The Northern rectangular notch of Bijana village will need to be rehabilitated to smoothen the proposed quarry batter for better mining operation and conservation & safety of the mine, as shown in Plate No. 04, Surface Feature Plan. A barrier of 50 meters has been left from this village. Only 7.5 meters has been left for other parts before fixing the final quarry, in the South.

5.2.1.4 West:

Near the South-West corner of the proposed quarry, there is a low lying area due to exiting route of nala as mentioned in Para 5.2.1.3. Therefore, a barrier of 35m has been left to accommodate an embankment to protect the proposed quarry from inrush of water into it as a safety measure as shown in Plate No. 35, Final stage Quarry Plan. After that, some portion of West side quarry boundary has been fixed after leaving a barrier of 7.5 meters from the block boundary, where there is block boundary. Thereafter, along the thickness ratio line (cutoff ratio line) of OB to coal of 9:1. The quarry batter has been straitened along the cutoff line for smooth quarry geometry for better mining operation.

5.2.2 QUARRY PARAMETERS

5.2.2.1. Geological parameters of the quarry

SL. NO.	PARTICULARS	UNIT	VALUE		
			MIN	MAX	AVG.
1	THICKNESS	m			
	TOP OB	m	65.39	226.80	131.38
	X-TOP	m	0.70	5.60	2.63
	INTERBURDEN	m	2.50	9.17	6.06
	X-BOTT.	m	0.02	2.80	1.47
	INTERBURDEN	m	8.79	28.10	17.79
	IX-L2	m	0.02	1.50	0.83
	INTERBURDEN	m	3.28	12.30	7.12
	IX-L1	m	0.10	5.41	1.03
	INTERBURDEN	m	0.77	19.08	7.51
	LOCAL-1	m	0.02	1.38	0.54
	INTERBURDEN	m	0.78	14.50	3.65
	IX	m	1.35	11.20	5.84
	INTERBURDEN	m	0.19	9.57	3.02
	LOCAL-2	m	0.02	3.58	0.32
	INTERBURDEN	m	0.33	19.24	7.04
	VIII	m	0.02	6.68	0.32
	INTERBURDEN	m	0.66	31.24	13.37
	VII	m	0.02	3.55	0.62
	INTERBURDEN	m	0.75	17.68	7.40
	VI-A	m	1	2.5	1.62
	VI-B	m	0.5	6.0	2.28
	VIA+VIB	m	4.5	8.0	5.51
	VI-C	m	1	5	2.84
	VIB+VIC	m	5	8	5.13
	VIA+VIB+VIC	m	7	9	7.97
	VI-D	m	3	5	3.31
	VIC+VID	m	5	8	6.68

SL. NO.	PARTICULARS	UNIT	VALUE		
			MIN	MAX	AVG.
	VIB+VIC+VID	m	9	13	9.69
	VIA+VIB+VIC+VID	m	12	15	12.36
	VI (composite)	m	7.11	19.29	13.26
	INTERBURDEN		1.5	4.5	2.5
	VI Local	m	0.5	1.5	1.2
2	**Gradient of the seams**	Deg	2	4	**3**

5.2.2.2. Technical parameters of the quarry

Quarry parameters are as provided in the table as follows:

Sl. No.	Particulars	Unit	Value	
			Min	Max
1	**Quarry Area**			
i)	Along floor(Total)	ha	1028.31	
ii)	Along surface(Total)	ha	1620.31	
2	**External dump area**	ha	1447.50	
3	**Strike length**	m		
i)	Floor		3250	4600
ii)	Surface		4050	5500
4	**Dip-Rise length**	m		
i)	Floor		1800	3500
ii)	Surface		2500	4200
5	**Depth of Quarry (from access point)**	m	140	266
6	**Extractable Reserves**	Mt	427.86	
7	**Overburden to be removed**	Mcum	2804.18	
8	**Stripping ratio (Avg)**	M^3/t	6.55	
9	**Annual production**	Mt	15	
10	**Life of proposed quarry including construction period of two years**	Yrs.	34	
11	**Quarry perimeter Total**	m	19047.50	

The mean composite thickness of the seams has been derived as 18-22m. Considering advance of at least 110-120m per year the capacity can be calculated as 15 MTPA.

5.2.3 CONSTRAINTS FOR MINE DEVELOPMENT

Envisaged constraints for mine development are as follows:

- Presence of about 20 villages within the proposed mining area.
- Presence of structures of JINDAL in the proposed area. The structures are
    - a pipe conveyor connecting Jindal Washery to Jindal Power Plant
    - part of the Jindal colony within the block
    - high tension power line passing across the proposed area for mining
    - part of Jindal Washery within the area under proposal.
    - Explosive & Detonator units

  These structures are to be removed before mining starts in the area.
- Chote bade jhar ka jungle within the quarry and outside area, requiring forest clearance before start of mining. Apart from this conveyors carrying washed coal to railway siding is to be laid through protected forest alongside the diverted public road, would also require forest clearance. Underground mining proposed below the protected forest in the North-West corner of Phase-I may disturb the forest above, needing diversion of forest land.
- Unavailability of non-coal bearing land outside the block for external dump, leading to dumping in the coal bearing area within the block.

5.2.4 MINING STRATEGY/ SEQUENCE OF MINING

5.2.4.1. Strategy

Top soil is proposed to be removed and stacked in temporary storage areas.

The quarry has been proposed to be opened from the location where seams are located in the shallowest depth. This allows early revenue for the project. The proposed location of the box cut is almost in the middle of the northern boundary of the quarry, along the common boundary with Gare Palma Sector IV/III. After one year, the X-top seam is envisaged to be touched promoting revenue inflow to the project. The mined coal is proposed to be carried by trucks to the receiving hopper of conveyor to be installed in the North-West corner (near the quarry mouth) of the quarry.

Initially the quarry is proposed to be advanced primarily in all three directions of East, West and South. Once the full strike of the seams is reached, the quarry is proposed to be advanced only towards south, along the dip of the seams. To carry coal to the surface from the advancing coal faces, three high angle conveyors are proposed to be installed in three coal horizons. The uppermost high angle conveyor will be installed in the North-West corner at the end of 4th year of the mine operation at 190m RL. to cater coal from the upper coal horizon i.e seams X-top & X-bot, IXL2 and IXL1. The middle high angle conveyor will be installed at the end of 5th year of the mine operation at 130m RL. to cater coal from the middle coal horizon i.e seams Local-1, IX, Local-2, VIII and VII. The lowermost high angle conveyor is proposed to be installed at the end of 8th year of mine operation at 100m RL for lifting mined coal to the surface from all the splits & merged seams of seam VI and seam VI-local. As the face will advance, three conventional conveyors to be laid in the floors of seam X-bot, seam IX and seam VI(A+B+C+D) / VI-Local respectively and will be discharging to the above three fixed high angle conveyors. These conventional conveyors are proposed to be regularly be advanced in the direction of face movement, at intervals of five years.

5.2.4.2. Coal Transportation

Coal conveyed from the quarry through high angle conveyors are proposed to be discharged into receiving hoppers of surface conveyors. Surface conveyors will feed coal to the Washery through Ground Bunkers and Reclaim Feeders. After coal being washed in the washery, it will be conveyed to the railway wagons in the proposed railway siding through Rapid Loading arrangements in Silos.

5.2.4.3. Production scheduling

The schedule of production for the proposed mine would be as follows:

Mining Schedule

Year	OBR (Mcum)	Cum OBR (Mcum)	Coal (Mt)	Cum coal (Mt)	Stripping Ratio (cum/t)	Avg. S.R (cum/t)
C1						
C2						
1	33.10	33.10				
2	76.67	109.78	3.40	3.40	22.55	32.28
3	91.16	200.94	5.00	8.40	18.23	23.92
4	91.45	292.39	12.00	20.40	7.62	14.33
5	103.70	396.09	14.00	34.40	7.41	11.51
6	107.58	503.67	15.00	49.40	7.17	10.20
7	107.58	611.25	15.00	64.40	7.17	9.49
8	107.58	718.82	15.00	79.40	7.17	9.05
9	107.58	826.40	15.00	94.40	7.17	8.75
10	93.63	920.02	15.00	109.40	6.24	8.41
11	93.63	1013.65	15.00	124.40	6.24	8.15
12	98.75	1112.39	15.00	139.40	6.58	7.98
13	99.43	1211.82	15.00	154.40	6.63	7.85
14	99.43	1311.25	15.00	169.40	6.63	7.74
15	99.43	1410.67	15.00	184.40	6.63	7.65
16	99.43	1510.10	15.00	199.40	6.63	7.57
17	101.22	1611.32	15.00	214.40	6.75	7.52
18	102.42	1713.74	15.00	229.40	6.83	7.47
19	102.42	1816.16	15.00	244.40	6.83	7.43
20	97.33	1913.49	15.00	259.40	6.49	7.38
21	97.25	2010.74	15.00	274.40	6.48	7.33
22	94.95	2105.69	15.00	289.40	6.33	7.28
23	94.95	2200.64	15.00	304.40	6.33	7.23
24	68.37	2269.02	15.00	319.40	4.56	7.10
25	68.37	2337.39	15.00	334.40	4.56	6.99
26	68.37	2405.76	15.00	349.40	4.56	6.89
27	68.37	2474.14	15.00	364.40	4.56	6.79
28	78.00	2552.13	15.00	379.40	5.20	6.73
29	78.00	2630.13	15.00	394.40	5.20	6.67
30	78.00	2708.13	15.00	409.40	5.20	6.61
31	78.00	2786.13	15.00	424.40	5.20	6.56
32	17.99	2804.11	3.46	427.86	5.20	6.55
TOTAL	**2804.11**		**427.86**		**6.55**	

5.2.4.4. Equipment configuration

The removal of huge volume of top OB has been proposed by Electric Rope Shovels of 42cum with 240T Rear Dumpers and Hydraulic shovels of 10-12 cum with 100T Dumpers. Drills of 311mm diameter & 160mm and dozers of 850-860hp & 410hp have

been provided to drill blast holes in the top strata and doze the face & the waste material in the dump site, respectively.

The partings between the seams have been proposed to be removed by hydraulic shovels of 10-12 cum in association with 100T dumpers. 850-860hp Dozers fitted with ripper attachment have been proposed for removal of thin partings, wherever required. 160mm drills and 410hp dozers have been proposed for drilling blast holes and dozing.

For mining of coal, surface miner of 100t weight have been proposed. Front end loaders of 10-12 cum in association with 60T coal body Rear Dumpers have been proposed for loading and transporting of coal to the conveyors in the batter as stated earlier.

The list of equipment, type, size and maximum population considered for the project is as follows:

EQUIPMENT	Size	Proposed Maximum No.
MAJOR EQUIPMENT		
Electric Rope Shovel	42 cum	**7**
Rear Dumper	240 T	**110**
Diesel Hyd. Shovel	10-12 cum	**17**
Rear Dumper	100 T	**158**
Surface Miner	100t (Wt)	**4**
FEL	10-12 cum	**6**
Rear Dumper (Coal Body)	60 T	**40**
Crawler Dozer	850-860 hp	**4**
Crawler Dozer with Ripper Attachment	850-860 hp	**2**
Crawler Dozer	410 hp	**24**
Wheel Dozer	460-500 hp	**3**
Drill (RBH) Electric	311 mm	**7**
Drill (RBH) Diesel	160 mm	**17**
SUPPORT EQUIPMENT		
Diesel Hyd. B'hoe (common)	1.5 cum	**2**
FE Loader	5-6 cum	**3**
Wheel Dozer	280-320 hp	3
Motor Grader	500-533 hp	**4**
Motor Grader	280-320 hp	**4**
Crane	150 T	**1**
Crane	75 T	**1**
Crane	55 T	**1**

EQUIPMENT	Size	Proposed Maximum No.
Crane	20-25 T	**2**
Crane	8-10 T	**4**
Water Sprinkler	70 kl	**7**
Water Sprinkler	28 kl	**7**
Wagon Drill (Tyre mounted)	100mm	**2**
Fork Lift	5 T	**2**
Tyre Handler	14TH	**3**
Diesel Bowser	20 kl	**3**
Fire Fighting Truck	14 kl	**2**
Boom Truck		**4**
Tipping Trucks	10T	**15**
Maintenance Van		**5**
Road Roller with compactor/vibrator		**1**

5.2.4.5. Elements of mining

Benches will be aligned along general strike. Main bench parameters for above mentioned equipment are:

Top OB:

Bench height : 10-18 m with 42 cum Electric Rope Shovel and 10-12 cum Hyd. Shovels.

Bench width : Working at least 50m, non-working at least 30m.

Parting between seams:

Bench height : 10-12 m with 10-12 cum Hydraulic Shovel.

Bench width : Working at least 50m, non-working at least 30m.

Coal

Bench height : Seam height with Surface Miner of 100t(Wt).

Bench width : At least 60m.

5.2.4.6. Drilling and Blasting

The site preparation will be carried out by the sufficient number of dozers provided in the project. The blast hole drilling is to be done in patterns decided in advance depending on the strata hardness. At intervals, site trials need to be carried on for revising the patterns to optimize explosive consumption.

Blast hole drills of 311 mm diameter will be used for Top OB only. Drills of 160 mm diameter will be used for drilling of top OB & partings. No drilling is required for mining of coal by Surface Miner.

The standard practice involving the electric detonators for the initiation of detonating cord, detonating relays to achieve hole to hole delays, use of Heavy ANFO, slurry or emulsion explosives as the column charge need to be used for Blasting.

5.2.5 DUMPING STRATEGY

Dumping has been proposed in the west of the quarry extending upto 100m from the Kelo river. Rear dumpers of 240T and 100T have been proposed to transport OB from uppermost strata and inter-burdens. As soon as sufficient void is created in the quarry, it is proposed to start back filling. In the initial years dumpers will ply from both the east and west batters of the quarry for backfilling. This will reduce the lead of plying appreciably. It is to be taken care of that the high angle conveys are so installed, that sufficient space if left under it and the haul roads for movement of 240T/100T dumpers.

Maximum Dump Height: 90 meters
Maximum Dump Bench Height: 30 meters
OB Dump Bench Width : 60 meters for active Benches
: 40 meters for Final Internal Dump
: 30 meters for Final External Dump
Individual OB Bench Slope: 37^0 (maximum)
Overall OB Dump Slope : 20^0-22^0 (maximum) for Internal Dump
: 25^0-28^0 (maximum) for External Dump

However, the actual Quarry & OB Dump Bench Parameters will be decided after Slope Stability Study.

he proposed dumping schedule is as follows:

Dumping schedule

Year	Annual OB removal (Mcum)	External OB dump (Mcum)	Internal OB Dump (Mcum)
1	33.1	33.1	
2	76.67	76.67	
3	91.16	91.16	
4	91.45	80.89	10.56
5	103.7	83.69	20.01
Sub-total 5 years	**396.08**	**365.51**	**30.57**
6	107.58	85.4	22.18
7	107.58	84.4	23.18
8	107.58	83.4	24.18
9	107.58	82.4	25.18
10	93.63	65.63	28
Sub-total 6-10 years	**523.95**	**401.23**	**122.72**
11	93.63	63.63	30
12	98.75	66.07	32.68
13	99.43	19.35	80.08
14	99.43	15.35	84.08
15	99.43	11.35	88.08
Sub-total 11-15 years	**490.67**	**175.75**	**314.92**
16	99.43	7.35	92.08
17	101.22		101.22
18	102.42		102.42
19	102.42		102.42
20	97.33		97.33
Sub-total 16-20 years	**502.82**	**7.35**	**495.47**
21	97.25		97.25
22	94.95		94.95
23	94.95		94.95
24	68.37		68.37
25	68.37		68.37
Sub-total 21-25 years	**423.89**	**0**	**423.89**
26	68.37		68.37
27	68.37		68.37
28	78		78
29	78		78
30	78		78
Sub-total 26-30 years	**370.74**	**0**	**370.74**
31	78		78
32	17.99		17.99
Sub-total 31-32 years	**622.73**	**0**	**622.73**
GRAND TOTAL	**2804.11**	**949.82**	**1854.29**

5.2.6 RESERVES

Geological Reserves considered for Opencast and underground are as follows:

Sl. No.	Reserves	Values in Million tonnes (Mt)
1.	*Total reserves of the block	1936.08
2.	*Geological reserves in the phase-I side i.e in the East of Kelo river.	1290.82
3	***Geological reserves of the open cast-Vertical geological reserves from quarry surface boundary upto seam VI Local**	606.91
4	Mineable reserves of the quarry without mining loss	450.38
5	Extractable reserves from quarry with mining loss of 5%	427.86
6	Geological reserves sterilized in the batters of the Quarry	
	a. East batter b. South batter c. West batter d. North **TOTAL**	23.64 42.02 31.54 59.32 **156.52**
7	Geological reserves sterilized in the North for leaving 60m i.e 15m for diverted road and 45 meters from diverted road, in the East, South (except 90m from diverted nala and 50m from Bijana village after taking Northern rectangular notch for proposed quarry) and part of West for leaving 35m/7.5m from block boundary and in the two triangular & one rectangular portions in the North where OC mining has not been proposed.	30.95

Sl. No.	Reserves	Values in Million tonnes (Mt)
8	Geological reserves for Underground	683.91
9	Extractable reserves for underground	297.90

* For reserve calculation, thickness of seams upto seam VI-Local from top have been considered >0.5m. Thickness of seams below the seam VI-Local has been considered >0.9m.

Part of the reserves blocked in the batters may be extracted by Highwall mining, if found feasible. Pilot projects can be taken up for studying feasibility of this technology.

5.3 SCHEME FOR UNDERGROUND MINING

5.3.1 GENERAL

In phase-I of the Mining Plan of Gare Palma Sector-I coal block, the area East of Kelo River has been divided into two parts, namely Part-A and Part-B. It has been proposed that opencast mining shall be done in Part-A of the block up to Seam VI-Local (with open pit floor being Seam VI-Local) and the overburden removed during mining operation shall be dumped in Part-B. All coal seams in Part-B of the block, major part of which will be covered by the overburden dump, and coal seams lying below the floor of proposed open pit (i.e. seam VI-Local) are proposed to be mined by underground. Area available for underground mining in Part-B shall be approximately 18.93 square kilometers, out of which, area proposed to be covered by overburden dump will be around 14.48 square kilometers and area available below the proposed opencast would be around 16.20 square kilometers.

In Part-B, since the area proposed for underground mining is beneath the overburden dump, final extraction with caving can be started only after cessation of active dumping operation, while in Part-A earliest start of underground mining operation can only be commenced after cessation of all mining and closure related activities. Coal seams considered for underground mining and their salient features are described below.

5.3.2 DESCRIPTION OF MINEABLE COAL SEAMS

Coal seams in this block (Phase-I) are deposited with strike in NW-SE direction dipping at 2^o to 4^o in south-west direction. Major part of the area is geologically undisturbed as

only four faults F1-F1 to F4-F4 have been interpreted in the southern part of the property. Brief description of mineable coal seams (by underground) are as follows:

Seam X Top: This is the top-most seam, but is mineable by underground mining in patches beneath the dump in Part-B and, therefore, would be accessible through drifts from workings in Seam X Bottom. The average thickness of this seam in mineable zones varies from 1.55m to 1.75m, while the thickness of parting with the immediate lower seam i.e., Seam X Bottom ranges from 3.65m (BH MGP-183) to 10.24m (BH MGP-144). The estimated extractable reserve of this seam comes to around 10.6 Mt with average grade of G12 in Part-B.

Seam X Bottom: This seam lies below Seam X Top and is mineable by underground method in major portion of Part-B. The estimated average thickness of seam in the mineable zone north of fault F2-F2 comes to around 2.2m and that south of fault F2-F2 is around 1.8m and the parting thickness from underlying mineable seam i.e., Seam IX varies from around 34m to 45m. The estimated extractable reserve by underground mining from this seam comes to around 29.7 Mt with average grade of G14.

Seam IX: Seams IX-L2, IX-L1 and Local-1 lying below Seam X Bottom are not mineable by underground due to low thickness. Seam IX underlies Local-1 coal seam and is mineable almost in the entire area of Part-B. The thickness of this seam in the mineable zone north of fault F2-F2 ranges from 1.73m to 6.38m and that south of fault F2-F2 ranges from 1.79m to 4.45m. The estimated extractable reserve comes to around 55.3 Mt with average grade of G11.

