PRE-FEASIBILITY REPORT FOR SIARMAL OCP (50.0 MTY)

1.0 INTRODUCTION

The Siarmal & Siarmal Extension and Banapatra blocks are located in north-western central part of Ib River coalfield of Odisha, known as Gopalpur sector. This coalfield is the southern middle part of lower Gondwana basin of Son Mahanadi Valley and occupies an area of about 1460 sq.km. with potential coal bearing area of around 1050 sq.km. The Ib River coalfield lies in between latitude 21°31' to 22°14' North and longitude 83°32'00" to 84°10'00" East and falls mainly in Sundergarh, Jharsuguda and Sambalpur districts of Odisha.

The proposed Siarmal OCP has been formulated within Siarmal & Siarmal Extension block and Banapatra (also known as Western Extension of Siarmal) block in the Gopalpur Sector of Ib-valley coalfield. Both are virgin blocks. The Mining plan is based on Geological Reports of Siarmal & Siarmal Extension Block and Banapatra Block and project report of siarmal ocp. The proposed mine area lies in the south of Basundhara West OCP (7.0 Mty) on the southern side of Basundhara river. Basundhara West OCP is an ongoing project. To its east lies the sanctioned Kulda OCP (10 Mty).

2.0 LOCATION & AREAL EXTENT, COMMUNICATION, DRAINAGE AND CLIMATE

2.1 LOCATION

The Siarmal & Siarmal Extension and Banapatra blocks are located in north-western central part of Ib River coalfield of Orissa, known as Gopalpur sector. This coalfield is the southern middle part of lower Gondwana basin of Sone-Mahanadi Valley and occupies an area of about 1460 sq.km. with potential coal bearing area of around 1050 sq.km. The Siarmal & Siarmal Extension and Banapatra, the two contiguous blocks lie towards north western part of Ib River coalfield in Orissa state to gether covers an area of 14.67 sq.km. The area of Siarmal and Siarmal Extension is 6.35 sq.km whereas of Banapatra block is 8.32 sq.km. The blocks are situated between the Latitude $22^0$01'19"-$22^0$03'59.99"N and Longitude $83^0$37'09" – $83^0$42'59.58" E in Survey of India topo-sheet no.-64N/12 on RF 1:50,000.

2.2 COMMUNICATION

District headquarter Sundergarh, on State Highway-10 (Sambalpur to Rourkela), is at a distance of about 46 km. from the blocks. The Sundergarh (Orissa) – Raigarh (Chattisgarh) all weather road passes through the blocks. The blocks are also connected by black top road with two important towns of Orissa namely Rourkela at 145 km and Jharsuguda at 75 km. The blocks come under Himgir Tahsil and Balinga police station in the district of Sundergarh, Orissa. The blocks are about 6 km. south west of Basundhara (West) OCP and are connected by part metallic road. Nearest rail head is Himgir on Mumbai-Howrah Broad Gauge of South Eastern Railway at a distance of about 35 km from the blocks. Jharsuguda railway station on Jharsuguda-Sambalpur-Bhubaneswar rail line of East Cost Railway is at distance of about 75 km. The nearest port at Bay of Bengal is Paradip and situated at a distance of about 600 km from the block. The Jharsuguda airport is the nearest airport from the block.

2.3 PHYSIOGRAPHY & DRAINAGE

The block under reference is represented by paddy fields, small hillocks and forests. Major part of the block is however, covered by paddy fields.

Basundhara river flowing west to east in the northern boundary of the block separates the blocks from Chaturdhara/Basundhara blocks and Chattanjhor nala flowing south to north in the eastern boundary of the block separates the block from Kulda block. One of the tributaries Barjhor nala flows from south to north towards the middle of the block and many other small nala cris cross within the block. Besides these, there are some small ponds and dug wells available within the block and used for irrigation and drinking purposes.

The general topography of the block is undulating and is used for agricultural purpose and some patches of barren lands are also featuring in the block. The general altitude of the block is varying from 260 metres to 311 metres. The lowest elevation is about 260 metres near borehole CMHG-45 along the Basundhara river within Siarmal and Siarmal Extn. block and highest elevation is about 311 metre and is located near the south-western corner near boreholes

CMBB-240, 233 & 060 on either side of Sundergarh-Raigarh state road within Banapatra block.

2.4 CLIMATE

The area experiences a sub-tropical warm temperature. About 70% of rainfall occurs during rainy season i.e. June to Sept. As per IMD data of Jharuguda 2016 the highest 24 hourly rainfall occurs in the month of August 63.20 mm. The temperature varies from 7.4^{o}C to 45.3^{o}C for the year 2016. The predominant wind direction is SW to NE.

3.0 MARKETING AND JUSTIFICATION

The consumers of MCL are linked to the company and not to any specific coalfield. The actual supply from any coalfield of MCL will depend upon the production and transport logistics. Under the above circumstances coalfield wise demand has been assessed based on the production share of these two coal field which is as below:

Projected coal demand on MCL from Ib-valley coalfield.

(Fig. in Mt)

Sl. No	Particulars	2021-22	2026-27
1	Total Demand on MCL	244.83	274.134
2	Projected coal demand on Ib-valley coalfield	97.93	120.56
3	Coal Availability	73.82	85.32
	Gap	**(-)24.11**	**(-)35.24**

As per the above estimate, there is gap between demand and availability of MCL by from Ib-valley coalfield alone. Further new coal linkages have been given to MCL for which MCL has already issued LOA. The proposed project will meet the coal demand from the coalfield, especially to the new consumers and reduce the gap between demand and availability.

The coal seams in both the blocks under consideration for the project (Siarmal & Siarmal Extn. and Banapatra) are thick and occur at shallow depth. The entire net geological coal reserves of 1866.83 Mt has high quarriable potentiality.

Considering the coal demand on MCL and quarriable potential of the blocks, formulation of the present opencast mine for rated capacity of 50.0 Mty is justified.

4.0 GEOLOGY

4.1 BLOCK BOUNDARY

The details of the boundary of the Siarmal and Siarmal Extension block are given below:

North : Northern boundary of the block is marked by east west trending Basundhara river.

South : Southern boundary is marked with arbitrary boundary of Barren Measures formation.

East : Eastern boundary is limited by Kulda block along Basundhara river, then followed by Chattanjhor nala.

West : Western boundary of the block is limited by Eastern boundary of Western Extension of Siarmal (Banapatra) block.

The limits of Banapatra block are as given below:

East : Western boundary of Siarmal & Siarmal Extn. block.

West : Eastern boundary of Rampia and Dip side of Rampia block.

North : Southern boundary of Chaturdhara & Basundhara West blocks

South : Northern boundary of Prajapara block

4.2 STATUS OF EXPLORATION

The blocks under consideration (Siarmal & Siarmal Extn. and Banapatra) have been explored in detail and geological reports are available for both the blocks, in Siarmal & Siarmal Extn. and Banapatra blocks combined, a total of 503 borehoes (by CMPDI & GSI) have been drilled covering an area of 14.67 sq.km with a borehole density of 34 BH/sq.km.

4.3 GEOLOGICAL STRUCTURE

Mostly soil, alluvium or weathered mantle cover the area under investigation. As such, the geological features of the block are interpreted mainly on sub-surface data. Though Talchir and Karharbari Formations have been encountered in boreholes drilled in nearby blocks, but they do not incrop or outcrop within the block. However, Barakar Formation outcrops at places in nala tract/cutting.

Since these two blocks from the structural continuity along with the adjoining blocks, the correlation, seam nomenclature, structural trend etc., have been maintained from the adjacent blocks i.e. Basundhara, Garjanbahal, Kulda, Basundhara East and West blocks.

The faults extending from the above adjoining blocks have been considered while making structural interpretation of the blocks. The nomenclatures of some of the faults have been given afresh following certain pattern. The nomenclatures of these faults are based on either encountering boreholes or level difference in floor of the seams.

DIP AND STRIKE

The strike of the strata has shown northwest – southeast trend with minor variation towards northern part. The strata dips 3° – 4° towards southwest. The same has increased to about 10° in the northern part with dip direction remaining towards south to southwest.

FAULTS

In total 28 number of faults with throw varying from 0 to 120 m have been deciphered in Siarmal & Siarmal Extn. and Banapatra blocks combined. Out of seven faults interpreted in Siarmal & Siarmal Extn. block, six faults extends to Banapatra block and hence common in both the blocks.

In Siarmal and Siarmal Extn. block, seven numbers of faults viz. F1-F1 to F7-F7 with varying amounts of throw and direction have been interpreted in the area under consideration. Eighteen boreholes have directly intersected the faults. The fault F1-F1 is continuing from adjacent Basundhara block with a throw of about 20 m. Most of the faults trend east to west.

In Banapatra block, twenty seven no. of faults with throw varying from 0 to 120 m have been interpreted mostly in the northern part of the block based on either direct evidence in boreholes or through level difference of seam floors.