Seam VII: The next mineable seam below Seam IX is Seam VII. Though seams Local-2 and VIII lie below seam IX, but they are not considered mineable due to low thickness. In almost half of the area of Part-B, particularly in the south-western corner, this seam has attained mineable thickness. The parting thickness between Seam IX and Seam VII ranges from around 25m to 40m in the mineable zones. The thickness of the seam in the mineable zone lying north of the fault F2-F2 ranges from 1.39m to 2.77m and the same in the zone lying south of the said fault ranges from 1.57m to 2.81m. The estimated extractable reserve comes to around 15.6 Mt with average grade of G9/G10.

Seam VI (with its sections): This seam underlies Seam VII and occurs in four sections and its combination viz., VIA, VIB, VIA+VIB, VIC, VIB+VIC, VIA+VIB+VIC, VID,

VIC+VID, VIB+VIC+VID and VIA+VIB+VIC+VID. The seam sections or its combination are mineable in the entire area of Part-B. In the zone north of fault F2-F2, the thickness ranges from 2.3m to 11.54m with an average of 6.38m while in the zone south of the said fault, the same ranges from 2.47m to 9.87m with an average of 6.37m. The estimated extractable reserve from this seam by underground method of mining comes to around 104.5 Mt with grade of G14/G15. Seam VI-Local underlies this coal seam.

Seam VI-Local: This seam underlies Seam VID with a parting ranging from around 0.7m to 23m. This seam is mineable in small patches in area north of fault F2-F2 and hence can be accessed through drifts from the upper seam. The thickness of this seam in mineable patches ranges from 1.5m to 2.59m. The estimated extractable reserve from this seam would be around 3.9 Mt with average grade of G12.

Seam V Bottom: Below Seam VI-Local lie seams Band-1, V-Top and Local-3, which are not mineable due to low thickness. Seam V Bottom lies below Local-3 seam. This seam has attained workable thickness in Part-A of Phase-I area of the coal block below the proposed opencast working, while in Part-B, boreholes have not reached up to the seam in almost half of the area. In some areas in Part-B, the seam has not developed. The parting between the floor of the proposed opencast mine and this seam would be more than 60m. Thickness of the seam in mineable zone varies from 1.5m to 4.3m with average being around 2m. The estimated reserve from this seam would be around 14 Mt with average grade of G13.

Seam IV: This seam lies below Seam V Bottom with Band-2 seam in between. Boreholes have not reached up to this seam in almost half of the area of Part-B and this seam has not developed in many patches in major portion of Part-A. This seam is mineable only in a small patch along the northern boundary below the access trench area of the proposed opencast mine. The average thickness of the seam in mineable zone would be around 1.7m. The estimated extractable reserve of around 1.7 Mt with average grade of G10.

Seam III: This is the next mineable seam below Seam IV. The intervening seam Band-3 is not mineable due to low thickness. Boreholes in almost half of the area of Part-B has not reached up to this seam and also this seam has not developed in the southern-most part of sub-block A and B. Northern half of the Phase-I block area (in both Part-A and

Part-B) has been found mineable with thickness ranging from 1.5m to 4.1m with estimated average being around 2m. The estimated extractable reserve would be 30.5 Mt with average grade of G11.

Seam II Bottom and Combined: Below Seam III, the next mineable seam is Seam II Bottom and Combined with a parting ranging from around 40m to 50m. Boreholes has not reached up to the seam in entire area of Part-B. Based on the exploration data, the seam is mineable in major area of Part-A, but in the southern-most part of sub-block A and B (falling under Part-A) the seam has not developed due to basement high. The seam thickness ranges from 1.5m to 9.8m with average being around 4.2m. Estimated extractable reserve from this seam would be around 31.5 Mt with average grade of G9.

Seam-wise estimated extractable reserve is shown in the table below.

Seam	Extractable Reserve (Mt)	
	Part-A	Part-B
X Top		10.646
X Bot		29.743
IX		55.323
VII		15.639
VI		104.483
VI-Local		3.918
V Bot	14.298	
IV	1.730	
III	20.364	10.182
II Bot & Comb	31.576	
Total	**67.969**	**229.935**

Thus, the total extractable reserve for underground mining has been estimated as 297.90 Mt with average grade of seams varying from G9 to G14. Cumulative weighted average grade of the entire estimated extractable reserve would be G12. It is, however, worth mentioning that since in major portion of Part-B, boreholes have not reached up to the lower-most seam, it is suggested that the lower seams particularly below Seam VI-L should be explored prior to start of opencast mining operation.

5.3.3 MINING STRATEGY

As described earlier, the entire area under consideration in Phase-I has been divided into two parts – Part-A and Part-B. It has been proposed to mine coal seams in Part-B by underground mining, while major portion of the area in Part-B is proposed to be covered with the external overburden dump from the proposed opencast mine in Part-A of the block. Coal seams lying below the proposed floor of the open pit is also proposed to be mined by underground. The dump being on the southern side of the Part-B, infrastructure for both opencast and underground mine has been proposed in the remaining Northern portion of Part-B.

In Part-B, since the area proposed for underground mining is mainly beneath the overburden dump, final extraction with caving can be started only after cessation of active dumping operation, while in Part-A earliest start of underground mining operation can only be commenced after cessation of all mining and mine closure related activities. It has been proposed that the external dump area in Part-B shall remain active till 16th (P16) year of opencast mining operation, while the life of the opencast mine has been envisaged as 32 (P32) years of opencast mining operation.

In view of the above, it is proposed that extraction of coal with caving in underground mine can be started only after 16 years of opencast mining operation in Part-B, while underground mining beneath the proposed opencast mine may be started after 35 years (32 years of opencast mining operation & considering a period of three years for mine closure activities). Thus, underground mining will also have two phases. For the first phase, construction activities for underground mine in Part-B is proposed to be started in the 13th (P13) year such that mine development work in coal seams can be started from the 15th (P15) year and final extraction with caving in the top-most mineable seam is proposed to be started from 17th (P17) year. It is proposed to mine from top seam downwards. The maximum capacity of 6.00 Mty is proposed from 22nd (P22) year of start of excavation.

Two inclines and two shafts has been proposed as mine entries for underground mining in Part-B. Both the inclines have been proposed to be used for transportation as well as

intake airways – one incline for coal transportation and the other for men and material transport. Out of the two shafts, one is proposed as downcast while the other as upcast shaft. The shafts are proposed to be sunk up to Seam VI-D in the first phase. Proposed location of inclines and shafts are shown in the Plate 35 & 46.

For the second phase of underground mining, separate set of entries would be required. Mine entries and required surface infrastructure can be set up in the north-east corner of the block as shown in the above referred drawing. But since this phase of the mine can be started earliest after 35 (P32+3) years, mining of this property has not been considered in this report.

5.3.4 MINING METHOD AND MINING EQUIPMENT

The property appears to be largely geologically undisturbed as per the interpretations made in the geological report. Only medium to small throw faults have been interpreted in the southern part of the block, out of which three faults have intersected the property obliquely in the southern half of Part-B. Also, the size and geometry of mineable property appears suitable for the application of longwall mining technology. Hence longwall mining has been proposed in suitable mineable zones of Part-B and those areas where longwall panels cannot be formed shall be mined with continuous miners. Longwall panel development has also been proposed with continuous/ bolter miners.

However, it is worth mentioning that for successful implementation of longwall technology, geological information of the deposit with higher confidence is desirable. As the average borehole density is around 6 per square kilometer, further exploration would be required to increase the level of confidence of geological information. Additionally, a few scientific studies would be required particularly for physico-mechanical properties, strata control, selection of type and capacity of equipment, etc. All these should, however, be done prior to start of dumping operation in Part-B.

Four sets of continuous and/ or bolter miners and two longwall sets have been proposed which would be installed in a phased manner. Proposed set of equipment will consist of the following:

Continuous/ Bolter miner set:

- Continuous miner/ Bolter miner
- Shuttle/ ram cars
- Mobile roof bolting machine (not required with bolter miner)
- Feeder-breaker
- Utility vehicle/ LHD
- Power centre
- Gate-belt conveyor

Longwall set:

- Self-advancing powered supports
- Armoured face conveyor
- Shearer
- Stage-loader crusher
- Gate-belt conveyor
- Power pack

Coal evacuation shall be done by belt conveyors from the active working faces to surface which would then be fed to the surface bunker (Ground Bunker) near the proposed coal washery for onward processing. Trackless transportation has been proposed for men and material in the mine. FSVs (Free-Steered Vehicles) and MUV (Multi-utility Vehicles) shall be used for the purpose.

5.3.5 PROPOSED PRODUCTION AND MINE LIFE

Initially production will come from development workings in seam X-Bottom. When access will be made to Seam X Top through drifts from seam X-Bot, production will come from continuous miner development and depillaring districts. It is envisaged that

production from the first proposed longwall panel would start in Seam X Bottom in the fifth year of underground mining. After a gap of around three years, second longwall set is envisaged to come into operation in Seam IX beneath the mined out area of Seam X Bottom. Envisaged peak production capacity with proposed system of mining would be around **6 Mtpa**.

As it has been stated earlier that underground mining below the opencast mine (Part-A) can be started only after completion of opencast mining operation i.e., around 35 years of start of opencast mine operation and that the same has not been considered in this report, life of this phase of mine cannot be estimated at this stage.

5.3.6 ADDITIONAL EXPLORATION

Additional boreholes are required in part-B area to increase the density to at least 12 boreholes per square kilometres from existing 6 bhs/Sq. km for underground mining. Boreholes in the lower seams are very scanty. Before considering these lower seams for underground mining, fresh drilling upto a density of at least 12 bhs/sq. km. needs to be carried out. The exploration in part-B side should be completed before the area is covered by external dump material, which is likely to continue for about 16 years after start of quarry operation in the Part-A.

In the part-A area, where quarry has been proposed, about 25 boreholes, in the central to dip side area, may be required for proving reserves of lower seams before they are considered for underground mining. The exploration in part-A side should be completed before quarrying is done in the area where exploration is needed.

5.4 COMPOSITE CALENDAR

The composite production schedule of opencast and underground operation for the life of the opencast mine will be as follows:

Year	COAL PRODUCTION (Mt)			
	OC Coal	UG Coal	Total UG	GRAND

			(Pahse-I: Part-B)	(Pahse-II: Part-A)	Coal	TOTAL
1	C1					
2	C2					
3	P1					
4	P2	3.40				**3.40**
5	P3	5.00				**5.00**
6	P4	12.00				**12.00**
7	P5	14.00				**14.00**
8	P6	15.00				**15.00**
9	P7	15.00				**15.00**
10	P8	15.00				**15.00**
11	P9	15.00				**15.00**
12	P10	15.00				**15.00**
13	P11	15.00				**15.00**
14	P12	15.00				**15.00**
15	P13	15.00				**15.00**
16	P14	15.00				**15.00**
17	P15	15.00	0.36	WILL BE PLANNED AFTER CESSATION OF ALL OPENCAST MINING & CLOSURE ACTIVITIES.	0.36	**15.36**
18	P16	15.00	0.86		0.86	**15.86**
19	P17	15.00	1.60		1.60	**16.60**
20	P18	15.00	1.60		1.60	**16.60**
21	P19	15.00	3.00		3.00	**18.00**
22	P20	15.00	3.50		3.50	**18.50**
23	P21	15.00	3.50		3.50	**18.50**
24	P22	15.00	6.00		6.00	**21.00**
25	P23	15.00	6.00		6.00	**21.00**
26	P24	15.00	6.00		6.00	**21.00**
27	P25	15.00	6.00		6.00	**21.00**
28	P26	15.00	6.00		6.00	**21.00**
29	P27	15.00	6.00		6.00	**21.00**
30	P28	15.00	6.00		6.00	**21.00**
31	P29	15.00	6.00		6.00	**21.00**
32	P30	15.00	6.00		6.00	**21.00**
33	P31	15.00	6.00		6.00	**21.00**
34	P32	3.46	6.00		6.00	**9.46**
TOTAL		**427.86**	**80.420**	**0.00**	**80.42**	**508.28**

CHAPTER-6

MANPOWER AND SAFETY

6.1 MANPOWER ASSESSMENT

6.1.1 OPENCAST OPERATION

Manpower requirements are assessed on the basis of 7 days week and 330 days of annual working. The peak manpower of the project has been estimated as 2724 for the mine to be operated departmentally. Manpower under broad heads, is as follows:

Sl. No.	PARTICULARS	Nos.
A.	***Operations***	
	Major HEMM	1091
	Support equipment	147
	Mine pumping & sub-station	29
	Sub total (A)	1267
B.	***Maintenance***	
	HEMM maintenance	988
	E&M Maintenance	44
	CHP & SILO maintenance	72
	Sub total (B)	1104
C.	***Supervision***	
	Project office and general management	16
	Mine supervision & safety	136
	HEMM maintenance supervision	73
	E&M supervision	16
	CHP & Silo supervision	36
	Sub total (C)	277
D.	***Others***	
	Communication	9
	Stores	14
	Survey	10
	Transport	2

Sl. No.	PARTICULARS	Nos.
	Accounts	9
	Personnel & welfare	6
	Civil & water supply	14
	Watch & Ward	1
	Canteen	1
	Medical & Sanitation	6
	Sub-total (D)	72
E.	***Reclamation & Environment***	4
	Total	**2724**

In addition there will be requirement of semiskilled/unskilled manpower for different activities who may be employed by outsourcing means. The list of such manpower is as follows:

Sl. No.	PARTICULARS	NOS.
1	Watch & ward	75
2	Semiskilled/Unskilled manpower as helper/greaser	315
Total		**390**

No manpower has been provided for vehicles to be used in the mine, reclamation equipment, canteen etc. as these activities will be carried on by outsourcing means.

6.1.2 UNDERGROUND OPERATION

Break up of estimated manpower for underground operation would be broadly as follows:

Place	Operation	Maintenance	Supervision	Others	Total
Underground	306	186	131	173	**796**
Surface	12	51	18	73	**154**
Total	**318**	**237**	**149**	**246**	**950**

6.1.3 WASHERY

Sl. No.	Particulars	No.
A.	Executives	25
B.	Monthly Paid	41
C.	Daily Rated	234
	Total	**300**

6.2 SAFETY & SUPERVISION

6.2.1 GENERAL SAFETY FOR OPENCAST OPERATION

The project report has been drawn in conformity with the prevailing statutory provisions applicable for safety in Opencast Mines. However, following matters related to safety during opencast operations has to be given special considerations.

- Danger of inundation from surface and/or underground water.
- Dust hazards
- Fire hazards due to spontaneous heating of coal in stockpiles and exposed benches. Fire hazards in stores & workshops where inflammable & highly inflammable materials are stored or used.
- Slope failure.
- Haul road design and maintenance.
- Dangers associated with drilling, blasting and handling of explosives.
- Accidents due to HEMM operation.
- Hazards associated with use of electricity.

Adequate statutory manpower has been provisioned, for compliance of safety in the mines. Regular training/refresher courses, "on job" training shall have to be conducted & mock rehearsals shall have to be made to make the manpower conversant with various rules, regulations, methods of prevention & combat with hazards.

All the mine persons entering the mine and mine premises shall be provided with safety helmets and safety shoes as a general practice

6.2.1.1. Statutory rules

Various activities/codes in conformation with the prevailing statutory provisions, such as Mines act 1952, CMR 1957 and various DGMS circulars & bye-laws need to be formulated for carrying on mining operation. All other statutory requirements related to Govt. licences, workmen compensation, insurance, minimum wages Act for outsourced manpower, rules imposed by State Govt./ central Govt etc. are to be adhered to.

Out of various Acts and Rules, the following find maximum application in mining operation.

1. Mines Act 1952
2. Coal Mines Regulation 1957
3. Coal mines Rules 1966
4. Vocational Training Rules 1966
5. Indian Electricity Rules 1956
6. Factories Act 1948
7. Updated DGMS circulars
8. Recommendations of National Safety Conferences,
9. Recommendations of Tripartite Safety Review committees
10. ILO code of Safety and Health in Opencast Mines

6.2.1.2. Danger of inundation from surface

Due care has been taken while planning and designing the quarry to prevent water ingress during mining operations from the rivers/nalas. Sufficient nos. of pumps have been provisioned to take care of maximum make of water during monsoon. The following important measures are proposed for precaution against surface water:

i. Implementation of DGMS circular tech. 2/1978 for Pre-monsoon reassessment of danger of inundation from surface water.
ii. Maintenance of a garland drain to drain out the surface rainwater from coming into the mine.
iii. Regular inspections for any accumulation of rainwater, obstruction in normal drainage.

iv. Implementation Standing order for withdrawal of working persons in case of apprehended danger from inrush of surface water.

v. During heavy rain, inspection of vulnerable points is essential. In case of any danger, persons are to be withdrawn to safer places. Vulnerable points are to be decided through inspection before advent of monsoon and accordingly schedule of inspection will be drawn.

vi. Nalla or water inlets may be diverted or isolated by embankments/if so required.

6.2.1.3. Dust pollution control measures

Systematic and regular air quality monitoring is necessary to examine objectively the status of compliance with the statutory standards and for making a real assessment of ambient air quality.

The following measures need to be ascertained to contain the pollution due dust generation:

- All the drills need to be provided with well-designed dust extraction/suppression system ;
- Blasting operations need to be designed in such a way so as to produce minimum dust;
- Effective use of sprinklers and dust suppression units during loading, transportation and handling of ROM/processed coal and overburden;
- Dust extraction/suppression system, installed in coal handling plant;
- Provision of greenbelt around quarry, industrial and residential areas and avenue plantation along the haul roads on surface;
- Black-topping or application of proper bitumen/non-bitumen based chemicals on permanent service roads besides proper maintenance.
- Wetting of the surface by deploying water tankers/sprinklers to reduce dust generation from haul roads.

- Use of water cannons for mist generation for dust suppression at various places

6.2.1.4. Fire and spontaneous heating

The following measures need to be ascertained to avoid spontaneous heating:

- Coal bench slopes and seam outcrops are overlain with an impervious layer of soil/clay is there is tendency of spontaneous heating.
- Exposed coal seams & outdoor coal stocks are treated with antipyrogenic substances.
- Avoidance of exposure of coal benches for long time.

6.2.1.5. Slope stability

COAL/OB BENCHES

The side batters of quarry has been designed with safe slope (slope angle generally adopted in the adjoining areas) to avoid slope failure and collapse of benches while the mine is in operation. Similarly, at the end of mining operation, safe terminal pit slope is provided to avoid pit failure. However, detailed site specific tests for slope stability need to be carried out and site specific parameters are determined. Present provision is a broad guideline.

HAZARD AND RISK ASSOCIATED WITH OB DUMPS

Hazard of OB dump failure is mainly governed by following factors:

1. Height of benches.
2. Slope of benches.
3. Nature of material.
4. Slope of foundation rock.
5. Nature of foundation rock.
6. Phreatic level of accumulated water.
7. Depth of ground water table.

The following precautions need to be ascertained to reduce the risk of dump failure during mine operation:

i. Height of OB benches is maintained at <30m in each tier.
ii. The overall slope of dump is maintained at <26^{o}
iii. Soil is scraped separately, so that it is not mixed in OB rock.
iv. The soil from the foundation ground is scraped before starting of backfilling.
v. Garland drain is made around OB dump area to avoid water flow during monsoon below the OB dump.
vi. Levelling, grading and drainage arrangement of OB dumps are done.
vii. Provisioning of toe wall at strategic points to restrict toe movement during rainy seasons.
viii. Technical & biological reclamation of OB dumps.
ix. Real time monitoring of dump & quarry slope movements by scientific means for advance alarm before a slope failure.
x. External dump limit in the south has been fixed at distance of 30m from the boundary. In must be taken care that any public road in the south side of the block should not be within 180m from the toe of the dump i.e. twice the height of the dump.

6.2.1.6. Haul road design and maintenance

Haul road shall be designed and maintained with considerations to the following aspects:

xi. Gradient of roads shall not be steeper than 1 in 16 at any place and at ramps over small stretches shall not be more than 1 in 10.
xii. One way traffic, otherwise width should not be less than 3 times the width of the largest vehicle.
xiii. Clear visibility at corners and bends of roads as per specifications of DGMS circulars.
xiv. Parapet wall (berm) of minimum of 1m high on road sides when roads are at elevated level.

xv. Separate road for light vehicles.

xvi. Formulation and enforcement of traffic rules regarding :

a) Authorization to drive within the mine premises.

b) Speed limits.

c) Right of way.

d) Parking & standing.

e) Overtaking.

f) Signs.

xvii. During rainy season soil erosion will take place and it will deteriorate the haul roads and therefore following needs to be ascertained.

a) Proper drainage arrangement is made along the haul road.

b) Cross slopes (1 in 50 to 1 in 25) is provided on the haul road so that water flows into the drain.

c) Water barrier, cross drains, relief drains etc. are constructed and maintained properly.

d) Culverts are designed, installed and maintained to withstand the vertical soil pressure, weight of the vehicles plying over the road etc.