4.4 COAL SEAMS

In Siarmal & Siarmal Extension and Banapatra block total 16 nos. of corelatable coal horizons/seams have been identified. In the Karharbari Formation Ib seam occurs in three splits. Barakar Formation contains seams Rampur and Lajkura in number of splits. Altogether, 13 nos. of seams / split seams are reported in Barakar Formation in this block. Among these, seam Rampur-I, II, III, IV, Lajkura-I, IIB, IIT1 and Lajkura-IV are the most potential thick coal horizons in this block. The sequence of coal seams within proposed mining area is given in Table below:

Table 1 : Sequence Of Coal Seams Of Siarmal & Banapatra Blocks

Seam	Thickness (in m.)	
	average	range
SEAM-LAJKURA-IV	12.92	1-17
PARTING	12.14	3-30
SEAM-LAJKURA-III	4.08	1-6
PARTING	2.19	1-7
SEAM-LAJKURA-II T3	1.51	1-3
PARTING	2.29	1-7
SEAM-LAJKURA-II T2	1.63	1-3
PARTING	2.04	1-8
SEAM-LAJKURA-II T1	21.04	14-27
PARTING	1.97	1-7
SEAM-LAJKURA-II B	5.75	2-12
PARTING	3.03	1-34
SEAM-LAJKURA-I	10.75	1-18
PARTING	52.79	31-95
SEAM-RAMPUR-V	4.53	1-8
PARTING	2.20	1-11
SEAM-RAMPUR-IV	13.27	4-18
PARTING	1.92	1-10
SEAM-RAMPUR-IVB	1.68	1-4
PARTING	2.72	1-8
SEAM-RAMPUR-III	8.02	2-12
PARTING	2.27	1-7
SEAM-RAMPUR-II	2.74	1-9
PARTING	2.71	1-9
SEAM-RAMPUR-I	5.99	1-15
PARTING	4.17	1-19

SEAM-IB TOP	1.68	1-7
PARTING	4.69	1-15
SEAM-IB MIDDLE	4.85	1-10
PARTING	2.87	1-15
SEAM-IB BOTTOM	1.69	1-4

5.0 MINE BOUNDARY, RESERVES & LIFE

The proposed pit considers most of the area of the combined block, barriers will be left towards north and east due to presence of Basundhara river and Chhatajhor nala respectively.

In view of conservation of coal, mine floor considered is the floor of any of the three sections of Ib seam which is found to be the lowermost workable seam having thickness of more than 1m within the block. In the area where all the sections of Ib seams area less than 1m quarry floor will be limited to the bottommost section of Rampur seam.

Within the mine boundaries detailed above, extractable coal quantity is estimated as 1547.82 Mt with corresponding overburden of 2269.69 Mcum. The life of the project is 38 years.

5.1 SURFACE BOUNDARIES

North : After leaving a sufficient surface barrier from the Basundhara river. This surface barrier will accommodate embankment against the river after considering HFL of that area, a transport road and conveyor passage. Embankment width will vary as per surface elevation in that area.

West : 15m from common block boundary between Banapatra and Rampia block. This space is required for drain, one road and fencing. Towards northwest corner 60m barrier is kept for nala diversion along the common boundary.

South : Floor of Lajkura-I seam is limited upto southern geological block boundary, the surface boundary has been arrived further south with a quarry slope angle of around 37^0 with horizontal towards south.

East : Around 60-80 m from Chattanjhor nala and straightening the nala course. Barrier width depends on the embankment width.

The total mining block has been proposed to be worked into two quarry sections i.e. Quarry-1 (eastern quarry) and Quarry-2 (western quarry)

A sum total of 1866.83 million tonnes net proved geological reserves for the coal seams viz. IB BOT to LAJ-IV have been estimated over an area of 14.67 sq.km in Siarmal & Siarmal Extension and Banapatra blocks combined.

SEQUENCE OF COAL SEAMS

The sequence of coal seams and its nomenclature is same in Siarmal & Siarmal Extension and Banapatra blocks. In the Karharbari Formation Ib seam occurs in three splits. Barakar Formation contains seams Rampur and Lajkura also in splits. Altogether, 13 nos. of seams / split seams are reported in Barakar Formation in this block. Among these, seam RAM-IV, LAJ-I, LAJ-II T and LAJ-IV are the most potential coal horizons in this block. (Refer plate no-G-14 for geological cross sections along D-D' and E-E'). The sequence of coal seams within Siarmal & Siarmal Extn. and Banapatra block is given in Table below:

	AREA CONSIDERED (Ha)	**THICKNESS RANGE** (m)	**NET GEOLOGICAL RESERVE** (Mt)	**Mineable RESERVE** (Mt)
LAJKURA IV		10-17	226.9	214.05
LAJKURA III		1-6	73.62	64.7
LAJKURA IIT3		1-3	15.78	11.72
LAJKURA IIT2		1-3	11.53	8.01
LAJKURA IIT1		14-27	405.7	368.73
LAJKURA IIB		2-12	116.88	100.5
LAJKURA I		1-18	218.77	192.7
RAMPUR V		1-8	84.4	62.99
RAMPUR IV		2-15	249.92	189.4
RAMPUR IVB		4-19	30.03	18.63
RAMPUR III		4-12	166.34	119.01
RAMPUR II		1-12	57.5	36.61
RAMPUR I		1-15	121.73	85.94
IB TOP		2-20	22.26	7.43
IB MIDDLE		2-21	52.09	34.88
IB BOTTOM		2-22	13.38	4.97
TOTAL	**1467**		**1866.83**	**1520.27**