6.2.1.7. Drilling and blasting

Site mixed slurry (SMS) has been proposed to be used for good fragmentation and obviate storage of bulk quantum of explosives.

For proper blasting and minimising the adverse side effects due to blasting viz. noise, ground vibration, back-breaks, air blast and fly rocks etc., the optimal blast design parameters are to be used, after field trials.

Provision has been made in the MP for qualified blasting-in-charge with requisite number of assistants. Adherence to relevant statutory safety provisions as stipulated by DGMS, Chief Controller of Explosives and others shall be made.

The OCP authority is advised to resort to controlled blasting if all the persons from the stipulated blast safety zone cannot be vacated while blasting near the surface. While blasting near the common boundary shared with the adjoining mine, proper joint code of conduct may be formulated for safety of the persons, by both the authorities of the adjoining mines before carrying out blasting operation.

All precautions related to explosives and blasting need to be adhered to. Blasting in coal needs utmost care due to presence of developed galleries. The conditions stipulate by DGMS should be strictly adhered to.

Departmental Security has been provided to guard Magazine to prevent any unauthorized entry.

6.2.1.8. Deployment of HEMM & workers:

Special precautions need to be taken while deploying HEMM and workers in the mine. Before employing any labor in the mine proper vocational training should be imparted and recommendations of the Safety Conferences should be strictly followed. Some of the major safety aspects to be followed for deployment of manpower are as follows:-

A For persons:

i. No persons shall be deployed unless he is trained at VTC. A record of it shall be maintained.
ii. Records in Form-B, Form-D shall be maintained.
iii. Records of Vocational training Certificate and driving license of operators shall be kept with the owner.
iv. Qualified competent persons shall maintain adequate supervision.
v. All HEMM operators and light vehicle drivers shall follow the traffic rules formulated by the management.

B For Machineries

i) As recommended by DGMS Cir. (tech.) 1 of 1999.

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

iii) No unfit machine shall be deployed before the defect is rectified.

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

v) The HEMM shall be provided with proper Audio-Visual Alarms and proper light for use at night

vi) Safety features of tippers/trucks – (Ref. DGMS Cir. tech 05 of 2010), provides for:

a. Cabin guard extension.
b. exhaust/ retard brakes for speed control
c. propeller shaft guard
d. tail gate protection
e. speed limiting device
f. audio visual alarm while reversing
g. provision of two brakes
h. body lifting position locking arrangement
i. fire suppression system
j. blind spot mirror- for viewing blind spot area.
k. fire resistance hoses at hot zones
l. electric wire and sleeves to be of fire resistant quality
m. turbo charge guard and exhaust tube coated with heat insulated paint
n. battery cutoff switch
o. retro-reflective reflector on all sides- for visibility of trucks during night
p. seat belt reminder
q. proximity warning device- to alert operator when approaching after vehicle/ obstruction
r. Rear vision system
s. auto dipping system
t. load indicator and recorder

C Other Precautions

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

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

iii) All worker should obey lawful instruction of mine management.

iv) Risk management plan shall be made and implemented.

v) All driver shall obey traffic rules prepared by management.

vi) During course of execution of the work, if any accident occurs whether major or minor, the matter shall have to be immediately informed to mine management i.e. Colliery Manager/Agent/GM of the area so that Notices of accidents in a accordance of (Reg.9 of CMR 1957) and Section 23 of Mines Act 1952 may be given and other necessary steps may be taken in accordance with the Mines Act 1952.

vii) Outside agency shall operate transport system in such a way as to minimize pollution in the mine.

viii) Inter-locking of starting with normal positioning of dumper body should be provided, so that dumper cannot be started when the body is in lifted position beyond a certain limit.

All safety features as per DGMS guidelines to be provided with all the HEMM in operation.

6.2.1.9. Use of electricity

To prevent shock hazards, proper earthing system has been proposed.

Moving towers/posts shall be provided for mine illumination in addition to fixed towers.

It is suggested to strictly comply with the relevant provisions of Indian Electricity Rules, 1956 to obviate hazards due to use of electricity. Provision of Electrical Supervisors has been provided in the manpower requirement to fulfill the statutory needs as per the rules, regulations pertaining to mining industry.

Provision for proper illumination of quarry faces, haul roads and other working places have also been made as per the statutory guidelines.

Concerned persons are to be provided with protective gloves and proper shoes in addition to safety helmets and shoes etc. for proper safety during handling electrical systems

6.2.1.10. Scientific studies

It is proposed that scientific studies in respect of effects of vibration and flying fragments on surface buildings/ structures due to blasting is carried out. Studies regarding slope stability should also be carried out for the mine and for the dumps.

6.2.2 DISASTER MANAGEMENT PLAN

6.2.2.1. Introduction

An emergency is any unforeseen event which has the potential to

a) Cause death or injury to employees, or general public
b) Disrupt or close the Mining Operation
c) Damage the machines and environment
d) Disturb economy of the company and community as a whole
e) Have Impact in the stock market

Disaster management plan is advance planning of activities during occurrence of disaster for early and efficient control of havocs of disaster to minimize/eliminate damages as enumerated above.

In mines disasters, generally occur from, fire, inundation and machines. The disaster Management may be planned on the following broad headings.

6.2.2.2. Emergency committee

Members of the emergency committee shall be constituted in advance and shall be renewed on regular basis with roll of action of each member predefined during disaster.

Heads of each department may be made permanent members of the committee apart from other skilled members.

6.2.2.3. Preparedness for administrative actions

The areas need administrative focus, during disaster, will be

i. Defining a place/room/office of assembly of all the committee members in case of emergency. The mine safety office may be the ideal location and shall be well equipped with computers with internet connection, communication devises, public address systems, updated plans of the mine, plans showing location of fire extinguishers etc.
ii. Contacting the statutory authorities like DGMS, district administration, immediately after occurrence of disaster
iii. Arranging emergency requirements viz. Rescue team, Ambulance, doctors, police, fire brigade etc.
iv. Handling of public and reporters etc. Arranging public address system for announcement of directives and of updates of the situation.
v. Maintenance of contact nos. of all important persons of the district and of important organisations, e.g. fire brigade, hospitals, Institutes for arranging nurses etc.
vi. Arrangement of rest shelters, food, washrooms, sanitation etc. for persons engaged in disaster management and disaster fighting.
vii. Transportation arrangement for fast movement of persons.
viii. Arrangement of emergency fund and its management for mobilizing all the disaster management activities.
ix. Arrangement for relatives of the affected persons

6.2.2.4. Technical preparedness

Technical preparedness shall consist of

i. Evacuation Plan:

Procedure for evacuation of persons affected by disaster in the mine shall be well laid out in case of inundation, fire or accident. In case of inundations there may be

preparedness for floating pontoons to rescue men and material from the mines. Arrangement of sufficient numbers of stretchers etc.

ii. Firefighting plan:

In case of fire, may be in the office buildings or mine infrastructures, HEMM, stockpiles or in the coal benches the preparedness shall be preparedness in the form of

a. Maintenance of updated plans showing locations of the fire extinguishers in mine infrastructures and HEMM. The updated plans may be available in the place of assembly of the emergency committee apart from particular site office.
b. Regular training of persons for use of fire extinguishers.
c. Predefining actions to be taken in case of fire in the buildings, in the HEMM, in case of electrical fires, in case of oil fires.
d. Immediate information to professional fire fighters in case of uncontrolled fires or which cannot be fought with fire extinguishers.
e. Awareness for arrangement of oxygen cylinder and masks, gas masks etc.
f. Arrangement for first aid to persons affected by burns.

iii. Plan for inundation

a. Preparedness for switching off all the power sources.
b. Preparedness for arrangement of additional pumps and fittings for pumping out excess water.
c. Preparedness for construction of pontoons for evacuation of man and material.
d. Preparedness for arranging sufficient no. of stretchers.
e. Preparedness with plans showing all possible source of water danger and action needed to contain the water flow in case of disaster.

6.2.2.5. Checklist in case of emergency

i. Mobilization of emergency action

a. Delegation of authority and duties to members of the emergency committee.
b. Review the areas requiring strengthening.

ii. Notification:

a. To activate notification procedure for emergency contacts
b. To notify the emergency committee
c. To notify miner's representatives
d. To notify Fire/ Rescue organisations
e. To notify medical support systems
f. To notify neighboring mines
g. To Notify District Magistrate
h. To Notify DGMS /Police

iii. Immediate actions:

a. To stop mining operations
b. To shut down power connection to the affected area. Care should be taken that evacuation actions are not hindered due to power shut down.

iv. Security and monitoring

a. To arrange for security to all access to the site of disaster
b. To prepare roaster for persons engaged in disaster fighting.
c. Maintenance of proper attendance system to monitor people's entry and exit from the site of disaster.

v. Communication

a. To mobilise team for operation and maintenance of communication system, such as internet facilities, walkie talkie, improvement mobile connectivity by informing service providers, land lines etc.
b. Monitoring and logging of communication.

vi. Medical arrangement

a. Establishment of first aid center
b. To arrange for first aid
c. To arrange for Ambulance and medical services
d. To arrange for stretchers
e. To arrange for additional nurses
f. To arrange for blood
g. To arrange for medicine in consultation with doctor

vii. Equipment, materials and services

a. Listing of all emergency equipment available in the mine premises
b. Listing of places where additional emergency equipment are available
c. Listing of availability of heavy rescue equipment in areas other than the mining premises and arrange for the same in case of requirement
d. Arrangement of food and shelter for persons engaged in disaster management and persons affected by disaster

CHAPTER-7

COAL HANDLING, WASHING & MODE OF DISPATCH

7.1 COAL HANDLING & DESPATCH ARRANGEMENTS

The proposed Gare Palma sector-1 Project is in Mand Raigarh Coalfiled. Gare Palma-1 OCP has been prepared for the production of 15.0 Mty of ROM coal from mine. An underground mine has also been proposed for 6.0 Mty production capacity. A Pit top Washery has been proposed under this project which will cater to about 21.0 Mty of coal to be produced from OC and Underground mines. Entire coal produced from Gare Palma-1 Project has been linked to nearby proposed Washery for washing of coal before final dispatch. A Coal handling plant has been proposed to cater entire production including underground mine production (total 21.0 Mty) of coal produced from OCP as well as underground mine and accordingly facilities of storage, conveying through belt conveyors & feeding arrangement through belt conveyors to Washery have been envisaged.

The proposed coal handling system includes conveying of ROM coal from mine floor of Quarry through belt conveyors. Since coal production of open cast mine has been proposed through surface miner (-100mm size) as such crushing of the coal is not required. Coal from different seams / floors will be lifted through high angle conveyors from different floors of mine to surface. Three nos. of high angle conveyors have been envisaged for three different floors as per mine advancement. Further during mine advancement, the coal to the high angle conveyors will be fed through floor conveyors which will be extended as per mine advancement. These floor conveyors will be extended as per mine advancement and requirement during mine life. High angle conveyors will be used for conveying of coal from three different floors of the open cast quarry to surface of the mine. Coal conveyed through high angle conveyors will be collected by three nos. conventional belt conveyors fitted for respective high angles conveyors. Further these coal will be conveyed and stored into two nos. of ground bunkers of 20,000 te each through tripper conveyors.

It has been proposed that the coal produced from underground mine will be conveyed up to tripper conveyors of the proposed CHP system through belt conveyors of UG mine. These coal will also be stored in one of the above proposed ground bunker and handled for further use.

Coal from two nos. of bunkers will be reclaimed through plough feeders and fed to proposed washery through four nos. of belt conveyors. Washed coal from washery will be fed to proposed two nos. of Silos through belt conveyors by washery operator. The same will be loaded in to railway wagons through Rapid load out facility envisaged with loading Silo.

A tentative coal flow layout have been shown in enclosed coal flow diagram.

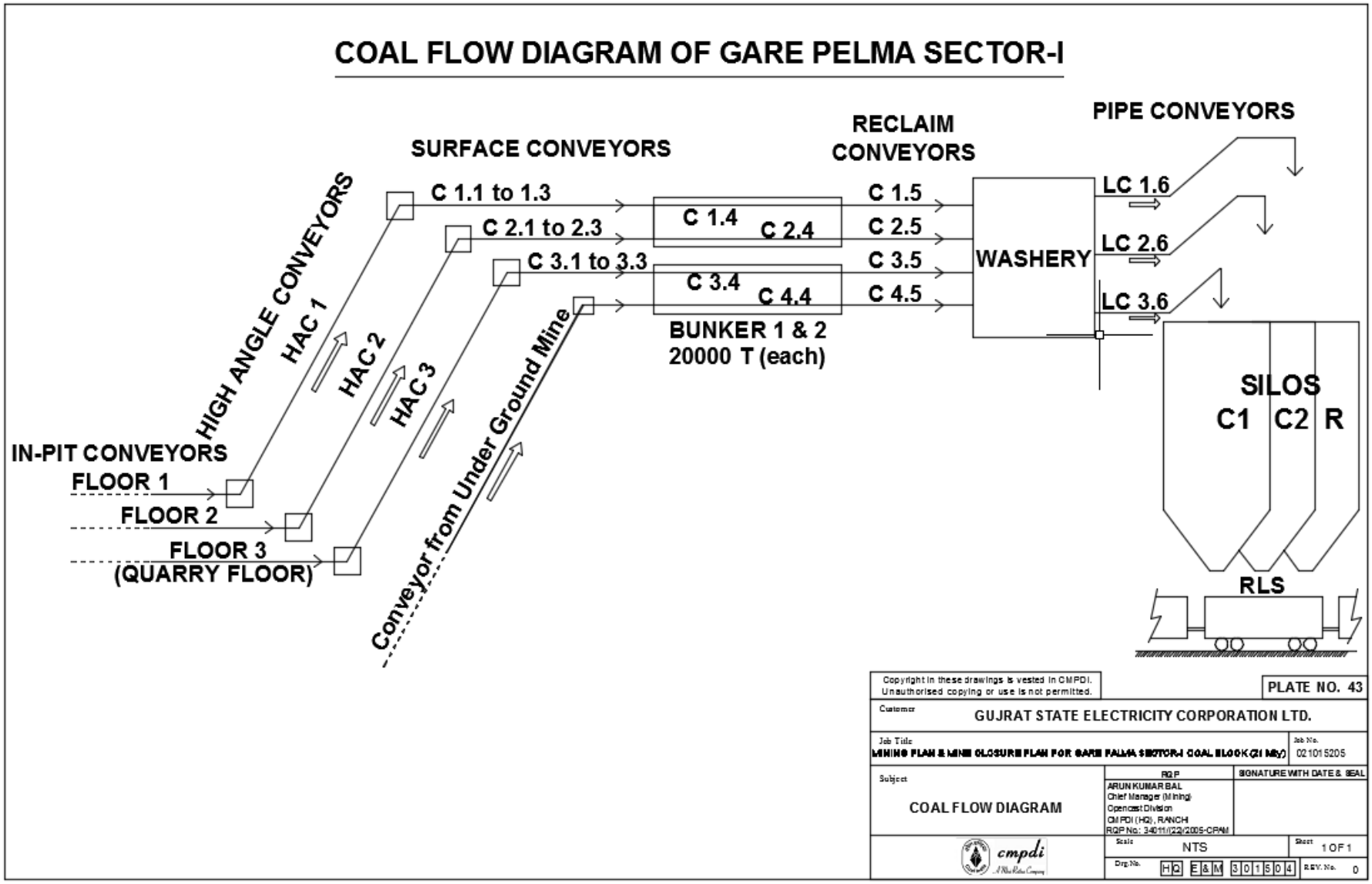

COAL FLOW DIAGRAM OF GARE PELMA SECTOR-I
SURFACE CONVEYORS
RECLAIM CONVEYORS
PIPE CONVEYORS
HIGH ANGLE CONVEYORS
HAC 1
HAC 2
HAC 3
IN-PIT CONVEYORS
FLOOR 1
FLOOR 2
FLOOR 3
(QUARRY FLOOR)
C 1.1 to 1.3
C 2.1 to 2.3
C 3.1 to 3.3
C 1.4
C 2.4
C 3.4
C 4.4
BUNKER 1 & 2
20000 T (each)
C 1.5
C 2.5
C 3.5
C 4.5
WASHERY
LC 1.6
LC 2.6
LC 3.6
SILOS
C1 C2 R
RLS
Conveyor from Under Ground Mine
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PLATE NO. 43
Customer
GUJRAT STATE ELECTRICITY CORPORATION LTD.
Job Title
MINING PLAN & MINE CLOSURE PLAN FOR GARE PALMA SECTOR-I COAL BLOCK (21 Mty)
Job No.
02101520S
Subject
COAL FLOW DIAGRAM
RQP
SIGNATURE WITH DATE & SEAL
ARUN KUMAR BAL
Chief Manager (Mining)
Opencast Division
CMPDI (HQ), RANCHI
RQP No: 34011/(22)/2005-CPAM
cmpdi
Scale
NTS
Sheet
1 OF 1
Drg No.
HQ E&M 301504
REV. No.
0

7.2 WASHING

7.2.1 GENERAL

Gare-Palma Sector-I Block, Mand Raigarh Coalfield has been planned for extraction of coal reserves by both opencast and underground method. M/s Gujarat State Electricity Corporation Limited (GSECL) intends to set up a washery for washing coal produced from this block. A two-product (viz. washed coal & rejects) non-coking coal washery has been conceptualized for washing of coal from Gare-Palma Sector-I Block. Washed coal for supply to thermal power plants and rejects for sale through MoU/ e-auction route have been considered.

The ash% of washed coal for thermal use has been considered as about 34% keeping in view the MoEF Gazette Notification according to which thermal power plants located beyond 500 kms. from the pit head and those located in urban areas or sensitive areas or critically polluted areas irrespective of their distance from the pithead shall use coal with ash content not exceeding 34% on quarterly average basis w.e.f. 5th June 2016 except any thermal power plant using Circulating Fluidized Bed Combustion or Atmospheric Fluidized Bed Combustion or Pressurized Fluidized Bed Combustion or Integrated Gasification Combined Cycle technologies or any other clean technologies as may be notified by the Central Government in the Official Gazette.

7.2.2 THROUGHPUT CAPACITY OF THE WASHERY

The total annual raw coal throughput capacity of the proposed washery has been considered as 21.0 Mty. However, keeping in view the production programme of both the opencast and underground mine, it has been envisaged that construction of 21.0 Mty washery will be done in a phased manner. In the 1st phase, a 15.0 Mty capacity washery and in the 2nd phase, a 6.0 Mty washery have been envisaged.

7.2.3 EXTRACTABLE RESERVES

The life of the opencast mine is projected as 32 years, excluding construction period. The total extractable reserves for 32 years of this block is 508.28 Mt. Out of this, 427.86 Mt is from opencast mine (about 84%) and balance 80.42 Mt (about 16%) is from

underground mine. The break-up of seam-wise extractable reserves along with percentage contribution from each seam in opencast mine is given below.

Seam wise extractable reserves

Seam No.	Seam Name	Mineable Coal (Mt)	% contribution	GCV	Grade
1	X Top	50.02	11.69	3806	G12
2	X Bottom	29.07	6.79	3716	G12
3	IX-L2	14.19	3.32	4492	G10
4	IX-L1	17.61	4.12	4280	G11
5	Local-1	7.08	1.66	4946	G8
6	IX	96.02	22.44	4035	G11
7	Local-2	2.57	0.60	3067	G15
8	VIII	1.78	0.41	3443	G13
9	VII	5.75	1.34	3241	G14
10	VI A	8.86	2.07	3808	G12
11	VI B	6.51	1.52	3292	G14
12	VI A + VI B	8.63	2.02	3159	G14
13	VI C	7.31	1.71	3229	G14
14	VI B + VI C	5.08	1.19	3098	G15
15	VIA+VIB+VIC	8.70	2.03	2884	G15
16	VI D	13.53	3.16	3526	G13
17	VI C + VI D	11.64	2.72	3428	G13
18	VIB+VIC+VID	20.99	4.91	3247	G14
19	VIA+VIB+VIC+VID	107.08	25.03	3149	G14
20	VI_Local	5.41	1.27	3643	G13
	Total	**427.86**	**100.0**	**3628**	**G13**

7.2.4 LIFE OF THE WASHERY

The total extractable reserves of Gare-Palma Sector-I is 508.28 Mt for first 32 (P32) years. The combined production programme from opencast and underground mine of Gare-Palma Sector-I along with the period of build-up, production period & tapered production is given in the Table as follows:

Calendar Programme of Production

Year		ROM coal in Mt		
		OC Coal	Total UG Coal	GRAND TOTAL
1	C1			
2	C2			
3	P1			
4	P2	3.40		**3.40**
5	P3	5.00		**5.00**
6	P4	12.00		**12.00**
7	P5	14.00		**14.00**
8	P6	15.00		**15.00**
9	P7	15.00		**15.00**
10	P8	15.00		**15.00**
11	P9	15.00		**15.00**
12	P10	15.00		**15.00**
13	P11	15.00		**15.00**
14	P12	15.00		**15.00**
15	P13	15.00		**15.00**
16	P14	15.00		**15.00**
17	P15	15.00	0.36	**15.36**
18	P16	15.00	0.86	**15.86**
19	P17	15.00	1.60	**16.60**
20	P18	15.00	1.60	**16.60**
21	P19	15.00	3.00	**18.00**
22	P20	15.00	3.50	**18.50**
23	P21	15.00	3.50	**18.50**
24	P22	15.00	6.00	**21.00**
25	P23	15.00	6.00	**21.00**
26	P24	15.00	6.00	**21.00**
27	P25	15.00	6.00	**21.00**
28	P26	15.00	6.00	**21.00**
29	P27	15.00	6.00	**21.00**
30	P28	15.00	6.00	**21.00**
31	P29	15.00	6.00	**21.00**
32	P30	15.00	6.00	**21.00**
33	P31	15.00	6.00	**21.00**
34	P32	3.46	6.00	**9.46**
TOTAL		**427.86**	**80.42**	**508.28**

As mentioned earlier, it has been envisaged that construction of 21.0 Mty washery will be done in a phased manner keeping in view the production programme. In the 1st Phase, washery will be constructed with capacity of 15.0 Mty. In the 2nd Phase, another washery with capacity of 6.0 Mty will be set up considering production from underground mine as well.

For the 1st Phase, 15.0 Mty capacity washery, it has been envisaged that the time required for carrying out washability test of Gare-Palma Sector-I, preparation of report & bid process management shall be about 18 months and a period of further 18 months has been considered for construction and commissioning of the washery including trial operation and Performance Guarantee Tests (PGT). Thus, total period of 3 years i.e. C1, C2 and P1 have been considered for development of washery. It has been envisaged that the washery will come in commercial operation from year P2 and will be operated for 31 years (from P2 to P32) after its commissioning.

For the 2nd Phase, 6.0 Mty capacity washery has been envisaged to come in commercial operation from year P15 and will continue till P-32 and beyond.

7.2.5 QUALITY OF RAW COAL FEED TO WASHERY

It can be seen from the mineable reserves that about 85% production is from opencast mine, hence average GCV of the opencast mine has been considered for projecting the likely quality of raw coal feed to the proposed washery. Based on the average GCV value of 3628 kcal/kg, the overall coal quality has been projected as Grade G-13. Thus, for projection of yield, the likely average ash of raw coal feed to the proposed washery has been considered as 43.5% considering average GCV as 3628 kcal/kg and moisture of 6.0%.

7.2.6 LABORATORY TEST RESULTS

Full scale washability test results of ROM coal samples of Gare-Palma Sector-I are required for selection of process, projection of balance of products etc. These data are not available. In absence of these test results, the available washability test results of

bore core coal samples of boreholes pertaining to Gare-Palma Sector-I coal mining block carried out by Coal Preparation Laboratory, CMPDI in July 2012 for Mineral Exploration Corporation Limited (MECL) have been considered for projection of yield. While envisaging this chapter, it has been assumed that the raw coal ash% and characteristics of the bore core samples will be the same as that of the output of the mine. However, the washability and other tests of representative ROM coal samples of Gare-Palma Sector-I is required to be carried out to assess the likely quality of raw coal feed to washery, selection of process, prediction of yield etc.

7.2.7 CAPACITY & OPERATING CONDITIONS OF WASHERY

The daily and hourly annual average raw coal input capacity of this washery as envisaged is given below:

a) Annual : 21.0 Mt
b) Daily : 64000 t
c) Hourly : 3500 t

It has been envisaged that there will be three main sections viz. raw coal section, washing section and loading & dispatch section in the proposed washery. The operating conditions of different sections are given hereafter:

7.2.7.1. RAW COAL SECTION

The raw coal section includes receiving arrangement of -100mm coal from mine CHP through belt conveyors, surge hopper, crusher house for crushing of (-)100 mm coal down to 50mm size and half-day storage of crushed coal (32000 t).

7.2.7.2. WASHING SECTION

The washing section includes reclamation arrangement of (-)50mm crushed coal from storage, desliming of -50mm coal, treating of 50-0.5 mm coal in HM cyclones, direct mixing of -0.5 mm fraction for achieving the targeted washed coal ash of 33.5$\pm$0.5% and covered storage of washed coal (45000 t capacity).

7.2.7.3. LOADING & DISPATCH SECTION

Washed coal will be reclaimed from covered washed coal storage (45000 tonne) and conveyed by Pipe Conveyors to 2 nos. Silos (C1 & C2) (4000 tonne capacity each) at proposed Railway siding (about 1500 m from washery site) from where it will be loaded into Railway wagons through Rapid Loading System (@5500 tph) and dispatched to consumers. To cater to the needs of dispatch of washed coal, 2 nos. of Silos with Rapid loading system, Railway siding etc. has been envisaged in the provisions of the CHP.

Rejects produced from the washery will be conveyed to temporary reject storage site for sale through MoU route. In case the distance to which the rejects are to be transported is less than 10 km, then provision of conveying of rejects by pipe conveyor is to be envisaged. In case the same is beyond 10 km, then suitable arrangement for loading and dispatch of rejects through a Pipe Conveyor to a Silo (R) with Rapid Loading System, Railway Siding etc. has been envisaged.

7.2.7.4. SELECTION OF PROCESS

Generally, selection of the process depends on seam wise, year wise production programme of linked mines, quality of feed to the proposed washery, full scale washability test results of representative ROM samples of linked feed coal for the life of the mine and desired quality of saleable product i.e. washed coal for use in thermal power stations for power generation.

The main washing process for the washery has been selected on the basis of qualitative requirement of washed coal of the thermal power stations. The ash percentage of washed coal has been kept as 33.5%. The proposed washery has been planned to produce two products i.e. washed coal and rejects. Selection of process is based on the study of the available washability test results of bore core coal samples of boreholes pertaining to Gare-Palma Sector-I

The process consists of desliming of 50 mm, treatment of 50-0.5mm fraction in HM cyclones and direct mixing of -0.5mm fraction with beneficiated coal from HM cyclones

to achieve the desired product of washed coal of 33.5±0.5% ash. However, the process is to be finalized after generation of washability and other tests of ROM samples of linked feed coal.

The salient features of process are shown in Drawing No. HQ/CMP/ 021015205/04/001

The process of the proposed washery is based on closed water circuit system. All the water fed into the system will be collected after use and re-circulated after treatment in various units and no effluent will be allowed to escape into the natural drainage system. Provision of rain water harvesting of roof top water has been envisaged by recharging the same to ground and/ or by collecting the same into the constructed/ developed water bodies for use in the washery.

7.2.7.5. BALANCE OF PRODUCTS

The tentative balance of products (washed coal & rejects) on the proposed scheme under practical conditions have been estimated based on the available test results of bore core coal samples of boreholes and considering the likely average ash% of raw coal feed to the proposed washery as 43.5%. The same is given in Table as follows:

Balance of Products

Products	Wt%	Ash%	Quantity (Mtpa)	GCV(kcal/kg)
Washed Coal	65.0	33.5	13.65	
Rejects	35.0	62.1	7.35	2347* (G-17)
Total	100.0	43.5	21.00	

Based on the washability test results of ROM coal samples, the washing process for the washery will have to be finalized keeping in view the qualitative requirement of washed coal for utilizing in thermal power stations i.e. about 34% ash and state-of-the art technology of washing. This may result in change of provisions and projections envisaged.

7.2.8 INFRASTRUCTURAL FACILITIES

The infrastructure facilities generally considers land for setting up of washery, land for temporary storage of rejects till selling through MoU route, requirement of power & water. Selection of site is to be done keeping in view the distance of mine from the washery site, Railway siding, reject dumping/ utilization site, source of water & power etc.

7.2.8.1. REQUIREMENT OF LAND

An area of about 53 Ha has been identified for the proposed washery. An area of about 10 Ha out of this would be required for 50 m width green belt around the washery premises. Balance area available for washery would be about 43 Ha. Requirement may vary based on the proposed/ existing infrastructure facilities, infrastructure facilities to be developed within the washery complex such as raw coal receiving arrangement, crusher house, storage of raw coal feed to washery, washery building etc.

The rejects produced from the washery is proposed to be sold through MoU/e-auction route. Hence, it has been envisaged that the rejects would be dumped in the temporary reject storage site adjacent to the washery site in an environmentally friendly manner till the selling process starts. As per the projected product balance, approximate quantity of rejects is about 7.35 Mt per annum for 21 Mty washery. Out of the balance area of 43 Ha, an area of about 13 Ha may be allocated for temporary storage of rejects for two month till the selling of rejects through MoU/ e-Auction route (considering the land requirement for dumping of rejects @ 10 Ha/Mt).

7.2.8.2. REQUIREMENT OF POWER

Requirement of power depends on the throughput capacity, process selected and auxiliary facilities. The tentative requirement of power for operation & maintenance of the proposed 21.0 Mty washery is about 20 MVA. Power at 33kV for operation of the washery will be provided from proposed Central Substation 132/33 kV adjacent to the washery site.

7.2.8.3. REQUIREMENT OF WATER

Requirement of water depends on the throughput capacity and the process selected. The washery has been planned to operate on closed water circuit. Requirement of water for pollution control arrangements would be primarily for dust suppression, floor washing, watering of the plant site and plantation. In accordance with the technology adopted, process and other features, the tentative industrial water requirement of the washery for the above usage has been broadly worked out to 1.67 MGD including losses with products, dust suppression, plantation, evaporation loss etc.

The water requirement of the washery is proposed to be met from the mine water reservoir adjacent to the washery site. Power supply for drawl of water from source has been envisaged from nearby power source.

7.2.8.4. RAILWAY SIDING FOR DISPATCH OF WASHED COAL

Washed coal will be reclaimed from covered washed coal storage (45000 tonne) and conveyed by belt conveyors to 2 nos. Silos (4000 tonne capacity each) at proposed Railway siding (about 1500 m from washery site) from where it will be loaded into Railway wagons through Rapid Loading System (@5500 tph) and dispatched to consumers.

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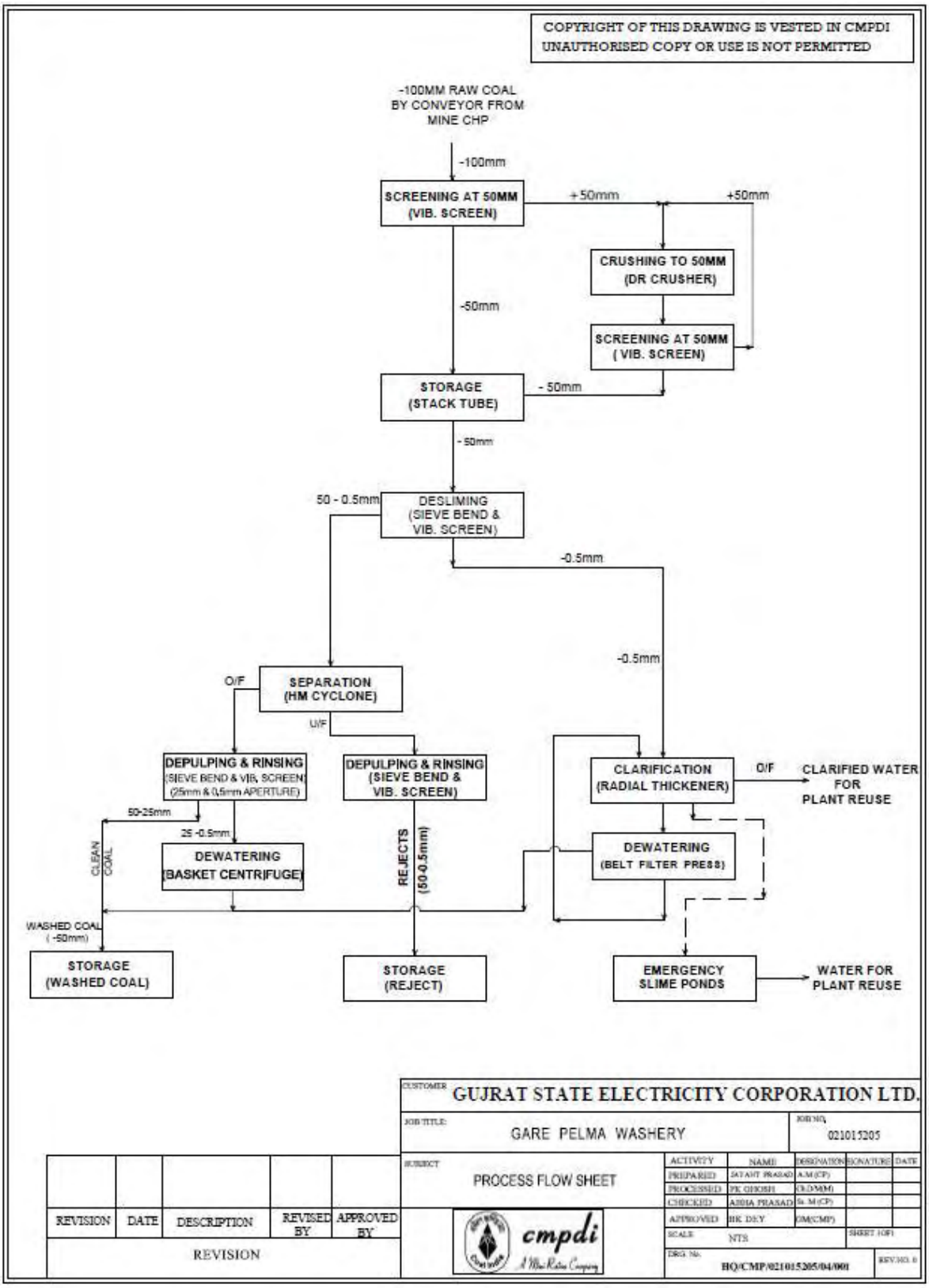
7.2.8.5. MANPOWER

The total manpower required for operation & maintenance of washery has been broadly estimated as 300. Breakup is given hereafter in Table as follows:

Requirement of Manpower

Sl. No.	Particulars	No.
A.	Executives	25
B.	Monthly Paid	41
C.	Daily Rated	234
	Total	300

Flow diagram



CHAPTER-8

INFRASTRUCTURE FACILITIES AND THEIR LOCATION

8.1 CIVIL CONSTRUCTION

8.1.1 INTRODUCTION

Infrastructure facilities have been envisaged for opencast operation only. For underground operation this will be envisaged in the project report prepared for UG only.

The life of Gare Palma Sector I OCP with a target capacity of 15 MTY has been estimated to be more than 30 years excluding construction period. Hence Permanent specifications shall be adopted for the construction of residential and service buildings.

Specifications towards the civil construction shall be based on BPE guidelines, CMPDI Norms & practice for planning of coal mines.

8.1.2 BUILDINGS

Provisions shall be made for residential buildings with total number of quarters required for the project is 1943 satisfying 70% of the target manpower of 2775. Workshops, stores, statutory facilities, magazine, sub-stations, office complex, different community buildings shall be provided as per technological requirement and a sound living condition for the project people. For the township land requirement has been assessed as 44 Hectares.

8.1.3 ROADS & CULVERTS

Provisions for colony roads, haul roads, road to for workshops, Magazine road and approach road to mines and colony shall be made as per requirement. An existing road going through the proposed mine boundary needs to be diverted.

8.1.4 WATER SUPPLY & SEWERAGE

The total water demand in Million Gallons per day (MGD) for the Project would be as follows.

Particulars	Washery	Opencast	Underground	Total
Industrial water	1.67	0.67	0.456	**2.296**
Potable water in the industrial premises	0.001	0.05	0.02	**0.08**
Potable water for colony	0.04	0.36	0.12	**0.52**
Grand total	**1.72**	**1.08**	**0.596**	**3.396**

Water would be treated, both for industrial and colony uses.

8.1.5 OTHER DEVELOPMENTAL FACILITIES

Provisions for garland drains, fencing, toe wall, nallah diversion, embankment, RCC Bridge etc. shall be made as per requirement.

8.2 PUMPING

8.2.1 INTRODUCTION

The pumping system of Gare Palma Sector-I block OCP has been designed to dewater the inflow of water due to precipitation falling within the active pit limit during the monsoon season to enable the mining activity to continue round the year.

General topography of the block is highly undulating. The range of elevation in the area varies from 270.0 m to 318.0 m above MSL. The general slope is from south-east to northern-westerly direction. Kelo River is passing along the western periphery of the block. The monsoon in this area usually stretches from June to September.

The planning of de-watering of the mine has been done in such a way that as far as possible the working faces remain dry. The layout of the quarry provides suitable gradient along the quarry floors and the benches to facilitate self-drainage of water to the sump at the lowest level of the quarry.

The rainwater intake to the opencast mine is non-uniform during the year. The maximum rainwater intake will be between Junes to September in a year. The average annual rainfall is about 1,587 mm.

8.2.2 SOURCE OF WATER

In general the source of water in the quarry is:

- Direct rainfall in the open excavated area
- Inflow of water from back filled area due to rainfall on it
- Inflow of water from area beyond excavation.
- Seepage of water from strata water / ground water.

8.2.3 BASIC DATA

The following data have been taken into consideration for arriving at the capacity of additional pumps:

a. Pumping capacity required on account of rainfall has been computed based on maximum daily rainfall, which will be pumped out in 5 days.
b. Effective working hours taken here is 20 hrs/day for pumping calculation, but in monsoon period pumping will be done round the clock, whenever necessary.
c. Probable maximum daily rainfall computed from rainfall data(likely to occur in the lifetime of the mine)
   : 235 mm
d. Life of the mine operation : 32 years
e. Maximum depth of mine (northern section) : 285 m
f. Consideration of different run-off co-efficient for mined out area, internal dumped area and area beyond excavation

8.2.4 ASSESSMENT OF VOLUME OF WATER TO BE PUMPED

The volume of maximum make of water for the quarry has been computed for various stages of mining operation are as follows:

Particulars	1st year	3rd year	5th year	10th year	15th year	20th year	25th year	Final year
Total make of water in the day of maximum rainfall (in M^3) considering 5% seepage water	77093	217688	485357	728003	796857	959160	872833	886425

8.2.5 PUMPING CAPACITY

Pumping system has been designed for the volume of water accumulated in the mine at the final stage of production considering maximum daily rainfall as 235 mm.

Pumping capacity required along with depth of the mine in the various stages thus worked out is given in the table below:-

Particulars	1st year	3rd year	5th year	10th year	15th year	20th year	25th year	Final year
Total pumping capacity (in M^3/Hr.)	771	2177	4854	7280	7969	9592	8728	8864

8.2.6 SELECTION OF PUMP

From the above pumping load, depth of operation etc. main pumps, Intermediate pump, face pumps, slurry pumps, diesel pumps, pipes and fittings etc. can be selected judiciously for safe and smooth operation of the mine.

8.3 WORKSHOP

8.3.1 INTRODUCTION

For maintenance and repair of equipment deployed at Gare Palma Sector-I coal block, the following facilities has been envisaged:

a. Daily maintenance, scheduled maintenance, minor repair and medium repair proposed to be carried out in project workshop.
b. Capital repair and major overhauling of equipment to be carried out at OEM workshop.

Facility planning has been done for providing maintenance and repair facilities to all the major equipment deployed in the opencast project and a comprehensive layout plan for project workshop and project store has also been prepared. The proposed project workshop and project store will facilitate the maintenance and repair requirement of mining, mechanical, electrical, transport and other auxiliary equipment and storage of spare-parts, sub- assemblies and consumables.

In general, two-shift working has been envisaged for the project workshop with only essential maintenance facilities in the 3rd shift and one shift working for project store.

8.3.2 EQUIPMENT MAINTENANCE PLANNING

The size of project workshop and store complex is given below:

Particular	**Area (m^2)**
Project workshop and store	309,970

8.3.3 SCOPE OF WORK

The scope of work for Excavation and E&M workshop will be as under:

8.3.3.1. Excavation Workshop

- Preventive maintenance
  a. Daily maintenance, routine lubrication and weekly washing of HEMM.
  b. Technical inspection and running repair of transport equipment and checking of tires.
  c. Daily and fast filling of diesel at fuel delivery station for transport equipment and at site for field equipment.
  d. Dismantling, opening and refitting of tires.
  e. Incidental minor repairs of assemblies and sub-assemblies of mining and mechanical equipment i.e., dumper, dozer, shovel, drill etc.