	AREA CONSIDERED (Ha)	THICKNESS RANGE (m)	NET GEOLOGICAL RESERVE (Mt)	MINEABLE RESERVE (Mt)
LAJKURA IV		12-15	14.38	14.05
LAJKURA III		3-5	3.34	3.11
LAJKURA IIT3		1-2	1.16	0.93
LAJKURA IIT2		1-2	0.65	0.53
LAJKURA IIT1		21-23	9.07	8.93
TOTAL	**182**		**28.6**	**27.55**

	NET GEOLOGICAL RESERVE (Mt)	MINEABLE RESERVE (Mt)
GRAND TOTAL	**1895.43**	**1547.82**

5.2 MINEABLE RESERVE AND STRIPPING RATIO

Particulars	**QUARRY-1**	**QUARRY-2**	**TOTAL**
Grade A-C	28.45	6.91	35.36
Grade D	21.61	17.25	38.86
Grade E	232.53	90.45	322.98
Grade F	384.59	356.27	740.86
Grade G	217.58	192.18	409.76
Total Coal (in Mt)	**884.76**	**663.06**	**1547.82**
Total OB (in Mcum)	**1147.56**	**1122.13**	**2269.69**
Stripping Ratio (in cum/t)	**1.30**	**1.69**	**1.47**

The mine is proposed for production of 50 Mty, mine life will be of 38 years.

6.0 MINING TECHNOLOGY

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

Shovel-dumper system is very flexible and also offers convenient mining operations to deal with sudden occurrences of unworkable or poor quality patches and change of floor position due to repeated faulting and varying seam gradient and thickness. It also offers flexibility for easy transition to any other technology or equipment configuration. The technology is well known and advantageous to get skilled manpower. So shovel-dumper mining method is adopted for overburden removal and partial coal extraction.

Surface-miner excavation is still limited to winning coal only. This method of mining by deploying outsourcing agencies has become very popular in Talcher & Ib valley coalfield. There are many advantages in this technology, of avoiding drilling, blasting, crushing of coal and related environmental hazards, improvement in grade of ROM coal by removing thin bands, clean surface for transport etc. Ideally, surface miners require working space of about 400 m length and about 50 m width for its optimum use. The high-wall angle required is comparatively flatter to shovel-dumper system. This bench geometry makes overall working angle flatter which will generate more overburden compared to shovel-dumper system if the seams are thin with thick intermediate parting. But as seams Lajkura-IV, IIT1,IIB,I and Rampur-IV,III,I are thick seams with number of bands, surface miner will be introduced in these seams. Other thin seams and lower seams with thick intermediate parting. But as seams Lajkura-IV, IIT1, IIB, I and Rampur-IV, III, I are thick seams with number of bands, surface miner will be introduced in these seams. Other thin seams and lower seams with thick intermediate partings will be worked by either surface miner or shovel-dumper system depending on geological and geotechnical conditions.

As the seam gradient is relatively flat (around 30 to 40), coal and the parting will be worked by parallel slicing method (working along seam floor) whereas top overburden and thick parting between Rampur and Lajkura seam will be removed by level slicing method.