- Scheduled maintenance of all HEMM at stipulated working hours as per operating manual.
- Medium/minor repair and replacement of assemblies and sub-assemblies.
- Mobile repair team with crew and facilities to cater the maintenance and minor repair needs of field equipment at site.

8.3.3.2. E&M Workshop

The scope of work for E&M workshop will be as under:

Minor repair, medium repair and replacement of components, assemblies and sub-assemblies of pumps, motors and electrical equipment.

8.3.4 WORKSHOP FACILITIES

Following facilities have been provided in the Excavation workshop and E&M workshop for maintenance and repair of equipment as envisaged in the scope of work:

8.3.4.1. Excavation Workshop

Brief description of major functional shops in excavation workshop is given below.

Major Shops	No. of bays	Bay size (m x m)	Shop size (m x m)	Bracket height (m)	EOT Crane Capacity (t)
240T Dumper Repair Shop	30	14 x 20	220 x 70	15.0 m	65/5 te. – 2 nos. 10 /2 te – 1 no.
100/60T Dumper Repair Shop	34	10 x 18	180 x 54	11.5 m	25/5 te. – 2 nos. 10 /2 te – 1 no.
Dozer & Surface Miner Repair Shop	5	14 x 12	60 x 40	8.0 m	15 / 2 t - 1 no.
Shovel & Drill Repair Shop	-	-	60 x 50	8.0 m	15 / 2 t - 1 no.

8.3.4.2. E&M Workshop

Size of major functional shops of E&M workshop shall be as under:

Major Shops	Shop size	Bracket height
Mechanical Repair Shop	50 m x 24m	6 m
Machine Shop	50 m x 24m	6 m
Structural Repair Shop	50 m x 24m	6 m
Electrical Repair Shop	50 m x 24m	6 m
Light Vehicle Repair Shop	60m x 18m	4 m

8.3.5 WORKSHOP LAYOUT

General layout drawing of workshop and store complex has been given in Drg No.: HQ/E&M/301502.

8.3.6 WORKSHOP PLANT & MACHINERY

The selection of workshop plant and machinery (machine tools) for workshop will be done in accordance with the maintenance programme of various equipment, job-wise requirement in respect of dimensions, nature of operations to be performed, frequency of such requirements and degree of precision.

Provision of E.O.T. cranes, motorised wire rope hoist, chain pulley blocks, jacks etc. will be made for quick and effective handling of heavy materials and tires within and outside the shops.

8.3.7 PROJECT STORE

The Mining Plan envisages a project store for reception, storage and issue of all kinds of materials, equipment and consumables required for mine operation and maintenance of mining, mechanical and electrical equipment. The storage capacity is planned for 30 to 45 days consumption of materials.

Size of major functional shops of project store shall be as under:

Major Shops	Shop size	Bracket height
Store Shed	100 m x 24m	6 m
Store shed with raking arrangement	100 m x 24m	6 m
Oil & Lubricant Shed	50 m x 24m	4 m
Store yard	2 x (100 m x 40m)	-

Layout plan of the project store has been given in Drg No.: HQ/E&M/301502.

The project store will meet the total store requirement of the project and project workshop. Overall size of the store complex is 120 m x 290 m.

8.4 POWER SUPPLY, DISTRIBUTION AND ILLUMINATION SYSTEM

8.4.1 POWER SUPPLY

Gare Palma is an important coal block of Mand-Raigarh coalfield having substantial coal reserve. Overall development of this block consists of coal mining operation covering both underground and opencast mines as well as coal beneficiation plant. It will require deployment of a number of large coal mining equipment and other auxiliary installations like dewatering pumps, coal handling plant, workshop, coal dispatch arrangement, water treatment plant, workshops, residential complex etc. It is estimated that total power demand from this block will be around 40-45 MVA.

To meet this demand, it is envisaged that one number 132/33 kV, Central Substation with an installed capacity of 2 X 40 MVA shall be installed. This substation shall receive power at 132 kV from Gherwani substation of CGPCL through a double circuit overhead transmission line. Approximate distance of Gherwani from the coal block is around 20 km. This central substation shall be used to feed power to all installations of the blocks including opencast quarry, underground mine and coal beneficiation plant.

It is envisaged that proposed 2 X 40 MVA, 132/33 kV substation shall have provision for 2 nos. incoming 132 kV feeders and 10 nos. outgoing 33 kV feeders. The transformers for the substation have been selected considering maximum demand of the project and 100 % stand-by transformation capacity. 132 kV SF6 circuit breakers shall be used for primary control of the 132/33 kV transformers and incoming 132 kV feeders. Necessary CTs and PTs and other measuring and protective devices shall also be provided. Outdoor type 33 kV VCBs will be used for secondary control of transformers, control of 33 kV outgoing feeders and as a bus-coupler. Necessary protections against over current, short circuit and earth fault for all incoming and outgoing circuit breakers and transformers has also been envisaged. It is also envisaged to have an auxiliary bus at 33 kV side of the substation for improve reliability and maintenance purpose. The substation shall be installed at a suitable central for smooth and uninterrupted supply of power to different power consuming centers of the block. Functions of 10 nos. outgoing 33 kV feeders is envisaged as follows:

1. Opencast Project - 3 nos.
2. Underground Mine - 2 nos.
3. Coal beneficiation plant - 2 nos.
4. Residential Complex - 1 no.
5. Reserve - 2 nos.

In the proposed opencast project of the block, large electrical driven equipment has to be deployed. These are main heavy earth moving machinery, dewatering pumps, coal handling plant, in pit conveying system, workshop, illumination system etc. With these electrical driven equipment, it is estimated that power requirement for the proposed opencast project in the block will be around 25 MVA. To meet this demand of the project, it is envisaged to install three numbers of 33/6.6 kV substations at the different suitable locations in the project.

Out of these three substations, two substations each of capacity 2 X 16 MVA, 33/6.6 kV will exclusive to the quarry load of the project. These are mainly HEMMs, dewatering pumps, in pit conveyors and quarry illumination. One substation of capacity 2 X 10 MVA,

33/6.6 kV will exclusive to the surface load of the project. These are mainly coal handling plant, workshop, surface illumination and other miscellaneous load. All these three substations will receive power at 33 kV from 2 X 40 MVA, 132/33 kV central substation through three numbers of 33 kV overhead transmission lines. Normally each substation will receive power through one number of 33 kV feeder. It is envisaged that all three substations will be interconnected through a 33 kV ring main system. In case of breakdown of any feeder, substation can receive power with other feeder through the ring main system.

Further, it is envisaged that all the three proposed 33/6.6 kV substations shall have provision for 2 nos. incoming 33 kV feeders and 10 nos. outgoing 6.6 feeders. The transformers for the substation have been selected considering maximum demand of the project at overall power factor of 0.98, and 100 % stand-by transformation capacity. The main transformers of the substations shall be provided with neutral ground resistor to limit the neutral current as required by statutory provisions. 33 kV VCBs shall be used for primary control of the 33/6.6 kV transformers and incoming 33 kV feeders. Necessary CTs and PTs shall also be provided. Outdoor type 6.6 kV VCBs will be used for secondary control of transformers, control of 6.6 kV outgoing feeders, bus-coupler and capacitor bank control. Necessary protections against over current, short circuit and earth fault for all incoming and outgoing circuit breakers and transformers has also been envisaged. To maintain power factor at 0.98, capacitor bank of suitable capacity with automatic power factor correction relay shall be provided. Necessary provision of automatic fire protection of transformers along with portable fire extinguishers has been envisaged for fire protection in the substations. These substations shall be installed near the quarry at suitable location for supply of power to different equipment of the project.

8.4.2 UTILIZATION VOLTAGE AND POWER DISTRIBUTION

Main utilization voltages of the project has been envisaged to be 6.6 kV. Utilization voltage for shovels and main pumps shall be 6.6 kV. However small pumps and workshop equipment shall be rated at 415 V. Utilization voltage for quarry illumination

shall be 230 V (L-L). Power supply to the coal handling plant and workshop shall be made at 6.6 kV.

6.6 kV overhead line feeders originating from the substations is proposed to be drawn along the quarry periphery for feeding power to various shovels, pumps deployed in this project. Power shall be tapped from 6.6 kV overhead feeders by means of outdoor type isolators and power cables to energize the respective field switches / unitized substations / outdoor type switch board for supplying power to different quarry equipment / pumping and other installations.

Similarly, power at 6.6 kV shall be made available to coal handling plant through 6.6 kV overhead line feeders drawn from the Main Sub-substation. For electrical loads operating at 415 V in the coal handling plant, 6.6 kV / 415V substation of suitable capacity shall be installed in the CHP. Power at 6.6 kV shall also be made available to workshop through 6.6 kV overhead line feeder drawn from the main substation. At the workshop, power at 6.6 kV will be stepped down to 0.415 kV for supplying power to various power consumers of the workshop.

Power to residential colony shall be made available to colony through 33 kV overhead line feeders drawn from the 132/33 kV main substation. A 33/6.6 kV substation of suitable capacity is envisaged for power supply to the residential colony. Necessary provision for overhead line including terminal structures, colony distribution transformers, external electrification and street lighting has been envisaged.

8.4.3 ILLUMINATION

For illumination of permanent haul roads, 250 W HPSV lamps and luminaires mounted on 11/13 m (approx.) high steel poles have been envisaged. Illumination of quarry general area/dump area will be done with 400W HPSV lamp in flood light fixtures mounted on lighting towers. Sufficient no. of 25/10 kVA, 6.6 kV / 0.23 kV (L – L) transformers shall be provided for illumination of quarry general area / dump area / haul road / face etc.

250/150 W HPSV lamps in street light luminaires are proposed for service road illumination in the project. 28/30 W LED lamps in street light luminaires are proposed for colony road illumination in the project. The luminaires on steel tubular poles 9 m high is proposed for this purpose. Some areas in the colony may be illuminated with 150/250 W HPSV lamps also.

CHAPTER-9

LAND REQUIREMENT

9.1 INTRODUCTION

For implementation of proposed OCP and Underground in Phase-I (East of Kelo River), there will be requirement of 3583.81 Ha of land. This includes quarry area, external OB dump area, infrastructural facilities for OCP and Underground, road, nala diversion and colony for opencast & washery manpower etc. Area of colony for underground manpower and for rehabilitation of PAFs is not included in this. As the block is surrounded by other coal bearing blocks, no land for blast safety zone has been proposed to be acquired. Land requirement for residential colony has been computed as 48.68 Ha. and 15 Ha for opencast+washery manpower and underground manpower, respectively. Inside the proposed leasehold area, colony area for 48.68 Ha has been envisaged. The 15 Ha of land of colony for underground manpower has been envisaged outside the leasehold, for which no area has been demarcated yet. For resettlement colony for project displaced families additionally of about 20.00 Ha of land would be required. This resettlement area has been assessed based on PDP (Project Displaced Person) of 2825 nos. as per Sensex 2011. The ground survey for actual no of PAF (Project Affected Families), PDPs & PDFs (Project Displaced Families) is in progress at Gare Palma Sector-I block area. Therefore, the actual nos. of PAFs and PDPs may vary from the census 2011 data. ,

9.2 LAND

9.2.1 PRESENT LAND USE

The existing land use of the proposed lease hold area is as follows:

Land Use Break-up of GP I (Ph-1) Coal Block in Ha		
Forest Land	Reserve Forest	0.00
	Protected Forest	48.22
	Chote bade jharka Jungle	134.54
Tenancy Land	Village/Town area	58.66
	Industrial land	71.29

Land Use Break-up of GP I (Ph-1) Coal Block in Ha		
	Agricultural land	3058.81
	Grazing land	43.39
	Barren land	0.00
Government land	Total Govt Land	168.90
Grand Total		**3583.81**

9.2.2 BREAK UP OF LAND PROPOSED FOR LEASE HOLD

Particulars of land within the proposed leasehold area are as follows**:**

Sl. No.	Particulars	Total land required in Ha
1	Quarry Excavation	1620.31
2	External OB dump	1447.50
3	Infrastructure (Opencast and Underground)	
	Opencast	113.65
	Underground	34.29
4	Siding and Conveyor belt from Washery	71.74
5	Colony (Opencast and Washery)	48.68
6	Other (Road diversion, nala diversion, embankment, Open space etc.)	212.19
7	UG below protected Forest	35.46
	Total	**3583.81**

9.2.3 AREA NOT CONSIDERED FOR MINING WITHIN THE ALLOTTED BLOCK AREA

The land break-up of the allotted block is as follows:

Sl. No.	Particulars	Area in hectare	Remarks
1	Area of the allotted block	5738.75	
2	Area proposed for mining in the 1st phase	3583.81	
i.	Area falling in the East side of Kelo river	3513.70	OC & UG mines, OC & UG infrastructures and external OB dump for OC mine have been proposed.

ii.	Area falling in the West side of Kelo river	70.11	Railway Siding, Conveyor from Washery to siding and part of the diverted approach road has been proposed here
3	Area not proposed for mining	2154.94	The area is including the area of Kelo river. Due to presence of power plant and other structures of JINDAL on the Western part of the Kelo river, only the part of the block in the Eastern side of the Kelo river has been considered for mining in the 1st phase.

9.3 VILLAGES AFFECTED

Altogether 20 (twenty) villages will be partly or fully affected by the project. The village-wise project affected persons (PAP) & Project displaced parsons (PDPs as per 2011 census are as follows:

PAPs & PAFs Details of Project Gare Palma Sector-I Coal Block

Sl. No.	Name of the Panchayat	Name of the Village / Pada	No. of PAPs					Total No. of PAFs
			Home Oustees	Land Oustees	Home & Land Oustees	Others*	Total	
1	Budhiya	Budhiya	14	26	324	14	378	338
2	Jhikabahal	Baghbadi	0	19	155	29	203	155
3	Tehli Rampur	Tehli Rampur	0	97	0	0	97	0
4	Aamgaon	Aamgaon	43	65	471	56	635	514
5	Dhourabhata	Tapranga	0	7	0	0	7	0
6	Tangarghat	Tangarghat	0	5	0	0	5	0
7	Tangarghat	Telaipara	0	0	27	0	27	27
8	Dhourabhata	Dhourabhata	79	42	275	114	510	354
9	Jhanjir	Nagramunda	41	96	25	17	179	66
10	Jhikabahal	Jhikabahal	0	66	158	43	267	158
11	Libra	Libra	24	98	378	53	553	402
12	Jharna	Jharna	0	235	453	34	722	453
13	Samkera	Raipara	13	156	66	16	251	79
14	Samkera	Samkera	0	302	0	33	335	0
15	Mahloi	Mahloi	0	632	251	61	944	251
16	Khuruslenga	Khuruslenga	0	0	318	0	318	318
17	Bijna	Bijna	8	338	85	63	494	93
18	Dolesera	Dolesera	0	35	0	0	35	0
19	Pata	Pata	0	113	0	0	113	0
20	Kunjemura	Kunjemura	0	84	0	0	84	0
Total			**222**	**2416**	**2986**	**533**	**6157**	**3208**

CHAPTER-10

ENVIRONMENT MANAGEMENT

10.1 INTRODUCTION

The impacts (both beneficial and adverse) of mining and its allied activities of the project have been assessed and presented in respect of air, water, noise, blasting vibration, socio-economic profile, flora & fauna, land resource, traffic movement and visual/aesthetic aspect in this chapter.

The control measures to mitigate various environmental impacts are also highlighted in this chapter for carrying out mining operation in an environmentally compatible manner. Further, all provisions of Coal Mines Regulations and Directives shall be followed in this project.

10.2 IMPACT ASSESSMENT & POLLUTION CONTROL MEASURES FOR AIR

The impact assessment has been carried out. Appropriate air pollution control measures will be taken to contain the air pollution for maintaining the ambient air quality within the stipulated standards besides making the mining operation eco-friendly in this project. All provisions of Coal Mines Regulations and Directives shall be followed.

10.2.1 AIR POLLUTION IMPACT ASSESSMENT

The pollution sources are obvious and to assess the impact, the project life is divided into following time frames:

- Operational phase
- Post-operational phase

The activities associated with these time frames and having impact on the ambient air quality along with the pollutants are enumerated in the following sections:

a) OPERATIONAL PHASE: During this phase, activities necessary for mining of coal, its handling and transport are taken up. Such activities having impact on ambient air quality are detailed below:

(i)	Drilling	:	Dust
(ii)	Blasting of coal and overburden	:	Dust and noxious gases
(iii)	Handling of coal	:	Dust and noxious gases
(iv)	Overburden handling	:	Dust and noxious gases
(v)	Dump formation (internal /external)	:	Dust and exhaust fumes from dumpers and dust till the development of green cover
(vi)	Movement of vehicles	:	Dust and noxious fumes

b) POST-OPERATIONAL STAGE: During this stage of the project, the activities related to the closure of mine are to be carried out. Preparation of final mine closure plan shall be carried out during the period four to five years before the closure of the mine. Some of the activities for the closure are:

- Modifications in physical and biological reclamation of backfilled area
- Salvaging and shifting operation of HEMMs and other equipment
- Clearing of coal and other materials, restoration of infrastructure area & colony area to the extent possible and necessary if not useful for other projects
- Management of hydrology and hydrogeology.
- Redeployment of workforce, etc.
- Arrangement & implementation of post-operation monitoring mainly keeping watch, vigil, etc.

The impacts are both direct and indirect. The nature of impacts will be short-term and reversible.

The mining and its related activities create impact on ambient air quality. The impact of mining on ambient air quality are highlighted below:

a) The ambient air quality is influenced due to the generation of RPM, SPM, SO_2, NOx, etc., which is due to various activities like drilling, blasting and material handling in the project. Further, the ambient air quality may be affected marginally to a varying degree due to the mining activities of other nearby opencast and underground coal mines due to dispersion of pollutants. The concentration of pollutants may vary depending upon the various micro-meteorological parameters and the seasons of a year.

b) The following activities are likely to generate the air pollution mainly SPM & RPM due to opencast mining :

- Top soil removal
- OB Removal
- Coal extraction by drilling and Blasting
- CHP operations
- Washery operations
- Transportation of coal
- Similarly following activities are likely to generate air pollution due to UG mining operation:
- CHP operations
- Transportation of coal

c) Presently base line data is not available for Gare-Palma Sector-1.

10.2.2 AIR POLLUTION CONTROL MEASURES

Appropriate mitigative measures shall have to be taken to contain the pollutants within the prescribed level. These measures (both preventive and suppressive) are enumerated below:

a) **Drilling operation:** All the drills will be equipped with well-designed dust extractor arrangement. Again, the thrust shall be put on their proper maintenance and handling.

b) **Blasting operation:** The following practices will be maintained

- Appropriate design of the geometry of blast holes.
- Use of proper amount of explosive taking into consideration the geo-mechanical conditions of the site.
- Controlled blasting will usually be done in daytime during the shift change over period.
- The operation shall be in conformity with the existing laws with more closer control of blasting parameters including results of blasting like desired fragmentation, permitted vibration, etc.

c) **Loading and transport:** The following measures will be taken

- Transportation of coal from the Quarry to Washery has been proposed through In-pit Conveyors-High Angle Conveyors-Surface Conveyors to reduce diesel consumption and dust generation.
- From Washery to Silos, Pipe Conveyors have been proposed for transportation of washed coal and rejects to reduce diesel consumption, dust generation and to avoid contamination river water by coal dust.
- Surfacing of all service roads/permanent roads by asphalt.
- The length of haul road will be reduced to the minimum possible. The permanent haul roads will be boulder pitched and maintained properly.
- The unmetalled roads shall be kept free of ruts, potholes, etc.
- Regular maintenance of HEMM engines to limit emission of harmful exhaust fumes.
- Provision of gas filter for exhaust fumes from HEMM.

- Frequent and at regular intervals, water will be sprayed on haul roads, service roads. Mobile water sprinklers of 28 kl capacity each will be provided in the project
- Provision of auto-start, time cycle controlled, fine nozzle mounted fixed sprinklers at siding and haul roads.
- Physical removal of dust from the roads.
- Greenbelts around quarry, industrial sites, service building area besides avenue plantation along roads.

d) Coal handling: The following control measures will be adopted during coal handling

- Suppression of coal dust during coal handling by fine nozzle mounted fixed sprinklers.
- Minimization of the height of coal-fall at transfer points to reduce the dust generation.
- Improved maintenance of plant and machinery.

e) Reject handling: It has been envisaged that rejects will be stored in stack tube and will be conveyed by belt conveyor to Silo at Railway siding for loading into wagons for onward dispatch to consumers. In case, reject is required to be stored, an area of 10 Ha per million tonnes of rejects generated will be required and the rejects will have to be stored in an environmentally friendly manner till disposal/utilization.

f) Fires at coalfaces, coal stockyards

1) **At coal faces:** To prevent and control such fires, the following measures will be taken:

- Exposures of coal benches for long time will be avoided.
- Provision of adequate firefighting arrangements including storage of sufficient quantity of water at all critical points.