7.0 MINE TARGET, LIFE AND PRODUCTION SCHEDULE

Table 2: CALENDAR PROGRAMME

Year	COAL(in Mt)			OB(in Mcum)			Stripping ratio
	Q1	Q2	TOTAL	Q1	Q2	TOTAL	(in cum/t)
1	1.50		**1.50**	3.73		**3.73**	***2.49***
2	4.00		**4.00**	4.78		**4.78**	***1.20***
3	7.00		**7.00**	4.78		**4.78**	***0.68***
4	10.00		**10.00**	12.03		**12.03**	***1.20***
5	15.00		**15.00**	23.87		**23.87**	***1.59***
6	22.00		**22.00**	26.92		**26.92**	***1.22***
7	30.00		**30.00**	37.22		**37.22**	***1.24***
8	40.00		**40.00**	49.67		**49.67**	***1.24***
9	50.00		**50.00**	60.00		**60.00**	***1.20***
10	50.00		**50.00**	66.56		**66.56**	***1.33***
11	50.00		**50.00**	66.56		**66.56**	***1.33***
12	50.00		**50.00**	66.56		**66.56**	***1.33***
13	50.00		**50.00**	65.59		**65.59**	***1.31***
14	50.00		**50.00**	65.59		**65.59**	***1.31***
15	50.00		**50.00**	66.56		**66.56**	***1.33***
16	50.00		**50.00**	72.03		**72.03**	***1.44***
17	50.00		**50.00**	77.50		**77.50**	***1.55***
18	50.00		**50.00**	77.74		**77.74**	***1.55***
19	50.00		**50.00**	77.74		**77.74**	***1.55***
20	50.00		**50.00**	76.90	2.45	**79.35**	***1.59***
21	49.00	1.00	**50.00**	49.55	2.21	**51.76**	***1.04***
22	46.00	4.00	**50.00**	44.08	7.68	**51.76**	***1.04***
23	42.00	8.00	**50.00**	40.51	18.05	**58.56**	***1.17***
24	18.26	31.74	**50.00**	11.09	45.65	**56.74**	***1.13***
25		50.00	**50.00**	0.00	89.60	**89.60**	***1.79***
26		50.00	**50.00**	0.00	89.16	**89.16**	***1.78***
27		50.00	**50.00**	0.00	94.62	**94.62**	***1.89***
28		50.00	**50.00**	0.00	94.94	**94.94**	***1.90***
29		50.00	**50.00**	0.00	89.45	**89.45**	***1.79***
30		50.00	**50.00**		93.31	**93.31**	***1.87***
31		50.00	**50.00**		93.29	**93.29**	***1.87***
32		50.00	**50.00**		93.30	**93.30**	***1.87***
33		50.00	**50.00**		87.08	**87.08**	***1.74***
34		50.00	**50.00**		70.15	**70.15**	***1.40***
35		50.00	**50.00**		67.95	**67.95**	***1.36***
36		30.00	**30.00**		43.15	**43.15**	***1.44***
37		20.00	**20.00**		35.26	**35.26**	***1.76***
38		18.32	**18.32**		4.83	**4.83**	***0.26***
TOTAL	**884.76**	**663.06**	**1547.82**	**1147.56**	**1122.13**	**2269.69**	***1.47***

8.0 RESERVE & STRIPPING RATIO

Within the mine boundaries detailed above, extractable coal quantity is estimated as 1547.82 Mt with corresponding overburden of 2269.69 Mcum. The average stripping ratio is 1.47.

9.0 GEO-MINING CHARACTERISTICS

Geo-mining characteristics are given below:

Sl.	Particulars	Unit	Q-1	Q-2	Total
1	Quarry floor area	ha	559.00	489.40	1048.40
2	Quarry surface area	ha	877.77	668.55	1546.32
3	Mineable reserve	Mt	884.76	663.06	1547.82
4	Overburden	Mcum	1147.56	1122.13	2269.69
5	Stripping ratio*	cum/t	1.30	1.69	1.47
6	No. of workable seams/ sections	No.	16	16	16
7	Annual capacity	Mt			50
8	Life (including 2 years of construction period)	Years	24	18	38
9	Average seam gradient	Degrees	3.7	4.4	
10	Strike length(along floor)				
	Maximum	m	2750	3200	5950
	Minimum	m	2200	1400	3600
11	Strike length(along surface)				
	Maximum	m	3500	3500	7000
	Minimum	m	2600	1600	4200
12	Quarry depth				
	Maximum	m	335	360	
	Minimum	m	115	90	
13	Quarry perimeter	m			18385
14	Dip-rise length				
	Along floor	m	2300	2200	
	Along surface	m	2900	2800	

*** working stripping ratio will be around 1.63 cum/t considering 246.04 Mcum OB rehandling of temporary external dumping in quarry-2 area.**

10.0 DUMPING

Minimum depth of the lowest quarriable seam in north-east corner of the quarry-1 is around 115m, so a long access trench is necessary to reach the quarry floor. It has been designed to develop the quarry initially with extraction of upper seams and simultaneously deepening the quarry in the lower seams to maintain high rate of production, in this process access trench of the quarry will be developed to touch the bottommost quarry floor, so there will be no internal dumping during this period upto year9. After year9 as the mining in quarry-1 is extended towards both west and south some quantity of backfilling can be started, but the volume of void generation in the quarry will be much less compared to the volume of overburden generated due to following reasons.

- Presence of multiple faults and narrow working width between different faults in northern part/ rise side of the quarry requires sufficient advance in overburden benches.
- Much void space will be lost with increase in depth due to creation of different dump tiers to maintain overall dump slope of 260.
- Western slope cannot be filled upto surface to avoid high quantity of rehandling.
- Long access trench/haul road on eastern quarry batter has to be maintained during quarry operation, so this side of the quarry cannot be filled up upto end of mining operation in quarry-1. All these factors will lead to a situation of creation of low void generation.

Dip side of quarry-1 cannot be filled upto surface after completion of its operation due to continuation of coal seam in the dip side block. So lot of void at a high depth towards dipside will be unused, all these factors necessitate requirement of huge external dumping.

There is no non coal bearing area in the block or towards south in dipside, the block is surrounded by Basundhara river and Chattanjhor nala towards north and east respectively, so there is no favourable area for external dumping in close proximity. Only non coal bearing area is available towards north of existing Basundhara west OCP, this area has been already selected for power plant to be set up by Mahanadi Basin Power Corpoartion Ltd which is a subsidiary of MCL. So only the void in Basundhara West OCP can be filled up by some quantity of overburden from Siarmal OCP. But construction of a bridge over Basundhara river is necessary to transport overburden, this bridge should be capable of withstanding load of heavy duty 190t rear dumpers suggested for overburden transport. Construction of this bridge may take long time, considering this fact it is proposed

to dump initial overburden towards dipside of quarry-2 towards south-western side. From year7 to year10 some dumping will also be done into the voids of Basundhara west OCP.

External Dump towards dipside of quarry-2 will accommodate 89.25 Mcum of overburden and external dumping in this area will continue upto 8th year. This dump will have to be rehandled while extending the mine operation towards dipside of the block after 38 years. Exploration in this dipside block should be completed before starting of external dumping. Economic viability of mining operations in the dipside block can be studied only after detailed exploration. From 7th year this same external dump will be extended towards north in the future quarry area of quarry-2 by overburden from quarry-1, around 193.85 Mcum of overburden of quarry -1 from year-7 to year14 will be dumped in mining area of quarry-2, this huge volume of overburden has to be rehandled while working quarry-2 in year29 to year38.

Backfilling in the quarry-1 will be started from year-10, simultaneous backfilling and external dumping will be done upto year18, from year19 there will be no external dumping and total overburden can be backfilled. From year12 to year18 external overburden will be located beyond southern boundary of quarry-1. This dump will have to be rehandled while extending the mine operation towards dipside of the block. Exploration in this dipside block should be completed before starting of external dumping. Economic viability of mining operations in the dipside block can be studied only after detailed exploration. Average height of all the external dumps will be around 82-85 m. care has been taken to accommodate external dump in the notified boundary of MCL.

It is proposed to complete the construction of heavy duty bridge over Basundhara river within year6 so that overburden from the mine can be transported beyond Basundhara river, the available void in Basundhara West OCP can be filled up by the overburden from Siarmal OCP in year7 to year10. Around 77.18 Mcum of overburden can be accommodated in exhausted Basundhara west OCP, some void towards dipside of this mine will not be filled for maintaining water reservoir considering scarcity of water in this area.

Average height of the external dump will be around 82-85 m. Details of external dumping and yearwise dumping schedule and are shown in following tables respectively.

Table 3: Details of Dumping

Particulars	Quantity (in Mcum)	Top reduced level (in m)
BACKFILLING IN OWN QUARRY	2007.79	350
BACKFILLING IN BASUNDHARA WEST OCP	77.18	310
EXTERNAL DUMP	184.72	
EXTERNAL DUMP 1	89.25	390
EXTERNAL DUMP 2	93.96	380
EMBANKMENT	1.51	

11.0 PUMPING & DRAINAGE

The principal drainage in the block is controlled by Basundhara river flowing west to east on the northern side of the block. The Chattanjhor flowing in the eastern boundary of the block controls the local drainage. Chattanjhor maintains base flow even in the summer.

The following considerations have been made for calculating the pumping requirement and selection of pumps:

1. Water garland drains shall be developed in advance for each stage of mine working so that water is collected by the garland drains and discharged to the nearby streams of Basundhara river.

2. Excavated mine area and its depth.

3. Maximum rainfall per day (325mm continuous rainfall for 24 hours).

4. Pumping requirement has been assessed on the basis that the make of water on the day of maximum rainfall will be pumped out in following five days.

5. Coal and OB working faces and the haul roads shall be maintained free of water as far as possible.

6. Within the quarry, the faces shall be so laid that water from the working areas shall flow into the sump by gravity. From the sump the water will be pumped out to the surface and will flow into the surface drainage system.

7. Concurrent backfilling will be done in the de-coaled areas of the quarries.

8. For the purpose of pumping calculation, effective pumping hours per day has been taken as 18.

9. An adequate number of standby pumps have been provided.

10. The external dump area has not been considered in the area beyond excavation and the area of working benches has been included in the mined out area.

There will be several stages in the quarry including final stage. The stage wise deployment of different pumps has been calculated. The total estimated cost provision on pumping has been given in the project report.

12.0 POWER SUPPLY AND COMMUNICATION

The project will receive power at 33kV from the 33 kV overhead line coming from 220/33 kV substation at Garjanbahal. Considering the stretch and progress of mine, it is proposed to construct two separate substations at two different locations nearby Transfer point (TP)-7 and TP-4. The total estimated connected load and maximum demand (excluding CHP) for both the substations comes to the tune of 76093 kW & 39470 kVA and 73690 kW & 37704 kVA for departmental and out sourcing variants respectively. This maximum demand has been achieved after improving the p.f. to 0.98 and considering diversity of 0.8. For improving p.f. to 0.98, adequate capacitor banks have been provided. To meet the above power demand (in all the three variants) there will be 3 nos. 10 MVA, 33/6.6 kV transformers in project substation – I and 3 nos. 10 MVA, 33/6.6 kV transformers in project substation – II to the demands of HEMM, pumping, lighting etc. The infrastructures will be fed from the respective substations near them.