- Careful removal of all loose coal from the abandoned coal faces.
- Regular supervision.

2) **At coal stockyards:** To prevent and control such fires, the following measures will be taken:
   - Limiting the amount of stock by giving close attention to marketing besides following the "first-in and first-out" sequence.
   - Attention to the following while stacking of coal:
     - Proper dimensions of stack (height to be limited to not more than 8m).
     - Dozing/compaction to make the stock semi-consolidated.
     - Regular and strict supervision of stacks.
     - Provision of firefighting arrangement with supply of adequate quantity of water at sufficient pressure.

10.3 IMPACT ASSESSMENT & POLLUTION CONTROL MEASURES FOR WATER

10.3.1 SOURCES OF WATER POLLUTION

Likely sources of water pollution from Gare Palma Sector-1 project along with the type of pollutants are as follows:

Sources of water pollution vis-à-vis pollutants

(i)	Industrial wastewater from workshop	:	Suspended solids, oil & grease;
(ii)	Wastewater from mine	:	Suspended solids of coal, clay and oil;
(iii)	Surface run-off passing through coal stockpiles	:	Suspended solids;
(iv)	Storm water from leasehold area and built-up area	:	Suspended solids.

10.3.2 IMPACT ASSESSMENT

The impact of mining at this project on both surface water source and ground water resource has been assessed as follows:

A. Surface water sources:
   - Disruption of natural drainage pattern in the core zone,
   - Deterioration of water quality & pollution of water bodies,
   - Siltation and choking of water courses causing scarcity of surface water, etc.

B. Ground water resources:
   - Affected due to mine workings.
   - Affected due to mine water. Consequently, the water table of the peripheral villages/ basties may get lowered.
   - Disruption in ground water aquifers.

10.3.3 WATER POLLUTION CONTROL MEASURES

For complying with the statutory provisions of MoEF and Pollution Control Board, water quality will be monitored and evaluated. Corrective measures will be taken on the basis of monitoring results. As the mining operations advance there may be changes in the water quality due to mine water discharge, workshop effluent discharge, domestic sewage, etc. The following measures are suggested to control the water pollution:

a) Sufficient safeguards during the planning stage to make the project eco-friendly from water pollution control point of view;
b) External OB dump and Washery have been proposed at a distance of 100m from Kelo River to avoid contamination river water.
c) From Washery to Silos, Pipe Conveyors have been proposed for transportation of washed coal and rejects to avoid contamination river water by coal dust.
d) HEMMs are being used for OB removal in the opencast mine of the project. Effluent from workshop will be treated in the effluent treatment plant with zero discharge.
e) Sanitary waste water will be treated mainly for total suspended solids (TSS) and bio-chemical oxygen demand (BOD). Domestic effluents will be treated in septic tanks and soak pits.
f) Drains will be provided around coal stacks to collect run-off water and diverting it into settling ponds before discharging it into natural water courses.

g) Sufficient standby capacity will be provided in the main/ intermediate sumps, so that the suspended solids generated due to mine workings settle down and comparatively cleaner water is discharged to the surface drainage system.

h) The process of the proposed washery is based on closed water circuit system.

   a. All the water fed into the system will be collected after use and re-circulated again into the circuit and no effluent will be allowed to escape into the natural drainage system i.e. the washery will be with zero effluent discharge.

   b. Provision of rain water harvesting of roof top water should be envisaged by recharging the same to ground and/ or by collecting the same into the constructed/ developed water bodies (settling pond) for use in the washery after settling.

   c. Emergency slime ponds have to be provided for settling and natural drying of slimes in case of emergency draining of the thickener. The slimes will be evacuated occasionally and depending upon quality will be either mixed with washed coal or rejects. Overflow water from the slime ponds will be reused in the washery.

10.4 IMPACT ASSESSMENT & CONTROL MEASURES FOR NOISE & BLASTING

10.4.1 SOURCES OF NOISE POLLUTION

The sources of noise will be:

- Drilling operation in coal and OB.
- Blasting for coal & overburden
- Operation of HEMMs like shovels, dumpers, dozers, graders, front-end loaders, etc
- Operation of equipment in workshop, etc.

The noise associated with mining activities may be classified into three types

- Continuous

- Intermittent
- Impulse

The workmen associated with the operation of HEMMs, etc. will experience a noise level above stipulated 90 dB (A) [DGMS Circular, No.18 (Tech.) of 1975] for more than 4-4.5 hours per shift. Unless suitable mitigatory measures are taken, high noise pollution will have impact on the workmen. It is worthwhile to mention that intermittent and impulse noises are considered to be less dangerous than continuous noise due to the short exposure duration except under the situation when the level exceeds 115 dB (A).

10.4.2 IMPACT OF NOISE NUISANCE & BLASTING

The ambient noise level of the project will be monitored regularly. Noise levels are likely to remain within the limits of the prescribed standard. So the noise produced from this project will not have auditory, non-auditory, masking effects, etc. as suitable mitigation measures shall be taken in the project.

Controlled blasting technique will be adopted in the project. So, there will be no adverse effects on life, property and ambient noise.

10.4.3 ACCEPTABLE NOISE LEVELS AND PEAK PARTICLE VELOCITY

Assessment of impact of noise nuisance of a workplace can be achieved by comparing the level with TLV prescribed by the DGMS. There are also standards relating exposure time with noise levels from the International Standard Organization (ISO) and American Conference of Governmental Industrial Hygienists (ACGIH). These standards may also be used to assess the impact of noise in workplaces.

The acceptable noise levels for residential, commercial and other institutional areas prescribed by the Central Pollution Control Board are given in Chapter III.

10.4.4 NOISE POLLUTION CONTROL MEASURES

The following measures shall be taken:

- Proper designing of plant & machinery by providing in-built mechanisms like silencers, mufflers and enclosures for noise generating parts and shock absorbing pads at the foundation of vibrating equipment.
- Routine maintenance of equipment.
- Rational deployment of noise generating plant and machinery.
- Greenbelts around the quarry, infrastructure sites and service building area besides avenue plantation on both sides of the roads
- To maintain noise level at night time within the limit for the inhabited localities situated at a very close proximity.
- HEMMs with sound proof cabins.
- Personal protective devices to all the persons working in high noise areas.
- Regular monitoring of noise levels at various points.

10.4.5 BLASTING VIBRATION CONTROL MEASURES FOR SAFE BLASTING

Due attention will be given to the following factors:

a) All provisions of Coal Mines Regulations will be followed.
b) Quantity of explosive: The quantity of explosive will be decided as per conditions imposed by DGMS.
c) Stemming material: Stemming material to be used is sand. However, the drill cuttings and chips of triangular shape can be used as an effective stemming material with proper packing.
d) Delay system: Use of millisecond delay detonators that are initiated by shock tube initiation system, between rows and between holes in the same row.
e) Blasting time: Blasting will be done in day time during the shift change over period as per requirement. However, the frequency of blasting will depend upon the availability of land (tenancy in particular), DGMS permission for use of explosive, meteorological condition, geo-mining condition and method of mining.
f) Warning: Before blasting is done, warning sound shall be given and placards/flags will be displayed so that people can move to safe places.

10.4.6 VIBRATION CONTROL

- Proper conformation to measures for safe blasting as mentioned above, to avoid damage to any structure or annoyance to the people in the adjoining areas.
- Proper design factor will be taken while constructing various structures for stability against vibration.
- A safe blasting zone will be kept around the periphery of the quarry. This zone is kept free from village habitation and community infrastructure and thus impact of vibration after blasting on the surface structures is avoided.
- Controlled blasting will be done near built-up areas and surface features, as and when required.

10.5 IMPACT ON LAND RESOURCE AND ITS MANAGEMENT

10.5.1 IMPACT ON LAND USE PATTERN

The impact of opencast coal mine and underground mine on land is the change in land use pattern. The changes in this project are due to the following:

- Quarrying and external dumping
- Construction of infrastructure.
- Subsidence

The alteration in land use pattern due to infrastructure is not to be considered as true degradation as these facilities can be utilized for some other purposes after the mining operation is over. The change in land use pattern due to activities of quarrying may be considered as true change in land use pattern. Hence, land rehabilitation scheme is planned for reclaiming the excavation area of this project.

10.5.2 STAGES OF LAND RECLAMATION

This is carried out in two phases:

- Physical/technical reclamation.
- Biological reclamation.

a) Physical / technical reclamation: During the process, the geometrical shape of the internal & external dumps is improved to make it amenable to effective biological reclamation and also to provide safety and stability.

Backfilling & reshaping of internal dumps

The OC quarry will be backfilled with overburden. The backfilling will be carried out in a phased manner. Once the backfilling has reached a certain predetermined reduced level, the plots will be levelled, graded and cleared of large stone pieces lying on the surface. The slope of the ground will be made very gentle as far as possible (preferably less than 2%). The graded and levelled area will be divided into small sectors and small check bunds will be constructed to retain moisture and humus in the soil. The outer slope of each bench will be kept at the natural angle of repose of the spoil material and at overall slope angle of 20-22^{o} considering all benches, **however, the actual Bench Parameter & overall slope will be decided after Slope Stability Study.**

The drainage arrangements for precipitation run-off are as follows :

- During working stage, the run-off will be collected from internal dump by foot drain for diverting to sump on mine floor for pumping.
- In the post-mining period, the drainage pattern of the reclaimed area will be such that the run-off will be diverted to final void of the quarry.

Backfilling & reshaping of external dumps.

Once the external has reached a certain predetermined reduced level, the plots will be levelled, graded and cleared of large stone pieces lying on the surface. The slope of the ground will be made very gentle as far as possible (preferably less than 2%). The graded and levelled area will be divided into small sectors and small check bunds will be constructed to retain moisture and humus in the soil. The outer slope of each bench will be kept at the natural angle of repose of the spoil material and at overall slope angle of 25-28^{o} considering all benches,

however, the actual Bench Parameter & overall slope will be decided after Slope Stability Study.

The drainage arrangements for precipitation run-off are as follows :

- During working stage, the run-off will be collected from external dump by foot drain for diverting to sump on mine floor for pumping.
- In the post-mining period, the drainage pattern of the reclaimed area will be such that the run-off will be diverted to final void of the quarry.

Topsoil management

Topsoil from unbroken excavation areas will be scraped for progressive and concurrent utilization during physical/technical reclamation of backfilled area, thus obviating the necessity of large storage area of topsoil separately.

For external dumps, topsoil wll be scraped before dumping operation in the area for progressive and concurrent utilization during physical/technical reclamation of external dump area, thus obviating the necessity of large storage area of topsoil separately.

b) Biological reclamation: For successful biological reclamation of the reclaimed area, preference will be given to endemic species and mixed culture. The species will be selected carefully from the following groups for quick reclamation :

- Nitrogen fixing tree species for fuel wood, timber and fodder
- Fruit bearing tree species
- Tree species with dense foliage for shade
- Flowering and ornamental tree species.

10.5.3 SHEDULE OF RECLAMATION AND AFFORESTATION

10.5.3.1. Area of external dumping

External dump is proposed on total area of 1447.50 Ha. The areas covered at different phases are as follow:

Sl. No.	Phase	Cumulative Area in Ha
	1st year	102.47
	3rd year	397.27
	5th year	641.16
	10th year	1190.95
	16th year	1447.50

10.5.3.2. Schedule of Reclamation of dumps

Reclamation is bringing the degraded land to its original form to the maximum extent possible. Backfilling in opencast operation is a reclamation activity. Year wise schedule of backfilling has been provided in chapter-5. Normally biological reclamation is preceded by technical reclamation, which involves compacting, grading, spreading of Top soil above the graded land etc.

The actual schedule of reclamation and plantation will be provided in the EMP stage. A tentative schedule of reclamation and afforestation is provided in the table as follows:

Year	Proposed area of reclamation in Ha			Plantation	
	External Dump area	Quarry backfilled area	Total	Plantation in External dump area. (Thousand Nos.)	Grass topping in backfilled area of Quarry in Ha
P3	149.78		149.78	374	
P4	83.255		83.26	208	
P5	83.255		83.26	208	
Sub-total after P5	**316.29**		**316.29**	**791**	
P6	89.692		89.69	224	
P7	89.692		89.69	224	
P8	89.692		89.69	224	
P9	89.692		89.69	224	
P10	89.692	24.66	114.35	224	24.66
Sub-total after P6 to P10	**448.46**	**24.66**	**473.12**	**1121**	**24.66**

Year	Proposed area of reclamation in Ha			Plantation	
	External Dump area	Quarry backfilled area	Total	Plantation in External dump area. (Thousand Nos.)	Grass topping in backfilled area of Quarry in Ha
P11	97.54	16.21	113.75	244	16.21
P12	97.54	16.21	113.75	244	16.21
P13	97.54	16.21	113.75	244	16.21
P14	97.54	16.21	113.75	244	16.21
P15	97.54	16.21	113.75	244	16.21
Sub-total P11 to P15	**487.68**	**81.07**	**568.74**	**1219**	**81.07**
P16	97.54	16.21	113.75	244	16.21
P17	97.54	16.21	113.75	244	16.21
P18		16.21	16.21		16.21
P19		16.21	16.21		16.21
P20		16.21	16.21		16.21
Sub-total P16 to P20	**195.07**	**81.07**	**276.14**	**487.68**	**81.07**
P21		53.21	53.21		53.21
P22		53.21	53.21		53.21
P23		53.21	53.21		53.21
P24		53.21	53.21		53.21
P25		53.21	53.21		53.21
Sub-total P20 to P25		**266.07**	**266.07**		**266.07**
P26		53.21	53.21		53.21
P27		53.21	53.21		53.21
P28		53.21	53.21		53.21
P29		53.21	53.21		53.21
P30		53.21	53.21		53.21
Sub-total P26 to P30		**266.07**	**266.07**		**266.07**
P31		53.21	53.21		53.21
P32		53.21	53.21		53.21
Sub-total P31 to P32		**106.43**	**106.43**		**106.43**
Grand Total	**1447.50**	**825.36**	**2272.86**	**3619**	**825.36**

After rehandling of backfilled OB of the quarry, final net area reclaimed with plantation would be 2290.88 Ha after the completion of Mine closure at the end of 35th year.

10.5.3.3. Schedule of green belt development

Green belt is to be created along the different corridors and spaces. The plantation programme is shown in the stage plans and the reclamation plan. 5 (five) yearly target of green belt development is as follows:

Sl. No.	Year	Area in Ha	Plantation in Thousand nos.
1	P1	56.84	170.52
2	P3	19.66	58.98
3	P5	6.51	19.53
4	P10	7.89	23.67
5	P20	67.14	201.42
	Total	**158.04**	**474.12**

10.6 SUBSIDENCE

10.6.1 IMPACT OF SUBSIDENCE

The underground mining will be done by caving method. Mining will be carried out in such a manner so that there is minimum damage to the surface. However likelihood of subsidence cannot be ruled out completely.

10.6.2 SUBSIDENCE MANAGEMENT

Considering the impact of subsidence on surface topography and surface features, as explained in earlier chapters, the following subsidence management steps are required to be undertaken to minimise adverse effects.

i. Due to subsidence, surface cracks are likely to occur over the mining area which need to be filled up properly and regularly by clay and stone chips and thereafter with a 0.3m high clay heap over the cracks. It will help in achieving original drainage pattern over the mining area, improve water retention capacity of the soil and avoid the chances of underground inundation and spontaneous heating.

ii. Subsidence may result into depression on the surface with accumulation of water during the rains. These water bodies need to be filled up or drained out by cutting drains.

iii. Surface drains should be made outside of the subsidence area to prevent the surface water of adjoining area to coming into active subsidence area.

iv. It is suggested that the mine management should form a team that will be responsible for the proper and regular filling of surface cracks formed due to subsidence. The team will also maintain record of the development and filling of surface cracks. Adequate supply of filling materials should be arranged by mine management at the site.

10.7 IMPLEMENTATION OF ENVIRONMENT MANAGEMENT

The success of environmental management in an organization not only depends on deep involvement of its personnel at all levels but also on the creation of an effective implementing organizational structure. The objectives are:

- To implement environmental control and protection measures.
- Subsequent environmental monitoring of the efficacy of various control measures.
- Plantation/green belt development.
- Land restoration.

Keeping this in view, organizational structure responsible for the implementation of environmental control and mitigation measures as well as monitoring of such implementation has been discussed in this chapter.

10.7.1 IMPLEMENTING ORGANISATION

Gujarat State Electricity Corporation Limited (GSECL) will set-up an Environmental Department headed by a senior level officer with independent charge at its HQs. The department provides necessary support that is required for Environmental Management of the project. The responsibility for implementing environmental management plan would rest with the project officer of the project, who would be properly assisted by team of qualified and trained personnel. Organisation for environmental management in GSECL will carry out the task and responsibility connected therewith.

Generation of environmental data bank.

- Evolving micro environmental management plan for the project in collaboration with other agencies and consultants.
- Monitoring project implementation along with environmental control measures.
- Co-ordinate with other project activities to ensure timely implementation of the project.

Co-ordination with Ministry of Environment & Forest, Central /State Pollution Control Board for prevention and control of pollution.

ORGANISATION CHART

For effective implementation and mid-term corrective measures (if required) monitoring and control of programme implementation is essential. For this purpose a time bound action programme for environmental management has been prepared.

The scope of environmental management includes plantation, surface drainage, industrial waste water treatment plant, air, water and noise pollution check etc.

For the purpose of land reclamation and afforestation, the project shall interact with different Government departments like Department of agriculture, Forest department etc. Guidelines and advice from Ministry of Environment and Forest also result in systematic approach towards environmental management and control.

10.7.2 MONITORING & CONTROL

For air, water and noise pollution control measures, samples will be collected and tested for all four seasons at strategic places representing all the categories of areas as indicated by CPCB. The implementation authority should be guided and advised as per the feed back data from these tests.

10.7.3 MONITORING SCHEDULE

For air, water and noise, monitoring as suggested below is proposed. Following number of stations have been proposed to be fixed for monitoring of environment for the proposed project.

Ambient Air	:	4 Stations (Minimum) (Quarterly)
Water	:	6 Stations (Minimum)

Out of the six stations minimum 2 effluent points shall be taken. 4 parameters of which shall be monitored on quarterly basis and rest parameters on yearly basis. Minimum 2 drinking water sampling points should be taken into consideration monitoring of which shall be done on quarterly basis. Minimum 2 surface water sampling points should be taken into consideration monitoring of which shall be done on quarterly basis.

Noise	:	4 Stations (Minimum) (Quarterly)

10.7.4 PLANTATION MONITORING

The project authority at field level will continuously monitor the growth and survival/mortality rates of the plantation till the end of 3 years. Once trees attain desired growth, no further monitoring will be required but the safety of the trees should be ensured by the project management.

10.7.5 ACTION PLAN FOR LAND RECLAMATION AND PLANTATION

The action plan delineates the quantum of overburden to be excavated, backfilled, the plantation schedules etc. Interaction with different Government Departments like Department of Agriculture, State forest department, Forest Research Institute would give additional technical guidelines. Guidelines from State and Central Ministry of Environment and Forest will be obtained for effective implementation of EMP.

10.7.6 HEALTH MONITORING

A regular schedule will be programmed for monitoring health of the workers and staff associated with the mining operations and other connected industrial activities for identifying occupational diseases etc. in time and initiating remedial measures. Mobile ambulance will also be used for such programmes to monitor the health of the population around the area.

CHAPTER-11

PROGRESSIVE AND FINAL MINE CLOSURE PLAN

11.1 INTRODUCTION

A. Name of the mine owner/ company

GUJARAT STATE ELECTRICITY CORPORATION LIMITED (GSECL)

B. Address for communication

Registered office

Vidyut Bhavan, Race Course, Vadodara,

Gujrat, India-390007

Address for communication

Office of Chief Engineer (fuel)

Vidyut Bhavan, Race Course, Vadodara,

Gujrat, India-390007

C. Location of the mine

C.1 Location

Location has been provided at Chapter- 3, Para – 3.1.

C.2 Details of the area/physiography

Detail of the Area has been provided at Chapter- 3, Para – 3.5.

C.3 Accessibility/communication

Accessibility has been provided at Chapter- 3, Para -3.2.