One separate substation for CHP near TP-2 has been envisaged for CHP and allied loads for two variants. The CHP substation will receive power at 33 kV from the 220/33 kV substation at Garjanbahal near the access trench through double circuit over-head line on towers.

The estimated connected load and maximum demand of the CHP substations including loads of other infrastructures coming nearby comes 12510.50 kW and 6744.73 kVA. This maximum demand shall be achieved after considering 80% diversity and improving the system power factor to 0.98 by providing capacitor banks of adequate capacity.

13.0 COAL HANDLING PLANT AND DESPATCH ARRANGEMENT

As per approved project report coal handling plant has been designed for capacity of 40 Mty. Now the system will have to be updated to handle 50 Mty of raw coal. The permanent coal handling arrangement shall have the following provisions:

- Initially, two numbers of two stage Twin shaft sizer to crush from (-) 1200 mm to (-)100 mm will be provided near the first access trench to handle any coal produced from the conventional system.
- Initially, three numbers of Reclaim feeders will be provided near the first access trench to handle (-) 100mm size blast free coal.
- Belt conveyors system in three parallel series from the access trench up to the proposed washery.
- From the washery the washed coal will be transported to the number of Rapid Load out system with pre-weigh loading arrangement @5500(av) tph through no of silo/ central dispatch system and dispatch through the rail.
- The loading of the coal to RLS from washery will be the scope under washery.
- Based on the advancement of mine, in the intermediate stage about 60m below twin shaft sizer/ Reclaim feeder will be installed to handled the inpit coal and dispatch to the main stream on surface by the series of belt conveyors.
- In floor inpit, sets of reclaim feeder with Sizers will also be provided as the mine reached to the floor.

- Based on the production enhancement and the advancement of the mine the Sizers and Reclaim feeder will be shifted to Intermediate and Inpit floor.

The system layout plan showing mine entries, sizing and handling complexes, Belt conveyors, washery location, CDS siding with loading points etc. As per the production programme, the CHP will start functioning from 5th year.

14.0 WORKSHOP & STORES

Two-tier system of maintenance is envisaged for the plant and machinery of the project, one at the unit level in the workshop located at the quarry top to cater to the needs of day-to-day work and the other at Central Workshop for major overhauls and capital repairs.

The workshops for both HEMM and E&M and stores are proposed to be located at the same place with separate boundaries. The project stores shall be an integral part of this complex.

For outsourcing variant, HEMM workshop will be maintained by outsourcing agencies.

15.0 CIVIL CONSTRUCTION

Civil works for this project consists of mainly residential buildings, workshop with allied facilities, colony road and haul road.

The infrastructures are of permanent type. All the residential quarters and service buildings are of standard specification.

The HEMM workshop complex will have several sheds for maintenance and repair of dumpers with required washing facilities. For departmental variant manpower and machine will be provided by MCL. For outsourcing variant the same will be done by outsourcing agency. There is provision for Project Store to cater the need for the project and for main substation and substation for CHP.

There will be provision of 2628 quarters for 3773 nos. manpower in variant-I (Departmental variant). In outsourcing variant the provision for same will be 390 quarters for 590 nos manpower. Proposed site of the township will be selected by the project officials at the time of execution of buildings

The water supply arrangement basically includes potable and industrial water demand of the project. For all the variants the total potable and industrial water demand is estimated to be 10.704 MLD (2.204 MLD + 8.500 MLD). Water supply scheme is being taken into consideration to cater the need for both domestic and industrial water supply. Suitable off-takes will be provided for supply of water.

16.0 WATER REQUIREMENT, SUPPLY ARRANGEMENT AND SEWERAGE SYSTEM.

The water supply arrangement basically includes potable and industrial water demand of the project.

Water Demand

The requirement of water for potable and industrial purposes includes firefighting etc. and has been assessed as under:

a)	Potable water demand	2.204 MLD
b)	Industrial water demand (including firefighting)	8.500 MLD
	Total water demand	10.704 MLD

Provision made for water supply and sewerage has been kept same for all the variants.

17.0 ENVIRONMENTAL MANAGEMENT

Baseline data (Air, Water, Noise & Soil) has been regenerated for the period of Nov'17 to Feb'18. Detailed Environmental Baseline data will be incorporated in EIA/EMP.

18.0 SAFETY MANAGEMENT AND CONSERVATION

Opencast mining operation in general is associated with a number of hazards/risks.

Some of the various anticipated sources of danger are enumerated as under:

- Slope failure.
- Dangers due to handling and use of explosives and accidents due to fly-rocks and air-blasts following a faulty heavy blast.
- Hazards associated with use of electricity.
- Accidents due to unruly operation of HEMM.
- Dust hazards.
- Fire hazards due to spontaneous heating of coal in stock piles and exposed benches.
- Fire hazards in stores & workshops where inflammable & highly inflammable materials are stored or used.
- Danger of inundation from surface and/or ground water.