D. Extent of lease area

This has been described at para 5.2.1. of chapter 5

E. Type of lease area

Proposed land for the project is 3598.81 Ha, which comprises 3583.81 Ha of leasehold area and 15.00 Ha of land outside leasehold area. The lease area consists of protected forest land, land with Chote Bade Jhar Ka Jungle, Govt. land and tenancy land.

E.1 Present land use pattern

Present land use pattern has been provided in para 9.2 of chapter 9.

F. Method of Mining

F.1 Mining method

Mining Method has been provided at Chapter- 5, Para – 5.1.4.

F.2 Capacity of the mine

Gare Palma Sector-1 project is a proposed mixed mine to produce 15.00 MTY from OC mine and 6.00 MTY from UG mine. First two years are the construction years for opencast. Production of coal from OC will start from 2nd (P2) year and it will achieve the targeted production in the 6th year of mine life of 32 years. From 13th year construction work for UG will start. Production from UG will start in the 15th year and UG mine will achieve its targeted production from 22nd year.

G. Coal processing operations

Washing of coal is proposed at the pithead. A washery will be set up in the coal bearing area in the east side of the Kelo River within the block. Details of the washery is provided in Chapter-7

11.1.1 REASONS FOR CLOSURE

The OC mine will be closed due to the exhaustion of coal reserve i.e. after 34 (including 2 yrs. of construction period) years from start for OC mine. The mine may also be closed due to following reasons:

(i) Lack of demand of the coal

(ii) Uneconomic operations

(iii) Natural Calamity

(iv) Directives from statutory organisation or court.

11.1.2 STATUTORY OBLIGATIONS

There is need to define the liabilities, responsibilities and authorities of the different agencies like the mine management, other regulatory bodies, Central and State Governments after mine closure. Some obligations pertaining to the Mine Management Companies are as follows:

1 Health & safety – Regulations of Coal Mines Regulations, 1957 and its related DGMS Circulars.
2 Water (Prevention and Control of Pollution) Act, 1974.
3 Air (Prevention and Control of pollution) Act, 1981.
4 Environment (Protection) Act, 1986 and Environment protection Rule.
5 DGMS Directives on noise and ground vibration.
6 Forest – Forest (Conservation) Act, 1980.
7 Rehabilitation.
8 Decommissioning/ asset disposal, etc.
9 The statutory obligations as above and those specified by MoC or MOEF for mine closure will be adhered to.

11.1.3 CLOSURE PLAN PREPARATION

Mine Closure Plan has been prepared in accordance with the Guidelines issued by Ministry of Coal, New Delhi vide letter no. 550011-01-2009-CPAM dated 07.01.2013.

11.2 MINE DESCRIPTION

11.2.1 GEOLOGY

Geology has been described at chapter 4, para – 4.2

11.2.1.1. Topography

Topography has been described at para 3.5.

11.2.1.2. General Geology

General Geology has been described in Chapter-4.

11.2.2 RESERVES

Reserves has been described at para 4.4.2 (Geological Reserves), para 7.2.3. (Minable reserves) and para 5.2.6.

11.2.3 MINING METHOD

Mining Method has been provided at Chapter- 5, Para – 5.1.4.

11.3 CLOSURE PLAN

11.3.1 MINED OUT LAND

The break-up of land proposed for leasehold for the project is tabulated as below:

Sl. No.	Particulars	Total land required in Ha
1	Quarry Excavation	1620.31
2	External OB dump	1447.50
3	Infrastructure (Opencast and Underground)	
	Opencast	113.65
	Underground	34.29
4	Siding and Conveyor belt from Washery	71.74
5	Colony (Opencast and Washery)	48.68
6	Other (Road diversion, nala diversion, embankment, Open space etc.)	212.19
7	UG below protected Forest	35.46
	Total	**3583.81**

Outside the proposed leasehold there will be requirement of additional land for UG colony as follows:

Sl. No.	Particulars	Total land required in Ha
1	UG Colony	15.00
	Total	**15.00**

Therefore, OC project mine closure will be effective on **3514.06** Ha of land only. Similarly, UG mine closure will be effective on **84.75** Ha of land only.

The schedule of reclamation along with plantation have been provided in paras 10.5.2 and 10.5.3 of chapter-10. The reclamation programme of the project has been shown in the stage plans and the reclamation plan enclosed with the Mining Plan.

11.3.2 WATER QUALITY MANAGEMENT

Following are the sources of water pollution due to various mining activities:

a. Discharge of mine water;

b. Discharge of liquid effluents in the form of oil, grease, etc. mixed with water;
c. Suspended materials, solid as well as liquid and dissolved materials mixed with surface run off;
d. Contaminated stream water;
e. Domestic sewage from residential colony and service buildings etc.

The impact of mining at this project on both surface water source and ground water resource has been assessed as follows:

A. Surface water sources:
    - Disruption of natural drainage pattern in the core zone,
    - Deterioration of water quality & pollution of water bodies,
    - Siltation and choking of water courses causing scarcity of surface water, etc.

B. Ground water resources:
    - Affected due to mine workings.
    - Affected due to mine water. Consequently, the water table of the peripheral villages/ basties may get lowered.
    - Disruption in ground water aquifers.

11.3.2.1. Water pollution control measures

For complying with the statutory provisions of MoEF and Pollution Control Board, water quality will be monitored and evaluated. Corrective measures will be taken on the basis of monitoring results. As the mining operations advance there may be changes in the water quality due to mine water discharge, workshop effluent discharge, domestic sewerage, etc. The following measures are suggested to control the water pollution:

a. Sufficient safeguards during the planning stage to make the project eco-friendly from water pollution control point of view;
b. Recycling of waste water to the extent possible after appropriate treatment to achieve “Zero Discharge”;

c. Conforming to the limits of the Environment (Protection) Amendment Rules, 2000 ("Schedule-VI: General Standards for discharge of environmental pollutants, Part-A") for the quality of the treated effluents;
d. Sanitary waste water will be treated mainly for total suspended solids (TSS) and bio-chemical oxygen demand (BOD). Domestic effluents will be treated in septic tanks and soak pits.
e. Drains will be provided around coal stacks to collect run-off water and diverting it into settling ponds before discharging it into natural water courses.
f. Sufficient standby capacity will be provided in the main/ intermediate sumps, so that the suspended solids generated due to mine workings settle down and comparatively cleaner water is discharged to the surface drainage system.

Water pollution control measures have been provided in para 10.3.3 of chapter-10

11.3.3 AIR QUALITY MANAGEMENT

There is no natural source of air pollution in the area. However, manmade sources due to underground and opencast mining activities will be present in the form of industrial, vehicular, domestic and other sources in the area. The air pollutants from these sources will be mainly particulates and some quantum of gaseous emission.

Following are the sources of air pollution generation due to various mining activities:

a. Transportation of coal by trucks;
b. Coal transportation by conveyors, particularly at loading & unloading points;
c. Handling of coal through bunkers;
d. Solid waste disposal;
e. Roads – both paved and unpaved type;
f. Wind erosion from coal stockpiles etc.

11.3.3.1. Air quality

Air quality data has not been generated. Air quality data shall be incorporated after the same is generated.

11.3.3.2. Air pollution control measures

Appropriate air pollution control measures will be taken to contain the air pollution for maintaining the ambient air quality within the stipulated standards besides making the mining operation eco-friendly in the project. These measures (both preventive and suppressive) are enumerated below:

A. Coal loading and transportation:

The following control measures will be taken to prevent air pollution due to loading and transportation of coal:

a) Surfacing of all service roads/ permanent roads with asphalt;
b) Reduction of the length of coal transportation road to the minimum possible. Construction of permanent coal transportation road and maintenance of the same.
c) Un-metalled roads to be kept free of ruts and potholes;
d) Regular maintenance of pay-loaders, trucks and other vehicles to limit emission of harmful exhaust fumes;
e) Proper maintenance of tire quality of all tire-mounted vehicles to minimize formation air-borne dust;
f) Frequent water spraying on coal transportation roads.
g) Provision of fine nozzle mounted fixed sprinklers at coal dumps/ stockpiles;
h) Physical removal of dust from the roads;
i) Greenbelts around industrial sites, service building areas and residential colonies besides avenue plantations along roads;
j) Proper loading of coal on trucks to prevent spillage during transportation, etc.

B. Coal handling plant (CHP):

The following control measures will be taken to prevent air pollution at CHP:

a) Suppression of coal dust at CHP by provision of fine nozzle mounted fixed sprinklers;
b) Provision of duct extraction system;

c) Minimization of the height of coal fall at transfer points to reduce dust generation and if necessary, provision of duct suppression measures;
d) Improved maintenance of plant and machinery;
e) Provision for proper enclosure of CHP, etc.

C. Fire at coal dumps/stockpiles:

Normally there will not be any sizeable coal stock in the mine premises as the total mined coal will be transported to Pit-head Washery for its beneficiation and onward use. Even then, in order to reduce any chance for spontaneous heating and consequent fires, coal stocks will be limited by giving close attention to their off-take besides following the "First-in and First-out" sequence. Attention to the following will be paid while stacking of coal in stockpiles:

Proper dimensions of stack (height to be limited to not more than 8 m);

a) Dozing / compaction to make the stock semi-consolidated;
b) Regular and strict supervision of stacks;
c) Provision of firefighting arrangements with supply of adequate quantity of water at sufficient pressure;

All the measures indicated above will continue to be maintained so that the adverse impacts on ambient air become insignificant.

11.3.4 WASTE MANAGEMENT

11.3.4.1. Waste management in opencast

Year wise overburden generation and their dumping on external dumps and their internal filling has been provided at Chapter-5, para 5.2.4.3.

11.3.4.2. 11.3.4.2 Waste management in underground

Some solid wastes are likely to be generated due to drivages in stone and coal interbands and parting. Arrangements will be made to collect the materials, transport and dump them in low lying areas and crevices. Some solid wastes can also be used for construction of roads which will improve communication.

11.3.4.3. Top Soil Management

Year wise top soil removal from the area where external dumping will be done and from the excavation area is given below:

Values In Mcum

YEAR	EXT DMP		QUARRY		TOTAL
	Cummu	Annual	Cummu	Annual	
P1	0.31	0.31	0.26	0.26	0.57
P2		0.44		0.34	0.78
P3	1.19	0.44	0.93	0.34	0.78
P4		0.37		0.36	0.72
P5	1.92	0.37	1.65	0.36	0.72
P6		0.33		0.21	0.54
P7		0.33		0.21	0.54
P8		0.33		0.21	0.54
P9		0.33		0.21	0.54
P10	3.57	0.33	2.68	0.21	0.54
P11		0.13		0.14	0.27
P12		0.13		0.14	0.27
P13		0.13		0.14	0.27
P14		0.13		0.14	0.27
P15		0.13		0.14	0.27
P16		0.13		0.14	0.27
P17				0.14	0.14
P18				0.14	0.14
P19				0.14	0.14
P20	4.36		4.09	0.14	0.14
P21				0.06	0.06
P22				0.06	0.06
P23				0.06	0.06
P24				0.06	0.06
P25				0.06	0.06
P26				0.06	0.06
P27				0.06	0.06
P28				0.06	0.06
P29				0.06	0.06
P30				0.06	0.06
P31				0.06	0.06
P32	4.36		4.86	0.06	0.06
		4.36		**4.86**	**9.23**

During the first 3 years top soil both from quarry area and external dump area will be stacked in a designated place as shown in the plans. In 4th year the Dump area stacked soil will be spreaded above the external dump area, and batters where there is no more

dumping operation. 4th year onwards the top soil removed will directly be spreaded on the advancing external dump surface and batters. Therefore, no stacking of top soil is proposed for external dump beyond 4th year.

Space for technical and biological reclamation in the backfilled area will be available from 10th year onwards. Till then the top soil removed will be stacked and properly preserved in designated places as shown in the plan. Beyond 10th year top soil removed will be regularly spreaded on the backfilled surface.

11.3.4.4. Coal Beneficiation and Management of Coal Rejects

A washery will be established at pit-head. The details of the washery has been furnished at Chapter-7.

i. The process of the proposed washery is based on closed water circuit system.
ii. All the water fed into the system will be collected after use and re-circulated again into the circuit and no effluent will be allowed to escape into the natural drainage system i.e. the washery will be with zero effluent discharge.
iii. Provision of rain water harvesting of roof top water should be envisaged by recharging the same to ground and/ or by collecting the same into the constructed/ developed water bodies (settling pond) for use in the washery after settling.
iv. Emergency slime ponds have to be provided for settling and natural drying of slimes in case of emergency draining of the thickener. The slimes will be evacuated occasionally and depending upon quality will be either mixed with washed coal or rejects. Overflow water from the slime ponds will be reused in the washery.
v. It has been envisaged that rejects will be stored in stack tube and will be conveyed by belt conveyor to Silo at Railway siding for loading into wagons for onward dispatch to consumers. In case, reject is required to be stored, an area of 10 Ha per million tonnes of rejects generated will be required and the rejects will have to be stored in an environmentally friendly manner till disposal/utilization.

After the opencast mining operation ceases the wahery will be used for washing of coal from the underground operation. The dismantling of the washery is likely after 80 years and will be done in a proper manner. The area will be reclaimed physically and biologically.

11.3.5 INFRASTRUCTURE

11.3.5.1. Details of Surface Structures proposed to be dismantled

As far as possible, industrial structures will be will be dismantled and salvaged. The equipment will be removed and used somewhere else. Every effort will be made to restore the area to economic utilization value in line with mine closure plan. The washery of the project will continue as long as there will be underground mining. The area will be reclaimed thereafter.

A.) Service Buildings

The service buildings for OC viz. workshop, stores, office buildings etc. except the washery will be dismantled after the OC operation is discontinued. Every effort will be made to restore the area to economic utilization value in line with mine closure plan. Part of the office building may be retained to cater to the underground mining.

B.) Colony

The colony proposed within the lease area will be dismantled after discontinuation of opencast operation. Colony for the underground and washery manpower is proposed outside the leasehold area.

C.) Other Infrastructures

All other infrastructures like sub-stations, transformers, community services, pump-houses, water-treatment/ filtration plants, waterlines, power lines, roads etc. may be utilized by the community around the project.

However, possibility shall be explored for handing over the buildings and other infrastructures including the reclaimed land to the State Government for the benefit of

local villagers and strengthening the area infrastructures. The end use of these facilities shall be decided by the State Government with the help of District Authorities and Village Panchayat. The peripheral village community facilities developed by the Mine Authorities will be left to the Local Body/ State Government for their management and public use.

Prior to surface demolition/ restoration, a surface audit will be undertaken on all surface structures, spoil heaps etc. to assess whether there is any hazardous material that could cause problem, i.e. explosive, asbestos, chemical, oil, etc.

11.3.6 DISPOSAL OF MINING MACHINERY

All the machineries which will have residual life will be shifted to the other collieries of the company i.e. Gujarat State Electricity Corporation Limited (GSECL).

A list of surface assets (Plant & Machinery) will be prepared and made available to potential purchasers or transferred to other new/ working mines of the company. This will ensure that the assets perform during their economic life.

11.3.7 SAFETY AND SECURITY

11.3.7.1. Closure of mine entries

After closure of the mining activities, all the entries to the mine will be effectively sealed off to avoid any accident and to prevent access to any unauthorized person. The area that is not reclaimed shall be properly fenced/ sealed to prevent any unauthorized entry into the area. However, the guidelines / instructions from DGMS, if any, will be followed.

11.3.7.2. Providing one time lighting arrangement

Sufficient lighting as per standard will be provided at all the required places, i.e. workshop, sub-station, project office etc.

After closure of the mine, the lighting arrangements will be kept maintained at all locations which are not required to be demolished or dismantled.

11.3.8 ECONOMIC REPERCUSSIONS OF CLOSURE OF MINE

11.3.8.1. Manpower of the mine

The manpower has been furnished at Chapter-6.

Apart from the above mentioned direct employment potential, the proposed mining project will generate secondary and tertiary employment for the local people.

11.3.8.2. Manpower for mine closure

It has been proposed to monitor and implement the mine closure activities departmentally. Departmental manpower will be needed for closure of the mine and for monitoring and implementation of the mine closure activities. Manpower required for the same is given below:

Sl. No.	Manpower	Number
1	Mine Manager	1
2	Colliery Engineer	1
3	Colliery Civil Engineer	1
4	Supervisory staff to assist the above	4
5	E&M Personnel for lighting pumps etc.	2
6	Security Personnel	4

11.3.8.3. Assessment of Income Scenario of local people

The company employees will be gainfully engaged in the neighboring projects after cessation of mining activities. It is proposed that afforested land will be handed over to State Govt. for the benefit of local ecosystem. The forest wealth can also be utilized by local people or tribal in the form of fruits and fodders. Landscaping during closure of mine will make the spot for tourist attraction.

11.4 TIME SCHEDULING FOR ABANDONMENT

Gare Palma Sector-1 is a mixed mine which consists of both underground and opencast mine. The life of the OC project is 34 years (C2+P32) from start and the life of the underground mine is 20 years in this mining plan, starting from the 13th (P13) year. The time schedule envisaged for completion of all closure activities is presented in Table below in the form of bar chart.

11.4.1 IMPLEMENTATION SCHEDULE FOR MINE CLOSURE IN GARE PALMA OC (LIFE OF THE OC MINE: 34 YEARS)

IMPLEMENTING SCHEDULE FOR MINE CLOSURE

Sl. N	Activity	Time Frame	1st Phase					2nd Phase					Phase 3 to Phase 6 will be like phase 1 and 2 each of five years.					7th Phase					Post Closure Phase		
			1	2	3	4	5	6	7	8	9	10						31	32	33	34		PC1	PC2	PC3
A	**Dismantling of Structures**																								
	Service Buildings	2 years																							
	Residential Buildings	2 & ½ years																							
	Industrial structures like CHP, Workshop, field sub-station, etc.	2 & ½ years																							
B	**Permanent Fencing of mine void and other dangerous area**																								
	Random rubble masonry of height 1.2 m including levelling up in cement concrete 1:6:12 in mud mortar	2 years																							
C	**Grading of high wall slopes**																								
	Levelling &grading of high wall slopes	2 years																							
D	**OB Dump Reclamation**																								
	Handling/Dozing of OB Dump and backfilling	Throughout life of mine including 3 yrs. after cessation of mining operation																							
	Technical and Bio-reclamation including plantation and post care	Throughout life of mine including 3 yrs. after cessation of mining operation																							

E	**Landscaping**																							
	Landscaping of the open space in the leasehold area for improving its aesthetics and eco value	Throughout life of mine including 3 yrs. after cessation of mining operation																						
F	**Plantation**																							
	Plantation over cleared area obtained after dismantling	2 years																						
	Plantation around the quarry area and in safety zone	Throughout life of mine including 3 yrs. after cessation of mining operation																						
	Plantation over external OB Dump	After 3 years from start of external dumping																						
G	**Post Closure Env Monitoring / testing of parameters for 3 years**																							
	Air Quality	3 years																						
	Water Quality	3 years																						
H	**Entrepreneurship Development (Vocational/skill development training for sustainable income of affected people**	Throughout the life of the mine																						
I	**Miscellaneous and other mitigative measures**	Throughout life of mine including 3 yrs. after cessation of mining operation																						
J	**Post Closure Manpower cost for supervision**	3 years																						

11.4.2 IMPLEMENTATION SCHEDULE FOR MINE CLOSURE IN GARE PALMA UG MINE (LIFE OF THE UG MINE: 20 YEARS)

IMPLEMENTING SCHEDULE FOR MINE CLOSURE

Sl.No	Activity	Time Frame	1st Phase					2nd Phase					3rd Phase					4th Phase						Post Closure Phase		
			1*	2	3	4	5	6	7	8	9	10	11 12	13	14	15		16	17	18	19	20	PC1	PC2	PC3
A	**Dismantling of Structures**																								
	Service Buildings	2 years																							
	Residential Buildings	2 & ½ years																							
	Industrial structures like CHP, Workshop, field sub-station, etc.	2 & ½ years																							
B	**Permanent sealing of mine entries (incline mouth and air shaft)**																								
	Sealing of incline mouths and air shafts	2 years																							

Sl.No	Activity	Time Frame	1st Phase					2nd Phase					3rd Phase					4th Phase						Post Closure Phase		
			1*	2	3	4	5	6	7	8	9	10	11 12	13	14	15		16	17	18	19	20	PC1	PC2	PC3
C	**Subsidence Management**	Throughout the life of the mine, if required including 3 years after cessation of mining operation																							
D	**Landscaping**																								
	Landscaping of the cleared land for improving its aesthetic	Throughout the life of the mine including 3 years after cessation of mining operation																							
E	**Plantation**																								
	Plantation over leasehold area and on other open spaces	Throughout the life of the mine including 3 years after cessation of mining operation																							
F	**Post Closure Env Monitoring / testing of parameters for three years**																								
	Air Quality	3 years																							
	Water Quality	3 years																							