Adequate provisions have been made for safe working of the mine in form of design of operational systems, provision of safety measures for safe use of explosives, electricity and HEMM etc. Sufficient financial provisions have been made under different heads for procurement of necessary safety equipments.

Adequate skilled & trained manpower has also been provided, for compliance of safety provisions. Regular training/refresher courses, "on job" training shall be conducted & mock rehearsals shall be made to make the manpower conversant with various rules, regulations, methods of prevention & combat with hazards.

Embankment with a height of three meter above the HFL has been proposed against Basundhara river. Lump sum provision has been made for this in the PR. The HFL should again be ascertained & precautions taken before taking up the mining activities.

Sufficient provision has been made in the approved PR for the prevention & control of fire in the project store, both E&M & HEMM workshops & sub-stations by way of installing fire extinguishers of right type & size. Timely inspection & refilling of fire extinguishers will be done.

The exposed ends of the coal seams and OB shall be left with a safe slope to avoid slope failure and collapse of benches. Similarly, at the end of mining operation, safe terminal pit slope is provided to avoid pit failure. At design stage, a safe angle of not steeper than 40 degrees has been proposed as quarry slope. Detailed site specific tests for slope stability shall be carried out and site specific parameters determined. Present provision is a broad guideline.

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 minimizing 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 suggested to be used, after field trials.

19.0 LAND REQUIREMENT

Details of land requirement are as follows:

Sl. No.	Particulars	Total Area in Ha		
		Forest	Non-forest	Total
1	Mining & pit top infrastructure	260.769	1328.373	1589.142
2	Safety zone	3.930	14.662	18.592
3	External OB Dump, embankment, other infra & Blasting danger zone including future exp. area	85.01	597.71	682.72
A.	**Total mining lease area**	**349.709**	**1940.745**	**2290.45**

20.0 DIVERSION OF ROAD & DRAINAGE

The existing State Highway from Sundargarh to Raigarh is proposed to be diverted since it passes across the Kulda and Siarmal OCP. The alignment of the proposed diversion will be initially along embankment of Basundhara river temporarily and later it will be to the south of the proposed Siarmal OCP as decided by the project authority.

Straightening of Chattanjhor is also proposed.

21.0 REHABILITATION & RESETTLEMENT

The core zone of the project comprising of excavation zone, infrastructure area, OB dump sites, safety zone for blasting, etc., covers partly and/or fully the land from five (6) villages namely, Siarmal, Jhupuranga, Tumulia, Ratansara, Gopalpur & Kulda. About 2636 families will be displaced due to mining and other associated activities of this project. R&R benefit of Kulda village has been already incorporated in Kulda OCP.

These families will be resettled and rehabilitated socially, culturally and economically along with other displaced such as major married sons, unmarried daughters of 30 years of age, etc., as per latest Norms of Govt. of Odisha, May, 2006. Details of project affected families and project affected persons are given below:

Name of village	Project affected families	Project affected persons
Siarmal	189	943
Jhupuranga	529	1895
Tumulia	625	2974
Ratansara	238	943
Gopalpur	1055	3522
Total	**2636**	**10277**

However, the exact number of project affected families will be known after due enumeration by the Project Authority.

22.0 MANPOWER

Manpower for OB removal, coal extraction together with common services and land reclamation considering 330 working days and 16.5% absenteeism in a year has been estimated for all the variants. Office and allied functions shall be computerized. Security, canteen and some other services are proposed to be hired, as decided by MCL. Modern communication facilities shall be adopted. Essential numbers of vehicles has been provided and the required numbers of drivers has been provided for the same in variant-ii. Other vehicles which will be required is proposed to be provided on hire basis. Manpower assessment for departmental variant is given below:

Sl. No.	Particulars	No of persons upto target year (9th yr)	No of persons beyond target year.
1	OB	854	400
2	Coal	484	21
3	Common	1609	357
4	Land reclamation	48	
	Total	**2995**	**778**

22.0 RAIN WATER HARVESTING

Rain water is naturally pure water except where it becomes acidic due to industrial pollution. The rapid exploitation of ground water as well as surface water due to the industrial developmental projects, increase in population resulted in acute scarcity of fresh water availability. It has become necessary to conserve this valuable natural resource for sustainable development.

Conservation of this valuable natural resource can be done by collected this rain water scientifically and utilizing it either for drinking purposes or ground water recharging purposes.

Scientifically & technically designed system which helps us to collect and utilize the rain water effectively through various steps and collectedly termed as “Rain Water Harvesting”.

The various steps / methods are roof top catchments, check dams, percolation pond, storage tanks, etc.