Sl.No	Activity	Time Frame	1st Phase					2nd Phase					3rd Phase					4th Phase						Post Closure Phase		
			1*	2	3	4	5	6	7	8	9	10	11	12	13	14	15		16	17	18	19	20	PC1	PC2	PC3
G	**Entrepreneurship Development (Vocational/skill development training for sustainable income of affected people**	Throughout the life of the mine																								
H	**Miscellaneous and other mitigative measures**	Throughout the life of the mine including 3 years after cessation of mining operation																								
I	**Post Closure Manpower cost for supervision**	3 years after mine closure																								

PC1: Post Closure Year 1

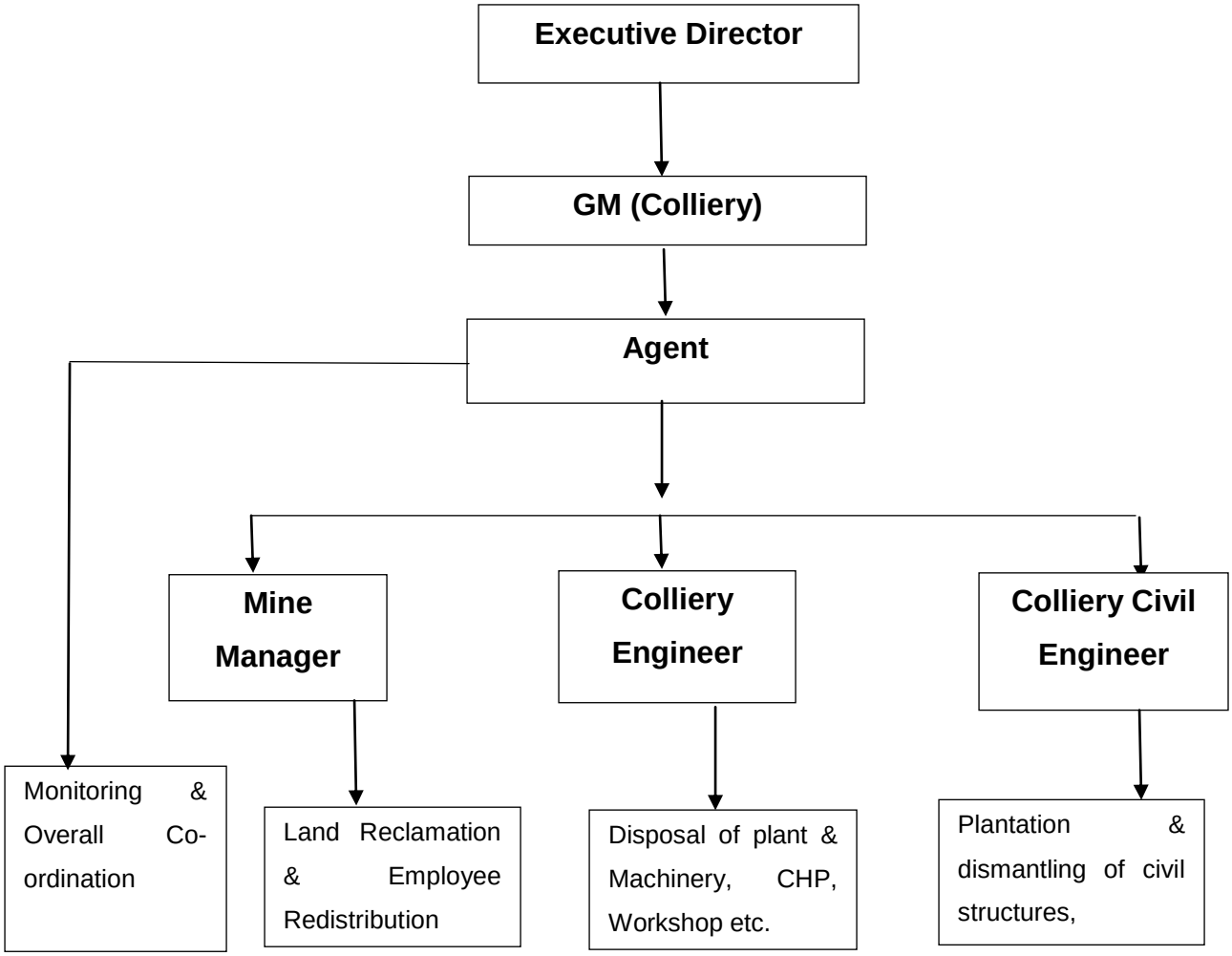
PC2: Post Closure Year 2

PC3: Post Closure Year 3

*Year 1 for UG Mine is the 15th (P13) year of the project.

11.4.3 ORGANISATIONAL STRUCTURE

For implementing the mine closure activities, the following organisational structure has been proposed:



Environmental monitoring for three years after closure of mine will be carried out to evaluate the environmental quality of the area. If need be, proper mitigation measures will be taken up after evaluating the environmental quality. The funds for this have been provided in the cost estimate. Before closure of the mine, Area GM will get prepared survey and disposal report and the same will be submitted to DGMS for acceptance.

11.5 ABANDONMENT COST

11.5.1 MINE CLOSURE COST FOR THE OPENCAST MINE

As per the guidelines of the MoC, the cost of the mine closure is to be computed based on the total project area involved in the project. The updated cost of the mine closure as on November 2016 is estimated to be ₹. 8.4769 lakh per hectare (considering the admissible escalation over ₹. 6.00 lakh per Ha as on August 2009).

* The amount has been escalated based on WPI of November 2016 (183.1) vis-à-vis WPI of August, 2009 (129.6) i.e. escalation by 1.4128

Project area considered for OC	:	3514.06 Ha
Mine closure cost per Ha	:	₹. 8.4769 lakh
Total mine closure cost (as on November 2016)	:	₹. 29788.34 Lakhs
Life of the OC mine	:	34 years (C2+P32)
Annual mine closure amount to be deposited	:	₹. 876.13 Lakhs (for the First year.)

Sl. No	Particulars	Values
1	WPI as on August '09	129.60
2	WPI as on November 2016	183.1
3	Escalation rate of closure cost (₹. Lakh per Ha)	8.4769
4	Rate of compounding of Annual closure Cost	5.00%
5	Amount to be deposited into Escrow Account after compounding @ of 5% "₹. in Crs"	745.30
6	Closure Cost "₹. Crs/Ha"	0.084769
7	Lease Area/Total Project Area in Ha for OC	3500.84
8	Amount to be deposited into Escrow Account "₹. in Crs"	745.30
9	Amount already deposited into Escrow Account "₹. in Crs"	NIL
10	Net Amount to be deposited into Escrow "₹. in Crs"	745.30
11	Life of the project "in Yrs." for OC	34 years
12	Annual closure Cost (in ₹. Lakhs)	876.13 (for the 1st year)

The break-up of closure cost for some of the major activities is given in the Table below. The detailed activity schedule for the Final Mine Closure Plan will be prepared at least five years before the intended final closure of the mine along with the detailed mine closure cost break-up.

11.5.2 ACTIVITY WISE BREAKUP OF MINE CLOSURE COST

Major Activity-wise Break-up of Mine Closure Cost OC

S.N	ACTIVITY	Mine Closure Cost in Rs. lakh	Remarks
A	**Dismantling of Structures**		To be included in final mine closure plan
	Service Buildings	149.06	
	Residential Buildings	1989.94	
	Industrial structures like CHP, Workshop, field sub-station, etc.	223.59	
B	**Permanent fencing of mine void and other dangerous area**		To be included in final mine closure plan
	Random rubble masonry of height 1.2 meter including leveling up in cement concrete 1:6:12 in mud mortar	1117.94	
C	**Grading of high-wall slopes**		To be done throughout the life of the mine.
	Leveling and grading of high-wall slopes	1319.17	
D	**OB Dump Reclamation**		71% for progressive and 17.66% for final mine closure.
	Handling/Dozing of OB Dump and backfilling	66077.86	
	Technical and Bio-reclamation including plantation and post care.	298.11	Equal weightage throughout life of mine
E	**Landscaping**		Equal weightage throughout life of mine
	Landscaping of the open space in leasehold area for improving its esthetics an eco-value	223.59	
F	**Plantation**		
	Plantation over cleared area obtained after dismantling	372.65	To be included in final mine closure plan
	Plantation around the quarry area and in safety zone	149.06	Equal weightage throughout life of mine
	Plantation over the external OB Dump	14.90	Equal weightage throughout life of mine
G	**Post Closure Env. Monitoring/testing of parameters for three years**		For three years after mine closure
	Air Quality	163.97	
	Water Quality	149.06	
H	**Entrepreneurship Development (Vocational/skill development training for sustainable income of affected people**	193.79	Equal weightage throughout life of mine
I	**Miscellaneous and other mitigative measures**	1490.59	Equal weightage throughout life of mine
J	**Post Closure Manpower cost for supervision**	596.24	To be included in final mine closure plan
	TOTAL	**74529.50**	

11.5.3 MINE CLOSURE COST FOR THE UNDERGROUND MINE

As per the guidelines of the MoC, the cost of the mine closure is to be computed based on the total project area involved in the project. The updated cost of the mine closure as on November 2016 is estimated to be Rs. 1.4128 lakh per hectare (considering the admissible escalation over Rs.1.00 lakh per Ha as on August 2009).

* The amount has been escalated based on WPI of November 2016 (183.1) vis-à-vis WPI of August, 2009 (129.6) i.e. escalation by 1.4128

Project area considered for UG : 84.75 Ha
Mine closure cost per Ha : ₹. 1.4128 Lakhs
Total mine closure cost (as on November 2016) : ₹. 119.73 Lakhs

The break-up of closure cost for some of the major activities is given in the Table below. The detailed activity schedule for the Final Mine Closure Plan will be prepared at least five years before the intended final closure of the mine along with the detailed mine closure cost break-up.

Sl. No	Particulars	Values
1	WPI as on August '09	129.60
2	WPI as on November 2016	183.1
3	Escalation rate of closure cost (₹. Lakh per Ha)	1.4128
4	Rate of compounding of Annual closure Cost	5.00%
5	Amount to be deposited into Escrow Account after compounding @ of 5% "₹. in Crs"	3.92
6	Closure Cost "₹. Crs/Ha"	0.014128
7	Lease Area (Project Area for UG) Ha	97.97
8	Amount to be deposited into Escrow Account "₹. in Crs"	3.92
9	Amount already deposited into Escrow Account "₹. in Crs"	NIL
10	Net Amount to be deposited into Escrow "₹. in Crs"	3.92
11	Life of the project "in Yrs."	20 years
12	Annual closure Cost (in ₹. Lakhs)	11.85 (for the 1st year of UG i.e. 15th (P13) year of the project)

11.5.4 ACTIVITY WISE BREAKUP OF MINE CLOSURE COST

TABLE : MAJOR ACTIVITY-WISE BREAK-UP OF MINE CLOSURE COST UG

S.N	ACTIVITY	Mine Closure Cost in Rs. lakh	Remarks
A	**Dismantling of Structures**		To be included in final mine closure plan
	Service Buildings	13.72	
	Residential Buildings	41.47	
	Industrial structures like CHP, Workshop, field sub-station, etc.	24.81	
B	**Permanent sealing of mine entries (incline mouth and air shaft)**		To be included in final mine closure plan
	Sealing of incline mouths and air shafts	20.85	
C	**Subsidence Management**	18.62	To be done throughout the life of the mine, if required.
D	**Landscaping**		Equal weightage throughout the life of the mine.
	Landscaping of the cleared land for improving its esthetic	34.49	
E	**Plantation**		Equal weightage throughout the life of the mine.
	Plantation over leasehold area and on other open spaces	50.96	
F	**Post Closure Env Monitoring / testing of parameters for three years**		For three years after mine closure
	Air Quality	26.77	
	Water Quality	24.85	
G	**Entrepreneurship Development (Vocational/skill development training for sustainable income of affected people**	29.98	Equal weightage throughout the life of the mine.
H	**Miscellaneous and other mitigative measures**	57.23	Equal weightage throughout the life of the mine.
I	**Post Closure Manpower cost for supervision**	48.21	To be included in final mine closure plan
	TOTAL	**391.94**	

11.5.5 PHASING OF MINE CLOSURE COST FOR OC MINE

As per the guidelines of the MoC, the annual closure cost has been computed considering the total project area and dividing the same by the life of the mine i.e. 34 years. An amount equal to the annual cost is to be deposited each year throughout the mine life compounded at the rate of 5% annually. Yearly phasing of closure cost to be deposited is given in Table below:

- Project Area considered for OC mine: 3514.06 Ha
- Total mine closure cost (as on November 2016): ₹.74529.50 lakhs
- Life of the mine : 34 years
- Annual mine closure amount to be deposited: ₹.876.13 Lakhs (for the 1st year.)

Yearly Phasing of Mine Closure Cost for OC Mine

Year	Amount (₹ Lakh)	Year	Amount (₹ Lakh)	Year	Amount (₹ Lakh)
Y1	876.13	Y13	1573.40	Y25	2825.60
Y2	919.93	Y14	1652.07	Y26	2966.88
Y3	965.93	Y15	1734.67	Y27	3115.22
Y4	1014.23	Y16	1821.41	Y28	3270.98
Y5	1064.94	Y17	1912.48	Y29	3434.53
Y6	1118.19	Y18	2008.10	Y30	3606.26
Y7	1174.09	Y19	2108.51	Y31	3786.57
Y8	1232.80	Y20	2213.93	Y32	3975.90
Y9	1294.44	Y21	2324.63	Y33	4174.70
Y10	1359.16	Y22	2440.86	Y34	4383.43
Y11	1427.12	Y23	2562.90		
Y12	1498.48	Y24	2691.05		
TOTAL ESCROW FUND FOR OC					**74529.50**

11.5.6 PHASING OF MINE CLOSURE COST FOR UG MINE

As per the guidelines of the MoC, the annual closure cost has been computed considering the total project area and dividing the same by the life of the mine i.e. 20 years. An amount equal to the annual cost is to be deposited each year throughout the mine life compounded at the rate of 5% annually. Yearly phasing of closure cost to be deposited is given in Table below:

- Project Area considered for UG mine : 84.75 Ha
- Total mine closure cost (as on November 2016): ₹119.73 lakhs

- Life of the mine : 20 years

  [**Note:** *Mine life for underground mining has been considered as 20 years only for the purpose of mine closure cost estimation so as to coincide with the life of the opencast working in Part-A i.e., 34 years. It is proposed to revise the Mining Plan at that stage when the mine closure plan for future underground mining of balance reserves will be prepared and submitted*.]

- Annual mine closure amount to be deposited : ₹ 11.85 lakhs (for the First year for UG i.e. Y17 (P15) year of the project.)

Yearly Phasing of Mine Closure Cost for UG Mine

Year	Amount (In Lakh Rupees)
Y15	11.85
Y16	12.45
Y17	13.07
Y18	13.72
Y19	14.41
Y20	15.13
Y21	15.88
Y22	16.68
Y23	17.51
Y24	18.39
Y25	19.31
Y26	20.27
Y27	21.29
Y28	22.35
Y29	23.47
Y30	24.64
Y31	25.87
Y32	27.17
Y33	28.53
Y34	29.95
TOTAL	**391.94**

11.5.7 COMPOSITE PHASING OF MINE CLOSURE COST FOR OPENCAST & UNDERGROUND MINES

Year	Year-wise Phasing of Mine-Closure Cost (₹ Lakh)		
	FOR OPENCAST	FOR UNDERGROUND	TOTAL
Y1	876.13		876.13
Y2	919.93		919.93
Y3	965.93		965.93
Y4	1014.23		1014.23
Y5	1064.94		1064.94
Y6	1118.19		1118.19
Y7	1174.09		1174.09
Y8	1232.80		1232.80
Y9	1294.44		1294.44
Y10	1359.16		1359.16
Y11	1427.12		1427.12
Y12	1498.48		1498.48
Y13	1573.40		1573.40
Y14	1652.07		1652.07
Y15	1734.67	11.85	1746.52
Y16	1821.41	12.45	1833.86
Y17	1912.48	13.07	1925.55
Y18	2008.10	13.72	2021.82
Y19	2108.51	14.41	2122.92
Y20	2213.93	15.13	2229.06
Y21	2324.63	15.88	2340.51
Y22	2440.86	16.68	2457.54
Y23	2562.90	17.51	2580.41
Y24	2691.05	18.39	2709.44
Y25	2825.60	19.31	2844.91
Y26	2966.88	20.27	2987.15
Y27	3115.22	21.29	3136.51
Y28	3270.98	22.35	3293.33
Y29	3434.53	23.47	3458.00
Y30	3606.26	24.64	3630.90
Y31	3786.57	25.87	3812.44
Y32	3975.90	27.17	4003.07
Y33	4174.70	28.53	4203.23
Y34	4383.43	29.95	4413.38
TOTAL	**74529.50**	**391.94**	**74921.44**

11.6 FINANACIAL ASSURANCE

The Gujarat State Electricity Corporation Limited (GSECL) shall strictly adhere to the following:

1. For financial assurance the Gujarat State Electricity Corporation Limited (GSECL) shall open an Escrow Account with any scheduled bank, with the Coal Controller organization (on behalf of the central government) as exclusive beneficiary before the permission is given for opening the mine by Coal Controller. The Gujarat State Electricity Corporation Limited (GSECL) shall cause payment to be deposited in such Escrow Account at the rate computed as indicated above. The Gujarat State Electricity Corporation Limited (GSECL) may select the scheduled bank where the Escrow Account is to be opened and inform the same to Coal Controller, Kolkata. The Escrow Account has to be opened as per the aforesaid guidelines of the mine closure plan. The amount being deposited will be reviewed with such periodicity as deemed fit by the Coal Controller.

2. Mining is to be carried out in a phased manner initiating afforestation/ reclamation work in the mined out area of the first phase while commencing the mining in the second phase i.e. continuation of the mining activity from one phase to other indicating the sequence of operations depending on the geo-mining condition of the mine. Up to 80% of the total deposited amount including interest accrued in the Escrow Account may be released after every five year in the line with the periodic examination of the closure plan as per clause 3.1 of the Annexure of the guideline. The amount released should be equal to the expenditure incurred on the progressive mine closure in past five year or 80% whichever is less. The balance amount at the end of the final mine closure shall be released to mine owner/ leaseholder on compliance of all provision of closure plan duly signed by the lessee to the effect that said closure of the mine complies all statutory rules, regulations, order made by the central/ or state government, statutory organizations, courts etc. and duly certified by the coal controller.

3. An agreement, outlining detailed terms and condition of operating the Escrow Account, shall be executed among the Gujarat State Electricity Corporation Limited (GSECL), the Coal Controller and the concerned bank in order to give effect to this. The agreement shall be executed before the grant of the permission by the Coal Controller to open the mine.

11.7 RESPONSIBILITY OF THE MINE OWNER

It is the responsibility of the Gujarat State Electricity Corporation Limited (GSECL) to ensure that the protective measures contained in the mine closure plan including reclamation and rehabilitation work have been carried out in accordance with the approved mine closure plan and final mine closure plan.

The Gujarat State Electricity Corporation Limited (GSECL) shall submit to the coal controller a yearly report before 1st July of every year setting forth the extent of protective and rehabilitative work carried out as envisaged in the approved mine closure plan.

11.8 PROVISION FOR MINE CLOSURE

1. The Gujarat State Electricity Corporation Limited (GSECL) shall be required to obtained a mine closure certificate from coal controller to the effect that the protective, reclamation and rehabilitation work in accordance with the approved mine closure plan/ final mine closure plan have been carried out by the mine owner for surrendering the reclaimed land to the state government concerned.

2. The balance amount at the end of the final mine closure shall be released to the mine owner on compliance of all provision of closure plan duly signed by the mine owner to the effect that said closure of mine complied with all statutory rules, regulations, orders made by the central or state government, statutory organizations, court etc. and duly certified by the coal controller. This should also indicate the estimated extractable coal reserve and coal actually mined out.

3. If the coal controller has the reasonable ground for believing that the protective, reclamation and rehabilitation measures as envisaged in the approved mine closure plan in respect of which financial assurance was given has not been or will not be carried out in accordance with the mine closure plan , either fully or partially, the coal controller shall give the Gujarat State Electricity Corporation Limited (GSECL) a written notice of his intention to issue the order for forfeiting the sum assured at least thirty days prior to the date of the order to be issued after giving an opportunity to be heard.